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THE

JOURNAL OF THE SOCIETY OF ARTS,

OF THE

INSTITUTIONS IN UNION,

AND

OFFICIAL RECORD OF ANNUAL INTERNATIONAL EXHIBITIONS.

VOLUME XX.

FROM NOVEMBER 17, 1871, TO NOVEMBER 15, 1872.

LONDON:
PUBLISHED FOR THE SOCIETY BY BELL AND DALDY, YORK-STREET,
COVENT-GARDEN.

1872.

Journal of the Society of Arts,

OF THE INSTITUTIONS IN UNION, AND

Official Record of the International Exhibitions.

118th Session.] FRIDAY, NOVEMBER 17, 1871. [No. 991. Vol. XX.

PROCEEDINGS OF THE SOCIETY.

◆

FIRST ORDINARY MEETING.

Wednesday, November 15th, 1871; Seymour Teulon, Esq., Vice-Chairman of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Armitage, William, Meal-street, Manchester.
Baggallay, John, Bridewell Royal Hospital, New Bridge-street, E.C.
Baker, Lawrence J., Haydon-hall, Eastcott, Watford.
Barker, Henry G., 15a, Grafton-street, Bond-street, W.
Beattie, Joseph, Joint Stock Bank (Limited), Birmingham.
Billinghurst, Henry, M.D., Redwood-house, Bromley, Kent.
Blackman, Rev. Edward Lewis, 29, Belsize-park-gardens, N.W.
Bluhm, Heinrich, Springfield, Lee-park, S.E.
Bolton, Major Frank, Junior United Service Club, S.W.
Breese, Edward, Morfa-lodge, Port Madoc, N. Wales.
Brocklehurst, William Coare, M.P., Butley-hall, near Macclesfield.
Brown, A. H., M.P., Richmond-hill, Liverpool.
Burstow, Edward, Horsham, Surrey.
Cantlon, Matthew, 143, Maida-vale, W.
Canton, Robert, 22 and 23, Aldersgate-street, E.C.
Carrington, Thomas, jun., F.G.S., Field-head-house, Sheffield.
Chappuis, Paul Emile, 69, Fleet-street, E.C.
Cochrane, Alexander D. W. R. Baillie, M.P., 26, Wilton-crescent, S.W.
Conrad, Herman, 4, New Basinghall-street, E.C.
Constable, George Sefton, Queen-street, Arundel, Sussex.
Dalrymple, Dr. Donald, M.P., Thorpe-lodge, Norwich.
Du Cane, Captain E., R.E., 44, Parliament-street, S.W.
Estall, Edwin Davis, 19, Sutherland-villas, Brixton, S.E.
Ferguson, William, 25, Albion-street, Leeds.
Fleming, Rev. Arthur Willis, Alfred-house, Alfred-terrace, Holloway-road, N.
Forbes, Peter, Aberdeen.
Forwood, William Bower, Hopeton-house, Seaforth, Liverpool.
Franklyn, W. Norris, Warnham-lodge, Horsham.
Fox, Thomas, Dover.
Gairdner, Charles, Union Bank of Scotland, Glasgow.
Goodall, Josiah M., 21, Fellows-road, Haverstock-hill, N.
Graham, T. B., 15, Warrior-square, St. Leonard's-on-Sea.
Hart, John, Zetland-villa, Forest-hill, S.W.
Haseltine, George, 8, Southampton-buildings, W.C.
Jones, Henry, 136, Fulham-road, S.W.
Jones, William Bonner, 26, Westbourne-grove, W.
Kendal, Alfred, Oakfield-house, Dukinfield.
McMinn, Frederick A., Sandford-house, Fulham, S.W.
McPherson, Daniel, Cadiz, and 1c, King-street, St. James's, S.W.
Mortimer, Frederick, 36, Conduit-street, Bond-street, W.
Moses, Assur Henry, 34, Westbourne-terrace, W.
Offord, Thomas, 12, Philip-terrace, Tottenham, N.
Paget, Admiral the Right Hon. Lord Clarence, K.C.B., Plasllanfair, Anglesea.
Pitkin, James, 50, Red Lion-street, W.C.
Ravenscroft, Francis, Birkbeck Bank, Southampton-buildings, W.C.
Readman, George, Clydesdale Bank, Glasgow.
Richardson, William Henry, Springwell-mills, Jarrow-on-Tyne.
Saunderson, Charles, Stanmore-lodge, Kilburn, N.W.
Sclater-Booth, G., M.P., 15, New-street, Spring-gardens, S.W.
Scott, Captain Robert A. E., R.N., Portland-villas, Highgate-hill, N.
Seeley, Charles, jun., M.P., Stubbings-court, Chesterfield.
Smith, J. Moyr, 50, Walham-grove, Fulham, S.W.
Steele, James P., 13, Charlotte-street, Buckingham-gate, S.W.
Stevenson, James C., M.P., South Shields.
Stewart, George A., Braemar-lodge, Queen's-road, Kilburn, N.W.
Symons, Elias Octavius, 3, Wellington-street, Chelsea, S.W.
Taylor, George J., 12, Montague-street, Russell-square, W.C.
Thorne, Thomas H., Leamington Priors, and Warwickshire Bank, Leamington.
Veitch, Harry James, King's-road, Chelsea, S.W.
Waite, Henry, Adelaide College, Conyngham-road, Shepherd's-bush, W.
Warner, Nutford, 64, Essex-road, N.
Willey, Robert, Ludgate-chambers, 66, Ludgate-hill, E.C.
Wright, Joseph Henry, 104, Hereford-road, Bayswater, W.
Young, William, 19, Exeter-hall, Strand, W.C.

And as Honorary Corresponding Member,

Newton, Robert S., M.D., 104, West Thirty-eighth-street, New York.

The Chairman announced to the meeting, with great regret, that Lord Henry G. Lennox, M.P., Chairman of Council, was prevented by a severe cold, caught in coming from the Polytechnic, where he had been delivering the prizes and certificates won in the last examinations, from occupying the chair, as he had intended, and delivering the inaugural address. Those present would need no assurance on his part to convince them that nothing but absolute necessity would have prevented his being in his place that evening. He called upon the Secretary to read the notes of the address which would have been delivered, and which had been prepared under very peculiar circumstances, a portion of it having been taken down in shorthand from his lordship's dictation whilst in bed.

The Secretary then read the following

ADDRESS.

Obituary.

It is usual on these occasions, as you are aware, for the Chairman of Council to announce to you the losses which the Society has sustained during the past year by the death of its members, and I regret to say that this year our losses have been more than usually heavy.

Amongst our members we have to regret the death of Mr. James Easton, the founder, and for nearly forty years the senior partner, in the well-known firm of engineers which still bears his name. It was this gentleman who, in 1822, introduced the hydraulic ram, the patent of which he had purchased from the celebrated Montgolfier. In 1825, he, in conjunction with the late Mr. Rennie, and in consultation with George Stephenson, surveyed the projected London and Northern Railway, and made Parliamentary plans for the sections from London, *via* Cambridge, to Peterborough. Many other successful engineering works he accomplished, as, for instance, the supply of above thirty towns with water, the improvement of the navigation of the Dartford and Crayford Creek, and the drainage of the whole of the marshes on the left bank of the Thames from London. In Mr. Easton the country has therefore lost one of the pioneers of engineering science.

By the death of Mr. J. H. Robinson, R.A., we have lost a line engraver who helped to render the English school of engraving in the last century pre-eminent. The "Wolf and Lamb," after Mulready's picture; Leslie's "Mother and Child;" and "Napoleon and the Pope," after Wilkie, were masterpieces from his hand. Indeed, so great was his ability in this respect, that it is asserted that in some instances the engraving was far superior to the painting of which it professed to be a reproduction. Mr. Robinson was elected Associate Engraver in the new class of Engraver Royal Academicians, in 1856, being the second artist who accepted the distinction. In 1867 he became, under the amended regulations, R.A., and, after a long illness, died at Petworth.

Sir John Herschel took much interest in the Society's proceedings, serving on its special committees and contributing to its *Journal.* Under one of the bye-laws of our Society, enabling the Council to admit a limited number of eminent persons as honorary life members of the Society, the Council, to mark their sense of Sir John's great services to science and its applications to the arts, admitted him a member in 1856. An obituary notice of this great man has already appeared in our *Journal.*

In the death of Thomas Brassey, the Society and the engineering world has sustained a great loss. Essentially a self-made man, he was connected with nearly every great engineering work, whether at home or abroad, and he has left behind him an honoured and enduring name. It is a matter of gratification to the Council that his son, Mr. Thomas Brassey, has consented to serve with them, and I sincerely hope he will give to our deliberations the benefit of his valuable experience.

Although Mr. Charles Babbage was not a member of our Society, he on various occasions contributed to our *Journal*, and it would seem but fitting to pay a tribute of regret to the memory of this remarkable man. One of his most anxious labours was the endeavour, in conjunction with Herschel and Peacock, to extend and raise the standard of mathematical education in this country. As an author he was most prolific, having some eighty works bearing his name on their title-page. In 1828, he was appointed to, and held for eleven years, Newton's chair as Lucasian Professor of Mathematics at Cambridge. Mr. Babbage took an active part for many years in the proceedings of various scientific institutions. He helped to found the Royal Astronomical Society, as well as the Statistical Society, and was one of the oldest fellows of the Royal Society. One peculiarity, which has appeared in the biographical notice in the *Athenæum* of this gentleman, is worth notice; it is that in early life he was so weak in body and in mind that it was not considered worth while to send him to school. He was therefore left to study nature in his rambles about the fields and commons. But the ramblings of the child may have prepared the foundation for those habits of thought which subsequently formed the eminent mathematician. Later, his education was entrusted to Mr. Freeman, of Enfield, where he had the late Captain Marryatt as a schoolfellow. From Enfield he was transferred to Peterhouse, Cambridge, and he aimed at the senior wranglership, but Herschel being in in that year, Babbage would not contend against his friend.

One of the most illustrious of our members, Sir John Fox Burgoyne, was taken away very recently, but to his brilliant career the daily journals have done such ample justice, that it is not my intention to repeat in detail the various achievements of which he was the hero. I may say, however, that only last year, although in his 80th year, he wrote to our Secretary a vigorous letter approving of the school drill review, which the Society was then proposing to organise. Sir John Burgoyne sank to his rest full of years and honours, although it is sad to think of the fearful trial which bowed the gallant old soldier with grief for the loss of his talented and brilliant son, Hugh Burgoyne, who perished in H.M.S. *Captain*.

Lastly, the Society has to mourn the death of Sir Roderick Murchison, with regard to whom I must say that I was so much struck with his biography, as given in the *Athenæum*, that I hope it will not be considered a liberty if I incorporate a great portion of it in my address: "Sir Roderick Impey Murchison, Bart., K.C.B., &c., was the eldest son of Mr. Kenneth Murchison, of Tarradale, in Ross-shire, N.B., and of Barbara, eldest daughter of Mr. Kenneth Mackenzie, and sister of the late General Sir Alexander Mackenzie, Bart., of Fairburn, in the same county. Sir Roderick commenced his education at Durham Grammar School, whence he proceeded to the Royal Military College at Marlow. In 1807, he obtained his commission in the army, and served throughout the Peninsular War. He was first in the 36th foot, and afterwards on the staff of his uncle, General Sir Alexander Mackenzie, and lastly became Captain in the 6th Dragoons. It was his boast that he could say, what perhaps no other officer in the British army could, viz., that he was in the army at the age of fifteen, in active service at sixteen, and before he was seventeen had fought in three general actions—Roliça, Vimiera (where he carried the colours of his regiment), and Corunna. In 1815, he married Charlotte, only daughter of General Hugonin; and it was from Lady Murchison, herself a most able conchologist, that he received his first impulse towards the pursuit of geological science. In 1855, Sir Roderick was appointed Director-General of the Geological Survey of England, as successor to Sir Henry De la Beche. In 1854, he summarised his experiences on the Silurian System in his great work entitled "Siluria," and in 1856 he brought out his magnificent Geological Atlas of Europe, in 4to.

"We confess to a self-indulgent pleasure in turning from what Sir Roderick Murchison did to what he was. To his strength of frame and intellectual power his scientific labours bear witness; we wish to speak of his character. The qualities which went to make up the success of Sir Roderick's life, and to win the admiration and affection of those around him were—unflinching courage united with great prudence; practical good sense united with fine tact and good taste; extreme kindliness of disposition and courtesy of manner. While devoted to science he threw into every social duty a hearty and gracious geniality.

"'A bare enumeration,' says Sir Bartle Frere, in his address to the Royal Geographical Society 'of the honours which have from time to time been conferred on Sir Roderick in recognition of his scientific labours, would suffice to show how highly they have been esteemed both in his own country and by foreign nations. By his own sovereign he was knighted in 1846, made a K.C.B. in 1863, and a baronet in 1866. By the Emperor of Russia he was made a Knight of the Second Class of St. Anne, and subsequently a Grand Cross of the same order, and of that of St. Stanislaus, and a Member of the Imperial Academy of Sciences; and he has received from other European sovereigns similar honours, the last of which was the dignity of Grand Officer of the Order of the Crown of Italy. But in the honours thus conferred on him, sovereigns have only confirmed the reiterated testimony of the leading men of science and scientific bodies in every part of the civilised world. In his own country the great Universities have conferred on him the honours of D.C.L., and LL.D., and M.A. The Royal Society, the parent of all our scientific societies, many years since recognised his merits by making him F.R.S., and subsequently a Vice-President, and by granting him the Copley Gold Medal. From Edinburgh he received the Brisbane Gold Medal, and the Honorary Membership of the Royal Society of Edinburgh: he is Vice-President of the Geological Society, Fellow of the Linnean Society, a Member of the Academies of St. Petersburg, Berlin, Copenhagen, Brussels, Stockholm, and Turin; a Corresponding Member of the French Institute; a Trustee of the British Museum, the Hunterian Museum, and of the British Association for the Advancement of Science. He has received the Prix Cuvier from the French Institute, the Wollaston Medal, and other honours of the same kind, which it would be almost impossible to enumerate.'"

FOUNDATION OF PROFESSORSHIP OF CHEMISTRY AT THE ROYAL ACADEMY.

During the last session, Professor Barff delivered a series of the Cantor lectures, the subject being "Artists' Colours and Pigments," and so great was their success that, through the influence of Messrs. Herbert and Cope, R.A., the Royal Academy was induced to found a Professorship of Chemistry in connection with that institution, for the investigation of the chemistry of colours, and to lecture thereon to the students, the first holder of that office being Professor Barff. Our members will have been glad to see that another series of lectures will be given during the session by Professor Barff, the subject being "Vitreous Colours and Pigments."

Channel Communication.

The Council hope, among other things, that they may have leisure, during the ensuing session, once more to turn their attention to the improvement of channel steamers between England and France. It would appear, from a paragraph which has recently appeared in the daily journals, that the French Minister of Public Works is turning his attention to the formation of a new harbour at Calais; and I am sure, on the part of the Society of Arts, I may promise every assistance in carrying out any mprovement in this respect.

Improvement of Marine Engines.

Our members will be interested in observing the large extent to which the economisation of fuel in the marine engine is in some places changing, and in others extending, the commercial operations of the world. Those who associate the present unexampled increase of mercantile steam ships too exclusively with the effect of the Suez Canal in shortening the route to the East, are not unnaturally beginning to feel some alarm lest the present demand for steam vessels should speedily prove excessive, and result, ere long, in a serious collapse. It is not for me, speaking here, to speculate upon the future of steam commerce, but I desire to point out that the improvement of marine engine science, and still more of marine engine practice, in reducing the consumption of fuel in steamers, is creating a very large and novel demand for steam vessels of almost all descriptions. Even as regards the carriage of passengers this is true, but it is much more true especially in regard to the conveyance of produce. It is not only true that steamers are replacing sailing ships almost everywhere, but they are also displacing, and about to displace, in no small degree, the transport of goods by land. Measures are on foot, I have reason to know, for taking the coal of South Wales to Paris for sale at a cheaper rate than that at which the inferior coal of Belgium is now sold there; for bringing the grain and other produce of inland America direct to Europe by steamships, from the river cities, on a larger scale than heretofore; the tea of China is about to be taken into Eastern Russia and Siberia by way of the Sea of Japan and of the Amoor, instead of by an overland route which occupies a far longer time; and many other changes of a like nature are in contemplation. It is to be hoped these changes will greatly stimulate our legislative action with regard to merchant shipping, to the rule of the road at sea, and to other like questions.

Ships' Life Boats and Lights at Sea.

The renewed competition for a model of a ships' life-boat to be used in our merchant service has been more successful than the former one. Three models, one in wood and two in iron, were considered of sufficient merit for further trial. The competitors will be requested, according to the terms of the offer, to construct full-sized boats on these models, and trials will take place during the summer months. In the event of these trials proving in every way successful, the Society's gold medal will be awarded to the builders. There is another subject connected with the dangers of the sea which I hope may be within the province of this Society to deal with. The Board of Trade are so deeply convinced of the inefficiency of the lights now in use at sea, that they have offered prizes for any improvement that can be effected in this matter; and I am sure I may promise that the Society of Arts, if they see their way, will assist in this good work.

School Drill.

Notwithstanding the bad weather, the Drill Review of the past summer passed off with great success, under the presidency of His Royal Highness Prince Arthur, who has since become a member of the Society. And the Council hope, if sufficient funds can be provided, to be able to make the review an annual display. So important to health and education is this question of drill, that I cannot but think our members and the public will come forward and give us their support, especially when I mention that an annual subscription of 5s. and upwards from about 1,000 persons would enable this useful work to be continued. The Metropolitan School Board have affirmed with their authority the great importance of drill in schools.

National Training School for Music.

I am directed by the Council to say that, in their opinion, the time has arrived when public opinion would justify them in taking active measures for promoting the establishment of a National Training School for Music. Her Majesty's Commissioners for the Exhibition of 1851 have often expressed their wish that this should be established at Kensington, and in connection with the Albert Hall, and, seeing the large funds they now have at their disposal, we may safely hope that they will assist us in this good work with something more substantial than their good wishes. The Council would gladly see the foundation of musical scholarships in the various counties in the United Kingdom, which should be obtained by public competition, and a suggestion has been made that an appeal might, in many instances, be made with success, if addressed to the deans and chapters of the various cathedrals. Our members have seen the report of the Musical Educational Committee of our

Society, and they will have observed in that report that a direct hope is expressed that cathedrals and other corporations will assist in this matter. The Council have it also under consideration whether it would not be advisable, at the time when Parliament meets, to hold a conference in the Society's rooms, for the purpose of appealing to her Majesty's Government. They have already announced their wish to found annual musical scholarships, and we are not without hope that the state of our funds may enable us to carry this into effect. The Lord Mayor and the principal City corporations have been appealed to, to set a good example in this direction by founding musical scholarships, to be competed for by the youth educated in the London schools; and the Council views with the greatest satisfaction the announcement of the intention of the Metropolitan School Board to cause music to be taught in schools subject to their authority, and will seek to enlist still further their sympathies with this important subject. By the united assistance of the State, of her Majesty's Commissioners for the Exhibition of 1851, the municipal and educational authorities of the country, and the benevolence of the public, the Council trust they will be enabled to announce, before long, the actual establishment of the National Training School for Music.

Annual International Exhibitions.

The members of the Society are probably already aware of the great success which has attended the first of the intended series of Annual International Exhibitions. It is understood that so large a surplus over the working expenditure has been obtained as to promise most favourably for the success of future exhibitions. It has also justified Her Majesty's Commission in reducing the price of the season tickets from three to two guineas for the general public, whilst members of the Society of Arts and similar bodies will have the privilege of obtaining season tickets for themselves and the female members of their families for one guinea each. The Society may thoroughly congratulate itself upon the great stride which has been made towards affording technical instruction to our artisan classes, as evidenced by the character of the work displayed at this exhibition at South Kensington.

Moscow Exhibition.

Whilst on the subject of exhibitions, I would inform the members that in the course of the vacation a special meeting of the Council was called to receive a deputation of the promoters of the Moscow Polytechnic Exhibition, who sought the assistance of the Society in furtherance of this object. The Council gladly agreed to render such aid as they could, and a committee has been appointed which is actively engaged in this work. The exhibition opens in May next, and already many of our manufacturers have expressed their intention of taking part in it.

Postal Telegraphs.

The establishment of the postal telegraphs throughout the United Kingdom has proved the correctness of the views of this Society in their advocacy of the system. By the latest returns that I have seen, it would appear that over 5 per cent. is being earned on the purchase money which was paid by the government, although there were many at the time who thought that purchase money excessive. The annual revenue derived from postal telegraphs is £250,000 per annum, and it is still rapidly increasing. By the returns published this morning, it appears that the receipts under this head, from the 1st of April to the 11th of November, amount to £450,000, as contrasted with £290,000 over the corresponding period of last year. The number of messages have increased threefold, and, if we take into consideration the great reduction of porterage that has followed, it will be seen that the public has saved nearly half the amount. During the ensuing session, one of the principal objects which we shall keep in view will be the exercising of a continuous and gentle pressure on the Postmaster-General, to endeavour to induce him to follow the good example of Belgium and Switzerland, and lower the postal tariff from 1s. to 6d. While I am on this subject, I may mention that we also intend to impress upon him the absolute necessity of extending to India and our colonies the post-office order system, such as now exists in the Netherlands, and between England and America. It will be a most important boon to the working classes generally, and, considering the strength of our forces permanently quartered in India, would be likely to meet with general appreciation. As a proof of what we may expect, I may mention that a million of money is now annually dispatched from America to the mother country by post-office and small bank orders.

Sanitary Construction.

While on the subject of convenience to the working classes, I would respectfully draw the attention of our members to a most able report, drawn up by my friend Mr. Chadwick, upon the best means of bringing about an improvement in the construction, material, warming, ventilation, and laying out of houses and cottages for the artizan classes. I am also told that this good work will receive much assistance by the adoption of a new cement, which has been invented by my excellent friend General Scott, of South Kensington Museum.

Food.

The Food Committee will continue its labours during the coming year, and I think we may congratulate ourselves upon the successful manner in which that committee has assisted in bringing into notice the Australian meats, the importation of which into this country is steadily increasing, while it is gratifying to know that its consumption among the artizans in our manufacturing towns is equally on the increase. We of this Society ought not to forget that this question was first put by my late friend Mr. Harry Chester, when he occupied this chair, for, in 1853, in his opening address as chairman, he asked the question, "Why should Australia export only the wool of the sheep and boil down the carcase merely for its fat. Is it impossible to preserve the flesh and to export it in a satisfactory condition to this country, where butchers' meat is not over abundant?"

Examinations.

The members of the Society are aware that in the year 1856 we established a system of examinations, which have proved eminently successful. Two years later, the Universities followed with their middle-class examinations, and shortly afterwards the Department of Science and Art took up the work. At the present time, the Society's examinations cost some £600 or £700 a-year, whilst the government is expending between £40,000 and £50,000 for the same object. As was natural, some difficulties have arisen from this double action. The Society of Arts is, after all, but a pioneer, its province being to initiate a course of action which it may think advantageous to the welfare of the community, and afterwards to leave it in the hands of those whose special function it may be to carry it out. Having fully succeeded in this instance, it will not improbably be the Council's decision to discontinue the examinations in their present form after 1872, and to leave the work to be carried on by the proper authority, namely, the government of the nation.

Work of the Society.

I have mentioned some of the principal objects to which the Council mean to address themselves during the ensuing session, but I have by no means exhausted the list of what we should like to do were sufficient funds at our command. And here I may be allowed to say that I do not think the aims and objects of our Society are sufficiently realised by the general public. Perhaps, therefore, it would not be out of place on the present occasion, were I briefly to bring under the notice of large firms and employers of labour, in this and other cities, what has been the successful result of our many labours.

As long ago as 1846, the Society turned its attention to designs for improved cottage dwellings for the labouring classes; and, since 1853, it has constantly been labouring to increase the sources of supply, and improve, the food of the people. From 1847 to 1851, the Society has been unremitting in its efforts to improve the condition of arts in relation to manufactures, by giving prizes and holding exhibitions of British manufactures, of paintings by British artists, and of decorative art, and it has sought to extend a knowledge of the applied sciences, by holding exhibitions of models of machinery, collections of specimens of chemical, agricultural, and trade products, patented inventions, and electrical appliances.

In 1859 and following years it carried on a prolonged series of inquiries into the condition of the patent laws; and was enabled to publish reports from time to time, and ultimately to draw a Bill which embodied the existing laws of patents, under which the present Patent-office Museum and Library has been created, and the patents granted from the time of James to the present day have been published for the information of mechanics, manufacturers, and merchants.

By connecting with its Exhibitions of British manufactures in 1849-50 a collection of works of ancient and medieval art, the Society prepared the way for International Exhibitions of manufactures, for the first of which, in 1851, it found contractors, and entered upon liabilities which were ultimately superseded by the issue of a Royal Commission and Charter, The Commissioners were subsequently incorporated trustees for the application of the surplus profits which arose from the Exhibition of 1851, by means of which the Exhibition of 1871 has been rendered practicable.

In promoting and establishing, in London and the provinces, elementary drawing and modelling schools, chiefly for artizans, and by awarding prizes for the manufacture and supply of drawing instruments and appliances at prices within the means of the workmen, the Society has aided the establishment of government schools of design throughout the country.

By continually seeking to make known, as largely as possible, the capabilities and resources of our Indian provinces and their requirements, and by the publication of essays and the holding of discussions on various subjects tending to develop trade, commercial enterprise has been stimulated, as in the case of Indian cotton, silk, tea, &c., and new industries have been created.

The Society formed, in 1851, an association to promote a cheap and uniform system of international postage for letters and printed papers, and subsequently aided the attainment of improved postal laws, and a cheaper and more uniform means of communication between settlers and traders in our colonies and residents in the mother country. More recently it has promoted the establishment of a small parcels post, and the amendment of the rules and regulations of the Post-office relating to the carriage of letters, books, newspapers, and parcels, which has induced a larger and more economic use of the Post-office service in the interests of Art, Manufactures, Commerce, and Literature.

By the establishment of a union of the literary, scientific, and mechanics' institutions throughout the United Kingdom and its colonies, the Society has been enabled to encourage the formation of classes for scientific instruction, by means of which it has led the way to an improved education of the artisan as tested by examinations, both written and oral, the direct result of which has been the establishment of the Middle-class Examinations of Oxford and Cambridge, as at present conducted.

In 1852, the first Exhibition of Photographic Works was held by the Society, which led to the establishment of the Photographic Society of London, and aided the advance of a new art which is now yielding important results bearing upon art-education.

The Society promoted, in 1852-3, and subsequently, the repeal of the paper duty, as tending to leave industries more free to develop themselves in new directions, and made known new sources of supply of raw materials for the manufacture of paper, thereby extending the productive power of that industry.

Various other important movements have been instigated by the Society. Among them are the consideration of the position of the law relating to property held in trust for public institutions, and the preparing of a Bill, which became law, in relation to such trusts; the holding of an exhibition of educational appliances in 1854, which laid the foundation of the national educational museum at South Kensington; and by inquiring into the question of music as an element of education, it has sought to promote its recognition among the arts, the establishment of a uniform musical pitch, and the foundation of a national training school for music, whereby the musical knowledge and education of the people may be extended and improved.

In promoting exhibitions abroad, and in organising visits to such exhibitions, as in 1867, by raising a fund to defray the cost of sending English artizans to visit and report on the educational, social, and industrial condition of the artizans of France, as evidenced by their exhibited works, and inquiring into their trade regulations, the Society sought to bring about a better understanding and the social advancement of the working classes both at home and abroad, and the encouragement of friendly rivalry between English and foreign manufacturers.

In many ways, since 1855, it has endeavoured to advance and improve the physical training and education of women, and an effort is now being made for promoting the establishment of an association for systematically carrying on such work in the interest of the middle classes.

A committee was appointed, in 1858, to consider a report on the condition of the existing law of British artistic copyright, its defects, and how those defects affect the interests of both purchasers and producers of works of modern art, the result of the labours of which was the Bill amending the copyright law in relation to works of art.

The Society promoted the International Exhibition of 1862, in aid of which it raised a guarantee fund of nearly half a million of money, thereby rendering it possible to carry it out; and, having nominated commissioners to superintend the same, applied for, and obtained a charter incorporating the Commissioners for the Exhibition of 1862.

In directing attention to the necessity for an improved technical education of artizans, it has led to the establishment of technical colleges and science schools in the various centres of industry, and by courses of lectures, called Cantor Lectures, in which the principles of mechanics and chemistry, in their relation to industry, are explained, the industrial and commercial education of the people has been advanced. By the offer of prizes for the production of works executed by art-workmen in various materials, after specified designs, new industries have been created, and old ones have been revived by means of modern appliances, as, for example, the execution of designs in mosaic by means of tesseræ manufactured by machinery, whereby production has been economised, and mosaics rendered more generally available.

Few bodies can boast of such a career of practical usefulness as the Society of Arts, and keeping this in view, I venture to hope that the example set by Dr. Swiney, and more recently followed by Dr. Cantor, Mr. Alfred Davis, and Mr. Alexander Robb, of presenting sums of money to the Society, to be held in trust for the promotion of the general objects of the Society, will be followed by many of the wealthy, so as to create a permanent endowment fund, the interest of which may be applied to the work of the Society, which, in seeking out new fields of industry for the people, will tend to improve their condition, and so prevent poverty and its attendant evils.

Mr Edwin Chadwick, C.B., said I beg to move the thanks of the meeting to the noble lord the Chairman of our Council, for the able address, so important in its prospective matter (dictated for us, as we all regret, from his bed), and so kind in its retrospect of the Society's past course, which is put forth as a claim to special support from men of wealth and spirit for public objects. With regard to the tribute paid to our late lamented member, Sir John Burgoyne, with whom I had the honour to serve for a time in an important civil commission, I may mention that, with myself at least, a primary object in the promotion of the military drill in schools has been the augmentation of civil productive force by early physical training. One object for the promotion of the volunteer movement, has been the conservancy of such force by physical exercises in the adult stages of life. The augmentation of our military force by school training, though secondary, is, I need not say, in itself an object of the highest order of importance, especially as supplying the additional intelligence needed to wield with efficiency the new arms of precision. Sir John highly appreciated the value of educated as compared with uneducated forces. He was accustomed to maintain that the Sappers and Miners, and the Engineer corps generally, officers as well as men, though more highly paid than the line regiments—efficiency in war, as well as in productive service in peace, duly estimated—was not a dear force; that it was, in fact, for results, a cheap force. In reference to this topic of the superiority of educated over uneducated force, I may state that, not long before his death, I received from him a letter of most gratifying commendation of the course taken in respect to it, and giving a strong encouragement to perseverance in it. On the subject of the improvement of our means of transit, I beg to note the distinct importance of the establishment of the postal telegraph as a precedent for railway reform. It may be remembered that the leading economical position taken in respect to it was this, that by the consolidation of multiplied trading establishments, under unity of public management, a capital might be saved, and that this saved capital might be divided between the public and the shareholders—that to the public might be given lower rates and an improved service, and to the shareholders better dividends. And this has been done. It was objected to the measure that it would be a precedent for railway reform. And in principle it is a clear, decided precedent. The first step has been prepared for its application to Ireland. A royal commission has examined the railways there, with a view to their purchase on behalf of the public. The commissioners have estimated that, by unity of management, an important saving may be made. I have good assurance that they have under-estimated that saving, which may there also be divided between the public and the shareholders; to the public in uniform reduced goods and passenger rates, on the scale expressly of those which are working so well in Belgium—in better speeds from better fitted trains. It is objected that our government cannot do the like. Who has ever supposed that a department like the Board of Trade, as at present constituted, can do the like? But surely it does not pass all our legislative and administrative skill to constitute a special commission, comprising practical engineering skill and administrative ability, which shall be responsible to the public for doing the work properly. And look at the advantages of it to the people, in what it is doing for Belgium. It has been recently proposed, I believe with the best intentions, that measures shall be taken to reduce the price of provisions to the wage classes. Now it is proved that this railway reform is a measure which of itself does in Belgium reduce the price of provisions to the wage classes, by enabling the farm and other produce to be sent to market in small as well as in large bulks, more quickly and cheaply than can be done by any other methods. The system benefits the wage classes in another way. A cheap half-franc telegraph as well as a cheap post enables them to be readily informed of varying demands for labour in distant parts, and very cheap railway fares give quick access to them. In this way stagnant labour markets have a ready and wholesome relief. For all this there are clear advancing precedents. To advert to another topic of the improvement of the condition of the wage classes, renewed efforts and combined efforts are certainly needed for the improvement of their habitations. The burning of Chicago, and the devastation of old cities on the Continent induce me to make an effort, with the approbation of the Council, to show what engineering art and architectural art may now do, under the guidance of the latest sanitary science, in the construction of new cities, and especially in the habitations of the wage classes. I will only observe further, on the motion of thanks to our Chairman for the extraordinary exertion to which we owe the address of to-night, that from the experience of the efficient service rendered to us in Parliament and elsewhere, your Council have again rescinded the bye-law which limits the duration of the office of Chairman, and have again besought him to continue his exertions for our objects—to which we hope that his illness will be only a passing interruption.

The Chairman said that he would second the motion, for, having acted for the last three years as Vice-Chairman of the Council, he had had the opportunity of judging of the services rendered by Lord Henry Lennox to the Society. If he had not attended the meetings of the Council on every occasion, whenever his services were likely to be of advantage he was always at his post, and never spared his personal exertions. He had therefore much pleasure in putting the motion, and adding an expression of regret at the circumstance which had prevented the noble lord being present, and the hope that his indisposition would be of short duration.

The motion having been carried unanimously,

The Chairman proceeded to distribute the following prizes:—

To Charles F. Chubb, the Society's Gold Medal for the importation into this country of silk cocoons grown in Queensland.

To Ferdinand Kohn (since deceased), the Silver Medal of the Society, for a paper read during last session, "On the Machinery used in Sugar making."

The Society's Silver Medals for Specimens of Art Workmanship to the following:—

Thomas Jacob, for an amboyna inlaid loo table.
J. W. Gould, for the figure of a child, modelled in plaster.
J. Daymond, jun., for designing and modelling friezes.
Messrs. Cox and Son, for church plate.
John Keith, for church plate produced under his superintendence.
B. J. Talbert, for designs for church plate.
T. Winstanley, for a pair of wrought-iron gates.
F. W. Porter (architect), for the design for the above gates.

The Prince Consort's Prize,

Consisting of twenty-five guineas, and accompanied by a special certificate, to

Thomas Dawe, aged 20, Devonport Mechanics' Institution, clerk, who has obtained during the present and three preceding years the greatest number of First-class Certificates at the Society's Examinations, as follows:—

1868. Arithmetic—First-class Certificate.
,, Navigation and Nautical Astronomy—First-class Certificate, with First Prize.
,, Mensuration—First-class Certificate.

1869. Book-keeping—First-class Certificate.
,, Algebra—First-class Certificate.
1870. Metric System—First-class Certificate, with First Prize.
„ Domestic Economy—First-class Certificate, with First Prize.
1871. Logic—First-class Certificate, with First Prize.
„ English History—First-class Certificate, with First Prize.
,, Political Economy—First-class Certificate, with Second Prize.
„ Geography—First-class Certificate.

With regard to the prize awarded to Mr. Chubb, the Secretary stated that he had received a letter from that gentleman, by the last mail, in which he expressed his great satisfaction at the successful result of his endeavours. He added that he was not a regular silk grower, being a lawyer by profession, but he had endeavoured to promote the culture of silk in Queensland, the climate of which country he considered very favourable. The mulberry grew rapidly there, and to large size, so that there was no difficulty in getting food. He had imported the best descriptions of "seed" from Japan; and up to the present time there had not appeared any prospect of disease attacking the worms, as had been the case in Italy and elsewhere.

ANNOUNCEMENTS BY THE COUNCIL.

CANTOR LECTURES.

The First Course of Cantor Lectures for the ensuing Session will be "On the Manufacture and Refining of Sugar," by C. HAUGHTON GILL, Esq., and will consist of four lectures, to be delivered on the following Monday evenings:—

LECTURE 1.—MONDAY, NOVEMBER 27.

Sugar from "cane" and from beet-root is the same—Exists dissolved in water in the plant-cells—Some bodies can pass through moist water-tight membranes—Diffusion—Colloids and crystalloids—Solubility: limits of in cold and in hot water—Crystallisation from hot saturated solutions on cooling—Phenomenon of supersaturation—Evaporation—Boiling—"Boiling point"—Boiling point dependent on pressure on liquid—Solutions of sugar boil at higher temperature than water.

LECTURE 2.—MONDAY, DECEMBER 4.

Properties of sugar—Its ready decomposibility—Action of a high temperature—Action of dilute acids—Conversion into grape and fruit sugars—Other varieties of sugar; their properties—Winning of cane juice by rollers—Rough evaporation in open pans, and consequent destruction of sugar.

LECTURE 3.—MONDAY DECEMBER 11.

The sugar-beet—Extraction of juice by diffusion and by presses—Defecation—Carbonation—Preliminary filtration—Concentration—Refiltration—"Boiling"—Separation of syrup from crystals—Treatment of Syrup—Second and third products—Molasses—Nature of molasses—Difference between molasses from cane and beet—Estimation of the value of raw sugar.

LECTURE 4.—MONDAY, DECEMBER 18.

The refining of sugar, the complete cleansing of it—Melting or blowing up—Filtering, charcoaling, boiling, filling out, draining, liquoring, stoving—Utilisation of syrups—Treacle.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose were issued with the last *Journal.*

INDIA COMMITTEE.

A Conference will be held on Friday evening, December 1st. Lieut.-Colonel A. ROMAINE WRAGGE will open a discussion on the subject of "Indian Forests and Indian Railways."

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

EXHIBITIONS.

THE MILAN EXHIBITION.

An occasional correspondent sends the following account of the Milan Exhibition:—

The idea of holding the exhibition is due to the Italian Industrial Association, which was established in that city in 1867, under the presidency of the Prince Humbert, and the successful manner in which it has been carried out is highly creditable to this association.

The Industrial Association, following the lead of the Royal Commission in London, propose holding, from time to time, in Milan, partial exhibitions, in all forming five distinct groups. The first of these has just been held, and embraces everything relating to "construction and the common arts" (the classification was published in *Journal* No. 963). The future exhibitions will consist of—Group II.—Textile arts. Group III.—Mineral products, their industry and application. Group IV.—Products of the animal and vegetable kingdom, and alimentary substances. Group V.—Educational sciences, fine arts, and the history of labour.

The exhibition was opened, with little ceremony, on the 2nd September, and was closed on the 2nd October, and notwithstanding, in our opinion, the high price of admission (viz., 1 franc on week-days, and 2 francs on Sundays), the returns of the number of visitors was highly satisfactory to the promoters.

The exhibition building consists of the "Salone del Giardino," which was completely restored last year, and admirably adapted for the purpose for which it is intended, namely, for holding exhibitions and concerts. This building is surrounded by four annexes, constructed roughly, but tastefully, in wood, the entrance from the Via Palestro representing a Swiss chalet.

The total area of the exhibition is upwards of 8,000 square metres, and the number of exhibitors considerably exceeded 1,200. The general effect was exceedingly good, and although the arrangement of the building was simple in the extreme, everything was in good taste. The arrangements were also good, and reflect great credit on the committee of management and the officials in charge.

Commencing the description of the exhibits in regular order, the first class to be noticed is that allotted to "materials for construction," and the various productions belonging to it which are exceedingly plentiful in Italy, and are well represented.

Signor Galletti, of Bergamo, gives some idea of the richness of his province, in a collection of 164 different samples of marble, varying in colour from the pure white, from the quarries of Vezia, to the black of Gazzaniga, and the streaked to the rich variegated specimens from other quarries.

The collection, however, has one defect, and Signor Galletti would have done well if he had followed the example of the Società Industriale Veronese, who have ticketed the twenty-four samples that they have exhibited with the price and size of the blocks that can be obtained. We cannot too highly commend this system, which should be stringently enforced at all industrial exhibitions. The marbles of Central Italy and Rome are also well represented, and those of Carrara are too well known to our readers to require any special description here. The collection of marbles contributed by the Minister of Agriculture are interesting, on account of their being productions from the recently annexed provinces.

An industry which is worthy of more special attention than it has hitherto received is that of the production of artificial marble, and in which, during the last century, the Prince Sanseverino of Naples acquired a well-merited reputation, imitating the celebrated marbles of the East. In this art, Sig. Campana is most proficient, and at his manufactory at Naples he is able to counterfeit, not only the most precious of the antique marbles, such as the *rono antico*, the *verde antico*, but also the green and red porphyry, malachite, &c. Chiccaglia, of Rome, and Gianoli, of Florence, also exhibit artificial marble, but their products cannot compete with those of Campana.

Passing the varied assortment of building stones, which are exceedingly numerous, we come to the lithographic stone exhibited by Sigs. Gozzi and Taddei, of Bergamo, which has recently been discovered in that province. It will prove, no doubt, a valuable acquisition for Italy, which, up to the present time, has been entirely supplied from the quarries of Bavaria.

A variety of sand-stone, of exceedingly fine grain, is also a speciality of the province of Bergamo, and, made into grind-stones, is exported in considerable quantity. The number of quarries worked is 36, giving employment to upwards of 1,300 persons, and producing 1,400,000 grind-stones annually. The best-known quarries are those of Nembro and of Pradalunga, from which samples are shown by Sigs. Taddei and Piccinini.

The manufacture of hydraulic limes and cement in Italy is most important, and, although it is but poorly represented at the exhibition, it should not be passed over without remark. Hydraulic cement is comparatively a new product in this country, as Pozzolana has hitherto been almost exclusively employed in the preparation of mortars to resist the action of water. In 1846, the rich deposits of marly lime-stone existing in northern Lombardy were first brought into public notice by the Society of Encouragement of Milan, but it was not until 1858 that the lime and cement works at Serra Valle, in the Venetian provinces, and at Palazsuolo, near Brescia, were established. These works, now the property of the Alta Italia Railway Company, are the most important in Italy. In 1864, a company was formed at Bergamo, for the manufacture of hydraulic lime and cement, and in the short space of six years the "Società Bergamascia" has attained considerable importance. Large quantities of this lime and cement have been employed in most of the public works that have been recently carried out in Italy. Amongst the most important may be mentioned the Canal Cavour, the port of Ancona, the Victor Emanuel Gallery at Milan, the bridge over the Adda, at Rivolta, built entirely of concrete, with the exception of the facings of the piers, which were of stone. The new sewers at Milan are being constructed entirely with concrete made with this cement.

The lighter coloured beds produce the slow-setting cements and lime, which is but adapted for concrete blocks of large dimensions, whilst those of darker colour, containing a larger proportion of clay, furnish the quick-setting cement, which, if not as quick-setting as the Roman and Portland cement, are still of excellent quality, and are produced at about one quarter the price.

hese works, which employ about 300 workmen, produce annually 6,000 tons of hydraulic lime, and 10,000 tons of cement.

Among the various applications of the Bergamo cement exhibited are, an arch of eight metres span, built entirely of concrete; a bath, pipes, and a short length of the sewer recently constructed under the Via Carlo Alberto, at Milan. The Alta Italia Railway Company does not show such a complete collection of various applications of lime and cement as the former company, and have contributed only a large block of concrete, made with the lime of Palazzuolo. Concrete blocks, or "*prismi*," are extensively used in Northern Italy, as a substitute for stone in river embankment works.

One of the best limes in Italy is that of Casale. It is being principally used by the contractors for the important branch canal of the Canal Cavour, now in course of construction between the Ticino and the Agogna, for the irrigation of the Lomellina.

The specimens of asphalte, and pavements in this material, are numerous; and now that asphalte is likely to come into more general favour in England, it is probable that some of the rich deposits which are abundantly met with in Central Italy, and which hitherto have remained unworked, will be turned to profitable account. Amongst the principal exhibitors of this substance are the "Società Generale degli Asfalti," of Rome, Praga and Erba, both of Milan. This last-named exhibitor has discovered a process by means of which he is able to colour both asphalte and lava, and to produce, at very reasonable prices, pavements of any design and colour. This material is unaffected by the heat of the sun, and has no unpleasant smell. The price of these pavements varies from 2fr. 50c. to 4fr. per square metre, according to the pattern required.

The fire-bricks and articles in fire-clay, exhibited by Ginori and Richard, and the crucibles of Bondi, of Rome, will bear comparison with those of English make. With regard to "timber for construction," which enters into the second section of Class I., we have but little to say, as the show is poor in the extreme, and gives no idea of the resources of the provinces of Piedmont, Lombardy, and Venice, which furnish excellent timber for ship-building and other purposes. Timber is also plentiful in Sardinia; and the larch from this island is remarkable by its absence.

Forestry is practically obsolete in Italy, although it is true that there is a school of forestry in Tuscany, and inspectors of forests, still sufficient attention is not given by the government to promote the conservation of forests in this country, and to prevent the ruthless distruction of them in the Alps and Appenines.

The parquet floors are in great variety in the exhibition, and many of them are exceedingly beautiful and accurately made. Amongst the most worthy of note may be mentioned those of Pedotti and Co., of Milan.

There is, perhaps, no country in Europe so rich in iron-ore as Italy, and none in which the production is so limited. One of the principal reasons for this is the scarcity of fuel; and considering that the cost of fuel alone to produce a ton of pig-iron averages 65 francs, it is not to be wondered at that Italy, in spite of her richness and quantity of her ore, is obliged to import two-thirds of the iron that she requires, to spend annually in this article alone 42,000,000 francs.

The most important exhibit in this section (3rd) is that of Signor Gregorini, of Lovere (Lago d'Iseo), who was the first to adopt the Siemens furnaces in Italy. The iron and steel exhibited by Signor Gregorini are remarkable for their excellence. The other exhibitors in this department are numerous, and tend to show that, as regards quality, Italy can compete with any other country in Europe. With, however, the exception of a few iron masters such as Gregorini, the iron manufacture is generally conducted on too small a scale, and in a most primitive manner.

The number of drawings and models of furnaces and kilns in the 4th section is surprising, but none present any especial novelty in system. Chinaglia of Turin, Novi of Milan, and many others show models and drawings of their continuous kilns for burning bricks, which seem to be all, more or less, modifications of Hofmann's patent. But this question has already been disposed of in the law-courts, which have decided that neither of these kilns were infringments of Hofmann's patent.

The machinery department gives but a poor idea of the importance of mechanical industry in Italy, which, yet in its infancy in this country, is but imperfectly represented in the exhibition. Neither Ansaldo, of Sanpierdarena, the works of Pietrarsa nor Westerman, of Genoa—all makers of marine and locomotive engines—seem to have thought it worth while to exhibit, and in this department the Milanese mechanical firms have all their own way, and by themselves make a very creditable show.

Bauer and Co., of the Helvetica Works, Milan, exhibit a gas engine, on Otto's principle, which is stated to be more economical than either the Lenoir or the Hugon engines, the consumption of gas being less than one cubic metre (35·88 English feet) per horse power an hour. Bauer and Co. also exhibit some well-constructed portable engines and a large centrifugal pump. Pumps of this construction are daily getting into favour amongst engineers, and superseding the old-fashioned Archimedean screw, which, however, is still largely used for pumping on public works in Italy. The show of other mechanical appliances and contractors' plant is poor in the extreme, and, beyond a very old-fashioned pile-driving machine and some windlasses of similar antiquated appearance, the exhibition gives no idea of the great engineering works that have been carried out of late years in Italy.

On the eve of the completion of one of the greatest triumphs of Italian engineering, the Mont Cenis, or, as it is now the fashion to call it, the Frejus Tunnel, it would have been most interesting if one of the tunnelling machines had been exhibited.

A large model of the horse-tramway which is to be made from Milan to Monza is also exhibited; but we think that Signor Lué, the inventor, has not hit upon the right form of rail for the purpose, and that the company are decidedly wrong in adopting this principle. The question of horse tramways in Italy is one of the greatest importance for that country, and one which the government would be wise if they looked into. As yet, the few lines that have been made have turned out failures, and unless some really good system be adopted, they will never be looked upon favourably by the public.

In this class, Signor Donati, engineer to the company for the cleaning out of the cesspools in Milan, exhibits the apparatus used for this purpose, amongst which is an ingenious arrangement for creating a vacuum in the cylindrical tanks, by the revolution of the wheels of the cart on which it is supported.

Signor De Simoni, of Milan, shows samples of wire-rope, of which he is the only maker in Italy. The same exhibitor also shows some samples of belts for driving machinery made of wire.

Passing on to Class II, which comprises apparatus and processes for heating and lighting, there is a good collection of stoves and "calorigens," cooking ranges, &c., some of which may be highly commended for their excellent workmanship and cheap rate at which they are sold. Some of the stoves in cast iron for apartments are exceedingly elegant, especially those of Alessandro Chicca, of Rome; Carlo Massazza and De Fabianis, of Turin; and Antonio Mazzini, of Milan.

A great number of ovens or stoves for killing the cocoons of the silkworm are also exhibited, amongst which may be mentioned that invented by Signor Giretti, of Pineroli, who claims the following advantages for his plan, viz., that the colour of the silk is not altered, neither do the cocoons suffer from the contact of the steam which is introduced during the first part of the operation, and they are perfectly dried by means of a current of heated air, which is introduced during the second.

Other systems are exhibited, for which each exhibitor claims certain advantages, either for economy in fuel, or facility with which the killing of the cocoons can be effected. Other exhibitors show stoves for the hatching of silkworms, and amongst which that shown by Signor Orlandi seems to be the best adapted for the purpose. The heat is generated by a petroleum lamp, and can be readily regulated to the required temperature.

Some important apparatus for the "conditioning of silk" is exhibited by Signor Odazio, and is the same as that at present adopted in one of the principal "conditioning" establishments in Milan.

The gas fittings and bronzes exhibited do not present any particular feature to merit any special mention.

The next in order of the official catalogue is Class III., allotted to the ceramic art, together with the manufacture of glass, which makes a most important show in the exhibition.

Terra cotta forms an important branch of industry in Italy, and particularly at Milan, as the number of exhibitors from that city testifies.

The statues and architectural ornaments shown by Boni and Ajzaghi, of Milan, have some artistic merit. We were greatly struck with two groups of figures by Boni, and a chimney-piece and cornice for a mirror by Ajzaghi.

Cheap, solid earthenware and stoneware has numerous exhibitors, amongst whom may be mentioned Dossena, of Lodi, and Legnani, of Cassano d'Adda, who furnish a quality of ware admirably adapted for cooking utensils, which, from its lowness of price, cleanliness, and capability of resisting heat will, no doubt, find a ready sale amongst the poorer classes.

The imitations of Etruscan ware and *faïence* of Giustiniani, of Naples, as also the exquisite vases designed by Professor Farina, in the quattro and cinque cento style, are most creditable productions of the potter's art. The chief attraction, however, in this class are the exhibits of Ginori and Richard. As long ago as 1735, a manufactory was established at Daccio, near Florence, by the ancestors of the present Marquis Ginori for the production of imitations of Chinese porcelain, and, in spite of the difficulties which were met with at first, the Daccio manufactory is now most flourishing, and its productions find a very ready sale throughout the world. Besides a good collection of porcelain for domestic use, the Marquis Ginori exhibits a magnificent dessert service and numerous vases, which for richness and elegance of design leave nothing to be desired. The statuettes in "biscuit" show that there is no lack of artistic resource, and that the reputation of the old Italian pottery is worthily sustained. Whilst the porcelain of the Marquis Ginori has more of an artistic character, that exhibited by Sig. Richard, of Milan, presents altogether a commercial appearance. not that we intend to detract anything from the merits of the latter, but it must be borne in mind that the class of ware manufactured by Ginori is intended more for the amateur than for the general public. Sig. Richard has introduced into his manufactory improved machinery, and, although both the workmanship and design do not want in elegance, yet he is able to produce ware which, for lowness of price, will compete with any other manufacturer.

Sig. Spreafico, of Milan, exhibits some very beautiful specimens of painting and decoration upon porcelain and glass. The decoration in white and coloured enamels upon glass, which are a *spécialité* of this exhibitor, are produced at reasonable prices.

The art of glass-making is, as usual, represented by Dr. Salviati, whose productions are now so well-known in England that they require no comment. The fine chandeliers of the old type, and the mirrors "Specchi," ornamented with wreaths and flowers, are most beautiful.

The exhibition of furniture in Class IV. is, on the whole, a most unsatisfactory one, as but few exhibitors seem to have thought it worth while to contribute cheap articles of common use. The majority of exhibits in this class is composed of fancy and expensive furniture. This is a great mistake, and one that is usually fallen into at exhibitions, where we see rather too few national and ordinary pieces of good furniture, and too much that is made specially as exhibition work.

Monti, of Milan, is an honourable exception to this rule, and shows a good collection of cheap wood furniture, made principally in the communes of Trecate, Cantù, Seregno, Cesano, and other villages of the Brianza, where the peasantry profitably employ their spare time in producing articles of furniture which find a ready sale in Milan.

The chairs of Chiavari are also a production of the peasantry in that neighbourhood, and from their elegance, lightness, and cheapness, are exported in large quantities to France, England, and South America.

The use of iron for furniture is becoming more generally appreciated in Italy than formerly. Among the principal exhibitors may be mentioned Cambiaggio, of Genoa, Francisco Carbone, of Milan, who exhibits not only bedsteads and other household furniture, but garden chairs, &c.

Milan has, from the middle ages, been celebrated for her fancy furniture, marqueterie work, and wood carving, and at one time the Milanese workshops were real art schools, in which the workman acquired a real artistic feeling. The invasion of the French fashion, and the prevailing idea that everything that was good and beautiful must come from abroad, have done a great deal of harm to this trade.

The class of furniture especially affected by the Milanese cabinet makers is that in carved ebony inlaid with ivory.

Carlo Corbetta exhibits a cabinet in the style of the 14th century; it is small, but quiet and judicious in design, tone, and execution; it is in ebony, with ivory and silver inlay. A large cabinet in ebony and ivory, by Mauprivez, may be examined as one of the best in the exhibition.

The fittings and ornaments in bronze, which some of the exhibitors have applied to their works, seem to us to be in a somewhat doubtful taste.

The Tuscan cabinet work is exhibited to great advantage, and a number of carved pieces, friezes, and frames, and including furniture of various kinds, are worthy of careful examination; nothing in the whole exhibition is more delicate than the bas-reliefs in walnut, representing Bacchus and Ariadne, by Rinaldo Barbetta, of Florence.

The light coloured marqueterie tables of Corridi is also worthy of note.

The only exhibits from the Neapolitan province in this class is the Serrento work, which is a most lively and characteristic description of wood mosaic, something similar to our Tunbridge ware.

Class V. (metal working) is vague and confused, as it embraces a variety of objects which have apparently no relation one with the other, except that metal enters into their composition; thus, mathematical instruments in the same class with jewellery, and musical instruments with cutlery; and a great many articles which belong properly to this Class have found their way into class 1, as metals used for construction.

In the first section of this class, the jewellery of the Princess Margherita, of Savoy, attracted universal attention, as also the exhibits of the well-known jeweller, Bigatti, of Milan, and Franconieri, of Naples. The diadem and diamond necklace belonging to the Princess Margherita, and exhibited by Bigatti, are masterpieces of the jeweller's art. Another work by the same artist, a necklace in the Longobard style, is heavy and in somewhat questionable taste.

Franconieri draws crowds to his stand, to see a bird of paradise, executed entirely in gold, brilliants, rubies, and other precious stones. The elasticity of curve, delicate forms, and exquisite taste with which it is executed, reflects the highest credit upon this artist.

Excellent examples of design and workmanship may be found in the cases of other Milanese jewellers; and representatives of other towns are not wanting, such as the Genoese filagree work, the work in turquoise of Florence, the Etruscan gems of Rome, and the great variety of mosaics of Venice, Florence, and Rome, cameos and coral work of Naples, &c.

A marked improvement has been made of late years in the philosophical instruments made in Italy; the theodolites and other engineering instruments exhibited and manufactured by Professor Porro, amongst which are numerous examples of an instrument which he calls the "cleps" theodolite, by means of which a most accurate survey can be made in an exceedingly short space of time, the readings of the instrument giving the angle, distance, and level. Whether this method will ever supersede the usual way of surveying, we are not prepared to say, but, at the same time, we strongly recommend it to the attention of engineers and instrument makers in England.

The levels, theodolites, and other instruments do not come up to those of English make, the extreme accuracy and high finish of which cannot be surpassed.

The brass wind musical instruments of Pelitti make a fine display, as might be expected.

With regard to wood instruments, only one exhibitor, Ranponi, of Milan, is found. These instruments are richly ornamented in ivory and silver. The only exhibitors of stringed instruments is Melegari, of Turin, who has sent some very good violins.

The exhibition of pianos and harmoniums is good, and amongst the principal exhibitors may be mentioned Bezza and Mola, of Turin, Ducci, of Florence, and Vigo, of Milan.

Amongst makers of fire-arms, Glisenti, of Brescia, is perhaps the first in Italy, and he has executed large orders for the French Government of chassepôts. In the exhibit of Glisenti may be seen flint guns, which are made for the African market, Martini, Albini-Remingtons, and a gun of his own invention, besides a number of revolvers and sporting guns, which last are highly commendable for the excellence of their make. The arms exhibited by Bignani, Dupont, and other Milanese makers are of excellent make.

Class VI.—The carriage department is well represented in the exhibition, the principal exhibitors being Locati, of Turin, who has sent a well-made brougham, the Omnibus Company of Milan, who show one of their omnibuses, and Sala, of Milan, who exhibits a model state carriage, which he has made for the Prince of Naples. This little carriage, which is in the Louis Quatorze style, is tastefully decorated and gilded, and is a masterpiece of workmanship.

Amongst the many exhibitors of saddlery and harness, the workmanship of Talamucci is highly deserving of praise, as is also Lichtenberger, of Turin, who shows two English saddles. The principal exhibitors of travelling articles is Franzi, of Milan. The portmanteaus and bags shown by this maker are strong and serviceable, and comprise at the same time lightness with convenience.

The title of "Economic Industries," applied to Class VII., is rather vague, and seems to be chiefly represented by chemical manufactures. The principal exhibitors in this class are Sclopis and Co., of Turin (who show samples of sulphate of iron and sulphuric acid, which they produce from iron pyrites), Frigerio, of Milan, Sbertoli, of Genoa, and a number of manufacturers of varnishes and dye-stuffs.

The principal soap-maker is Conti, of Leghorn, who shows some good samples of liquid soap made from olive oil, and used by cloth manufacturers.

Only one exhibitor of stearine candles is to be found in the exhibition, viz., Manganoni, of Milan. Candles are manufactured extensively also at Turin, by Langa and Company, but no samples of their products are to be found in the exhibition.

The art of printing, in Class VIII. is well represented by the principal Milanese publishers; and some of the editions exhibited by Treves, of Milan, are of really first-rate excellence. A distinguished place must be assigned to the firm of Saldini, the publishers of the engineers and architects' journal, the *Politecnico*, for the beautiful lithographs of engineering works, and especially for an album containing 100 architectural plates.

In conclusion, we may remark that great progress has been made in almost every branch of art in Italy, and that manufacturing industry is daily becoming more and more developed; and, now that the Mont Cenis Tunnel is opened, and the mail route to India is established *viâ* Brindisi, there seems to be every prospect that the former commerce and industry will return, and that Italy will once more take her proper place amongst European nations.

TRIBUNALS OF COMMERCE.

The Select Committee appointed to inquire into the expediency of establishing tribunals of commerce, or other means to be adopted for improving the administration of justice in causes relating to commercial disputes, in England, have continued an investigation which commenced in 1858, when much important information was obtained respecting the constitutions and operations of tribunals of commerce in several States of Europe. In further pursuing the inquiry, the committee have examined several witnesses, who, from their position and connections, were competent to express the views generally entertained by the commercial classes respecting the present state of the judicial system of this country, and they have come to the conclusion that dissatisfaction exists among the mercantile community at the manner in which justice is administered in commercial cases by the superior courts. We are enabled to gather portions from the evidence of certain of the witnesses given before the committee, and published in their report, which convey in general terms the character of the complaints, and the proposals made for the constitution of the tribunals, and the jurisdiction of the cases over which their decisions would extend.

Mr. Wm. Morris, worsted spinner, at Halifax, states that the Chamber of Commerce over which he presides have always expressed their wish, shared in by the town of Halifax, to have tribunals of commerce. That opinion arises from a sense of the delay, expense, and uncertainty of the judicial decisions which are given by individuals upon legal points, when in all probability they turn rather upon the customs of trade; therefore, an indiscriminate or miscellaneous jury are not likely to know those customs as well as local men, who could form the tribunal of commerce in each respective town. In fact, the business of the locality is conducted, not according to what may be called strict law, but according to custom; in case of any dispute arising between two parties, the difference would have to be determined according to law. For instance, unless a contract be reduced to writing, it would be invalid, although in point of custom, it is just as valid as if it were in writing. All such disputes, if brought rapidly before some two or three persons accustomed to the business of the town, would be settled at less expense, more rapidly, and more in accordance with justice, or what was the custom of the trade. In almost all the centres of industry on the Continent, these tribunals have been established for a length of time—time enough to to have discovered any errors or weakness if they had existed; and what still continues to be valuable for them is a strong *prima facie* case that the same would be equally valuable for us. The commercial classes, from whom the judges would be drawn, would be extremely unwilling to occupy their time with a number of unimportant cases now heard before the county courts. The new tribunals, to a certain extent, should therefore be used as courts of conciliation for questions of a larger amount, coordinate with them, and offering the power of selection to the litigants, or rather the means of escaping litigation by referring the question in dispute to men, honest and anxious to come to a speedy decision, with knowledge derived from their own transactions, and from a fellow-feeling with the two parties. The tribunal would be composed of individuals selected for their competency for their duty, such a body as the Committee of the Stock Exchange, or of Lloyds. The law would determine upon the number of individuals, conformably to the extent of the district, who should form that tribunal, and their names might be sent up by the Chamber of Commerce or the Corporation, and the Lord Chancellor would make proper inquiries as to their fitness, and then make a selection for given periods. The tribunal being thus constituted by an independent selection, it would be desirable to eliminate all sources of expense, and to exclude counsel and attornies as far as possible. The litigants should appear personally to give evidence, and state their cases before the tribunals. The legal element might very properly be represented by a judge appointed by some high authority, assisted by two or more commercial men. The county court judge, if not already overtaxed, would be an eligible chairman; his residence in the locality would give him a certain knowledge of the customs of trade; and the necessity of an itinerating judge, as was, formerly contemplated, would be then avoided. The legal element should be merely introduced to protect legal questions and legal proceedings as far as possible, and the lay element, or the non-judicial element should have the right of giving the verdict. The judge should point out the law upon the case, or anything that is necessary for him to elucidate, and then leave the assessors to arrive at their own decision. The courts should not be compulsory, but as a condition of the reference; the decision of the tribunal should be without appeal. It must be borne in mind that the tribunal would be continually changing; they should only be appointed for a given number of years, say for three years; and the men being new, would never acquire any superior knowledge over those who were first selected. At the same time, it always must be an inferior tribunal to the great courts of law; it does, in a rough and ready way, give substantial justice, but great interests may be involved in it, and in his opinion, it would be hard to deprive men of the value of those superior courts, where the highest legal counsel can be brought to bear, to seek out substantial justice. The duties of the assessors should be voluntary, unless the burden was too great upon their time, then it would become a question whether there ought not to be some remuneration; but it would be preferable for them to be independent, like the bench of magistrates.

Mr. Jacob Behrens, an export merchant at Bradford, and Chairman of the Chamber of Commerce, expressed the unanimous opinion of commercial men at Bradford, when he stated that the settlement of commercial disputes by the existing courts is most unsatisfactory; that commercial honour suffered from the existence of such a state of things; and a remedy by common consent is expected from the tribunals of commerce. Opinions may and do vary as to their constitution; but while a few gentlemen are desirous of eliminating the legal element altogether, they have always given way to the opinion of the great majority, that the Hamburg system is best adapted to our habits and way of thinking, and that it offers the best guarantee for the decisions, combining justice and equity with the most perfect adherence to law as it exists. Eperience has shown that a very great proportion of disputes, after having gone through the regular course of the law courts, are ultimately referred to private arbitration, because the judges themselves acknowledge their inability to decide complicated commercial cases. The desired amendment was merely an enlargement of the powers of the county courts, in a similar manner as the Admiralty courts, the only material difference consisting in the appointment and character of the assistant judges. Whilst in the Admiralty Court there are paid assessors, whose duty it is to aid the judge by their practical and technical knowledge, without having even the power of a jury, it was felt that such men would not possess the confidence of the public in the great centres of trade and industry. To obtain that confidence, their office ought to be honorary, and filled by men of the same class as that from which the magistrates are chosen. The Hamburg Court, for example, has a right to appoint from one to three referees or experts for the investigation of accounts, or verification and investigation of special facts, whose written reports are verified upon oath, and are, of course, guides to the judges in their decisions. By this means the necessity of the judges possessing the special knowledge of the facts involved in each case is avoided, and the ends of justice are secured. The decision still resting with the judges, and not with the referee, is a great improvement upon the English practice of reference. The jurisdiction, according to the words of the code, extends to "all undertakings to make, manufacture, deliver, or act as a factor ; all commissions, agency, ship-brokering, as well as all bullion exchanges, banking, and brokerage business, except, nevertheless, from the last such transactions as regards landed property. As an instance of the general estimation in which that court is held at Hamburg, a few years ago the 50th anniversary of its establishment was celebrated by a holiday, and many complimentary congratulatory speeches were delivered on the occasion. The jurisdiction of the tribunals of commerce, in his opinion, should extend to all commercial cases, whatever they may be, perhaps, excepting bankruptcy. As regards patent rights, it would be exceedingly useful, for if it should, as proposed, be empowered to attempt conciliation before the legal action commences, the parties would come together and explain their disputes before an impartial mind, and, in ninety-nine cases out of one hundred, litigation would be altogether prevented.

Mr. William C. Brocklehurst, a silk manfuacturer, at Macclesfield, and President of that Chamber, thought that a great deal of litigation would be avoided if the parties—the complainant and the defendant—were brought together before such a tribunal as proposed, and that the intervention of the legal profession would be very well avoided, as often leading to litigation rather than doing away with it. The most convenient way of setting up such a tribunal would be for the council of the town to nominate four commercial judges, assisted by the county court judge. Any such selection would gain the confidence of the community generally, because the community have already selected those who should select for them their commercial judges. With regard to the jurisdiction, he would leave the county courts, as at present, for small sums. The class of cases to be tried should be all cases of breach of contract, and where the customs and usages of the trade have been overstepped; all commercial dealings where articles are bought with the view of being re-sold, applicable to dealings between the retailer and the wholesale merchant, but not with the consumers; between merchants and their clerks, but not between the employers of labour and their workpeople; applicable to any breach of contract between a seller and a buyer, as in the case of a farmer who came into Macclesfield to sell his hay or his corn to a corn-dealer, but not in questions between a farmer and his landlord. He thought it very desirable that there should be liberty of appeal to the superior courts, that is if the president (the county court judge) should have any question as to the law, and it would therefore be for him to advise as to whether there should be such an appeal, but the decision should be final so far as the facts are concerned. He saw no objection to litigants employing professional assistance, as the experience of the county courts shows that litigants are, in many cases, unable to conduct their own causes. The names of the judges might be jointly handed by the town council and the chambers of commerce to the Lord Chancellor, and he would have to select from them. Men thus chosen, he believed, would feel the position an honourable one, and would be quite ready to occupy it, and to fulfil the duties.

Mr. John Nicholson, another witness, chairman of the Shipowners' Association in Sunderland, and himself extensively engaged in shipping, was of opinion that tribunals of commerce would be of very great service to the mercantile shipping, as disputes as to freight, demurrage, and so on, are constantly arising between merchants and shipowners. These cases which arise cannot now be settled off-hand, because the ship has to start upon another voyage immediately, especially in the case of steam-ships, and the officer must be kept on shore at the expense of the owner, in order to give evidence, if the dispute has to be tried in a superior court. But if a tribunal of commerce were existing, such questions could be settled at once, to the advantage of all parties. He would extend the jurisdiction to all matters of dispute with regard to shipping, for instance, cases where vessels have had accidents by collisions at sea, or other points that might arise between shipowners and underwriters. Since the increase of steam-shipping, the shipowners of Liverpool have had so many claims upon them for damaged goods, that they have now resorted to having special bills of lading made out, so as to protect them from all claims for damage, and they will only take the goods subject to the conditions which are on the bills of lading. The necessity that arises in these and all similar matters is to have a prompt settlement, because the shipowner has to dispatch his vessel, and the probability is that he may change his master and officers; and if he has to go to law in the superior courts, he has to keep those men for months on shore at an increased cost, whereas, if the dispute could be settled at once, the vessel could be dispatched again. On the Continent, at Antwerp and Hamburg, from experience derived of the tribunals of commerce there, he had found the decisions, on the whole, as wise and just as those given in the superior courts at Westminster, with the superior advantage of promptitude and inexpensiveness.

Mr. Charles Henry Wagner, a merchant carrying on business at Birmingham, had happily had very little experience of litigation in this country, but he had repeatedly appeared personally before the tribunal of commerce at Paris. In his opinion, it is wonderful that we in England can do without, or have done without, a thing which has been considered an absolute necessity for five centuries and a-half in France, and which is here upon the point of being discussed whether we should want or not. The time occupied in Paris to get a decision was only five days ; in Hamburg, on one occasion, it took eleven days, from the time instructions were sent out to the time at which judgment was given and the remittance made. The whole cost in a dispute before the tribunal at Paris was £3 or £3 10s. ; and in a complicated case, which involved about 480,000 francs, the expenditure was nearly 2,000 francs. He thought, if there was one town in all the world which required such a tribunal, it was Birmingham, where about 73,000 different kinds of articles are manufactured, and the multiplicity of disputes that arise in consequence is very great. He had made inquiries amongst the commercial community, and found that most people are quite ignorant of what a tribunal of commerce means. All that they clamour for is, "Let us have commercial matters settled by commercial men, and not by lawyers." That is the general impression.

Mr. Hyde Clarke, Secretary to the Council of Foreign Bondholders, stated the result of his experience, gained first on the London Committee in 1851, afterwards whilst practising at the Smyrna bar as an advocate, concurrently with financial transactions, which gave him the opportunity of examining several of the systems of law in operation. The courts in Turkey proceed, in the decision of commercial cases, upon the code applicable to the tribunals of commerce of the country to which they belong, with the exception of England and the United States. In Turkey itself there are, besides, two kinds of tribunals of commerce, the one a local system, affecting the citizens of the country, and the other for settling mixed cases, in which the subjects of the various consulates are concerned. With regard to the English merchants, until the abolition of the Levant companies, a similar system to the tribunal of commerce had been in operation for at least 200 years. The abolition of the Levant Company took place about the year 1826, and consequently many of the resident merchants had acted as members of the former courts under that company, which had only followed the system that seemed to have prevailed generally in Europe at the end of the Middle Ages. The code of commerce established at Smyrna in 1851 was in fact the "Code Napoleon," which has been found so well suited for the decision of cases arising against Ottoman subjects, that it is being extended yearly over the whole empire. It was begun at first in two or three of the large cities, and now there is hardly a small commercial town which has not its tribunal of commerce for native matters, and if it has any foreign trade there is likewise a mixed tribunal. Wherever English merchants have tried the system it worked effectually, and the general feeling entertained was in favour of such tribunals, in preference to any court under municipal law. In the formation of the court he would look to the practice of other countries, rather than attempt to make any new experiment. Hereafter he had no doubt that we could introduce great improvements, but in the first we must adopt the actual experience of those countries. Abroad, it is considered a very honourable position to be the president of a tribunal of commerce of any city.

M. H. Boisselier, the French Consul at Liverpool, speaking in the name of his countrymen, stated that in their opinion justice cannot be obtained. They very often prefer to give up a cause rather than pursue it, because they know very well that the expenses and the delays are so great, in comparison with the system in France. He gave an instance of a vessel which had been arrested, not in Liverpool, but by the Court of Admiralty in London. More than two months had elapsed, and the case was not more advanced than upon the first day. As French consul, he had to put in a claim for the crew, and was still waiting, with no decision whatever, whilst these men were kept without their money. The crew had been sent back to France; but still they must live upon something. What he wanted to point out was that the ship was arrested, not in Liverpool, but in London, there being one set of lawyers in London and another set of lawyers in Liverpool, and the captain will have to pay them all. Whereas, in France, the matter would be disposed of in three or four days, because the only question was to appoint experts to examine, who would have made their report to the commercial judge, and he would have decided at once upon the spot. In the French system, the disputants state their own case. Solicitors are prohibited from appearing before the courts as solicitors; they may appear as proxies, as mere representatives of parties, but not as lawyers. However, there is a certain class of people, called *agrées*, who are not recognised as an official body, but still they do exist, and their business is to take up cases, as lawyers would do, for people who may not wish to appear personally. He had heard the wish expressed by many for the establishment of these tribunals, and he saw a commencement of its fulfilment in the establishment of a county court, which, in many respects, does fulfil that object, but only partially; it does not take a whole set of people or a whole set of transactions. He should, however, prefer a separate jurisdiction, on the ground that it would eliminate all legal points and lawyers, and he believed that Frenchmen, and a great many English people too, if they had a contest with anyone, would very much prefer such a tribunal.

After hearing the evidence of other gentlemen, equally well qualified, the Select Committee, in their report appended, recognise that it has long been the prevailing opinion among the chief States of Europe, that the nature of the commercial disputes differ so widely from other causes brought before the ordinary courts of justice, that it has been deemed expedient to establish special courts, called tribunals of commerce, for their decision, under a special code of procedure. These courts are, in France, composed of three judges, selected from the commercial classes. In places where no tribunal exists, the local judge associates with himself mercantile judges, to constitute a tribunal for the occasion. But in Hamburg the tribunal is composed of a member of the legal profession assisted by two commercial men. There seems to be no reason to doubt that the manner in which justice is thus administered affords satisfaction to the commercial community, and the committee have therefore deemed it right to consider whether the system which so extensively prevails in Europe might not with advantage be introduced into this country.

CORRESPONDENCE.

MORE ABOUT COLOUR.

SIR,—Though the truth about colour has been really found out, and may easily be learnt, yet (as I had occasion not long ago to notice in your pages) those who ought to know most about it, as a general rule, know very little. On this account, anything tending to confuse the subject is to be deprecated. Much of what Mr. W. Cave Thomas has advanced in his letter in the *Journal* of October 27th is open, I fear, to this objection.

After asserting the undoubted truth that colours are merely sensations, he seems to demur to the physical theory, which attributes "every colour sensation to the mechanical action of undulations of various periods." "These various undulations," he says, "according to the theory, are of the self-same ether, which, of course, could not simultaneously be of every colour." The ether itself is of course invisible, and therefore of no colour at all; but, probably, Mr. Thomas means that undulations of different periods cannot simultaneously exist in the same part of it. Now, it is an established mechanical truth that distinct undulations of various periods may exist simultaneously in the same medium; and it is certain they always do so in the ether. If, then, it can be shown, as it has been, that the eye is capable of a certain number of distinct sensations of colour, and that one of these is excited most strongly by some waves, another by other waves, why may not a body which sends to the eye all sorts of waves simultaneously appear of a colour that includes in itself all these distinct sensations? Of course the body cannot be simultaneously of more colours than one, because it can only send to the eye at once some particular mixture of the different waves. But why may not that particular colour which is due to that particular mixture be a compound of several distinct colour-sensations?

Again, after asserting that, if colours are but sensations, "there cannot be primaries or secondaries, for a sensation can be primary or secondary only in relation to order of succession" (as if for four or five generations past those words had not been constantly used in regard to colours to denote what were supposed to be simple or binary compound colours, without any reference to order of succession), Mr. Thomas goes on to make what seems to me the astonishing statement—"From what we have just determined it would appear that there is no such thing as the mixing of colours; sensations cannot be mixed." Did Mr. Thomas never experiment with the common colour-top? What can the resulting colour be but a mixture of the separate rotating colours, received in rapid successions in the same eye? Did he ever try the effect of reflecting one coloured spot from that part of a piece of polished glass through which another coloured spot is seen? What can the result be here but the mixture of two colours simultaneously and continuously received in the same eye? But we can even mix the sensations received in the separate eyes. If we put a piece of paper coloured with French blue in one side of the stereoscope, and another coloured with lemon yellow on the other side, we find the two blend together into a perfect gray. Shut one eye, and the blue is seen alone, shut the other, and the yellow is seen; the two sensations compound the sensation of grey. Just as the sound produced in the ear by the aerial waves sent out from a vibrating string may be, and usually is, a mixture of several musical notes, due to several kinds of co-existing undulations, so the colour produced by the light sent out from any object may be, and usually, if not always, is some mixture of all the simple colour-sensations.

I am sorry, too, that Mr. Thomas endeavours to build up a theory of compensatory sensations on phenomena which are quite easily accounted for, on the supposition that those parts of the nervous tissue which are acted on more strongly lose sensibility more rapidly. The most careful experiment affords conclusive evidence that it is so. But the last paragraph of his letter is again astonishing.—"Light does not progress!" It is usually supposed to progress faster than most other things. Does not Mr. Thomas distinguish between the minute displacement of each part of the ether from its position of equilibrium and back again, and the spread of the disturbance from one part to another, which constitutes the advance of the wave through the medium?

In your Monthly Notes on Science, October 20th, you mention Dr. Aitken's argument, that blue is not a simple colour, because certain blue glasses and pigments in conjunction with yellow made a green. This is perfectly true of the blues of such glasses and pigments; they must have contained green as well as the yellow of the others, though probably not so much. But Dr. Aitken forgets, perhaps, how loosely the names of colours are used, and how many different colours are commonly called blue. Glasses and pigments which, when thick, give a near approach to pure blue, when thin are almost sea-green, yet, still are called blue. On the other hand, violet, the name which Newton applied to the faintly visible rays at the end of the spectrum, is also a blue. Milton talks of "beds of violet blue." The violet of the spectrum is doubtless a pure blue, diluted, as recent researches by Müller have shown, with a measure of white from the fluorescence of the retina, like Herschell's lavender rays. Newton's indigo is the deepest blue in the spectrum, and has been shown, both by Helmholtz and by Maxwell, to be complementary to the yellow of the spectrum, and, indeed, he himself, in his colour circle, put it opposite to the yellow. This is the colour of the blue salvia, and of the pigment called French blue, or ultramarine. Surely we may be content to call it blue. It is bad enough to have to tell artists that yellow is not a simple colour, without saying the same of blue, because some blues contain a strong mixture of green.—I am, &c.,

William Benson.

WILD BEASTS IN INDIA.

Sir,—I read in the *Daily News* of the 10th instant, a letter from Mr. W. Cave Thomas, who seems to have taken a great interest in this very distressing subject, and who, at the same time, offers practical suggestions for their diminution in numbers.

When I last wrote to the Society upon this matter I felt how great the evil was, and I am sorry to say that the wild beasts still continue to cause heavy loss in both human and animal life, for tigers still infest the Nullamallery-hills in Kurnool, and during the years 1870-71. I hear that government have generously paid over £165 in rewards for their destruction, and that the loss of human life from their ravages there still continues great.

During 1870-71 a great number of wild beasts have been destroyed in the Madras presidency—in fact over 1,100, of which 666 were cheetahs, 205 tigers, 129 hyænas, 97 bears, and 12 wolves, and a few jackals, and the government was very considerate in bestowing over £2,220 as rewards for slaying them. On the Neilgherry-hills, 16 tigers and 29 cheetahs were killed, and £110 paid in rewards. The sum of £77 was expended in rewarding persons for slaying over 5,800 dogs and 15 alligators, also in this presidency. On the average, about nine shillings per head was paid for these latter amphibious creatures, but the rewards should, I think, be increased, as they do much more damage than is ever discovered; their victims, both men and cattle, disappear without, in many cases, the fact being known, and their system of vengeance is often sly in the extreme, as I will now instance. It was only on Saturday last I met a friend of mine, who had just heard from India, and was in much tribulation at news conveyed to him by the mail in reference to his son, who is up at Tyrhoot, who, having wounded an alligator, and thought he had killed it, injudiciously approached within reach of its jaws, which were speedily opened, and his legs bitten and entrapped, and the monster made off with him to the river, with no doubt the intention of drowning him and swallowing him at leisure; but he was mercifully saved from such a fate, though it is not yet known to what extent his injuries may impair his future health, it is even feared that tetanus may set in from his wounds.

In Kistna district £70 was paid in rewards for the slaughter of wild animals, and in South Canara £624 for the killing of 146 tigers and leopards, but not before they had destroyed over 1,760 head of cattle—a slight diminution of the injury they inflicted last year, which was 1,838; but a heavy money loss must have been caused by them in these last two years, and it is certainly high time an organised raid was made against them, and I have have sketched out a plan by which government might, I think, soon reduce their numbers to respectable limits, but I have no idea of how to bring it to their notice. If any one could point out the way to me, I should have much pleasure in offering my suggestions for the consideration of government, but I really do not know who should be addressed on the subject.—I am, &c.,

A. Romaine Wragge, Lieut.-Col.

37, Maryon-road, Old Charlton, S.E.
13th Nov. 1871.

PROCEEDINGS OF INSTITUTIONS.

New Swindon Mechanics Institution.—The annual meeting and distribution of prizes in connection with the Local Educational Board of the New Swindon Mechanics' Institute, took place on Wednesday evening. The hall of the Institute was crowded. Sir D. Gooch, Bart., M.P., presided. The annual report, presented by Mr. J. Armstrong and J. Goudge, the chairman and secretary of the Local Board, said the committee, after careful consideration, have considered it desirable to make various alterations, which will be found embodied in the educational programme for the present season, and it is hoped that the new arrangements will attract numbers of young men to prosecute their studies in the more advanced subjects now recommended by the committee. The following table shows the attendance at the various classes during the educational season of 1870-1, as compared with the corresponding period of 1869-70:—

	1870-1.	1869-71
Mechanical drawing	10	12
Freehand drawing	16	16
Arithmetic (senior)	5	12
Arithmetic (junior)	24	33
Theory of music	6	7
Female class	36	41

In the elementary examinations the following was the result:—

	Higher grade.		Lower grade.	
	Examined.	Passed.	Examined.	Passed.
Males	9	5	16	11
Females	—	—	28	14
Total	9	5	44	25

At the final examinations six candidates presented themselves, four certificates being obtained. The prizes awarded annually by the institution have been awarded as follows:—Junior class (1st division)—1st, Benjamin Robinson, £1; 2nd, Joseph Bramwell, 13s.; 3rd, John William Wood, 7s. Junior class (2nd division)—1st, Samuel Tinson, £1; 2nd, George Clarke, 13s.; 3rd, Albert Wright, 7s. Freehand Drawing class.—1st, James Elliott, £1; 2nd, Charles Brittain, 13s.; 3rd Allen Hill, 7s. Female class—1st, Louisa Mizen, £1; 2nd, Agnes Clark, 13s.; 3rd, Louisa Jane Lowe, 7s. Extra prizes of books, to Eliza Sarah Sheldon, Isabella Fairbairn, and Frances Sarah Leonard. Sir D. Gooch's prizes for Mechanical Drawing—2nd prize, Thomas O. Hogarth, £3; 3rd prize, R. J. Blenkinsop, £2. The first and fourth prizes have been withheld, in accordance with the recommendation of the examiners. Lady Gooch's prize, of the value of five guineas, for the most proficient of the female class, in reading, arithmetic, dictation, and plain needle-work, is awarded to Hester Ann Barefoot. The members of the Board tender their best thanks to those ladies and gentlemen who had so kindly assisted them on this occasion. The meeting was addressed by the chairman, Mr. Roger Eykyn, M.P., the Rev. H. R. Hayward, and Mr. W. G. Larkins, who represented the Society of Arts.

NOTES ON EDUCATION.

Educational Provisions under the Act.—The *School Board Chronicle* draws attention to the important fact that "a new phase of the operation of the Education Act is to be expected shortly, which may arouse a good deal of excitement, and perhaps some angry feeling. For one year the towns and parishes of England and Wales have occupied this position in relation to the Act. It has been optional with them to apply to the Education Department or not for authority to elect a School Board. Some 340 have decided in favour of a board; a considerable number have arrived at an opposite resolve; and there is a large remainder who have not moved in any way. That is all very well for one year, but it cannot go on. The Act forbids it. The Departments have caused returns to be made to them of the public elementary school accommodation and requirements of every town and parish. They will next decide which places have not sufficient accommodation, and to those in the latter list will be forwarded a requisition to make up the deficiency. It may be that this requisition will wake up many a quiet parish for the first time to a sense of what it owes to this Act of Parliament. The question will arise, What is to be done? The ratepayers and promoters of such educational provision as exists will find it hard to agree, perhaps, upon any plan, but they will have only six months in which to make up their minds. At the end of that time, 'if the Education Department are satisfied that all the public school accommodation required by the final notice to be supplied has not been supplied, nor is in course of being supplied with due despatch, the Department will cause a school board to be formed for the district.' Those are the words of the Act, and the succeeding words are to the effect that the Department thereupon 'shall send a requisition to the school boards so formed requiring them to take proceedings forthwith for supplying the public school accommodation mentioned in the requisition, and the school boards shall supply the same accordingly.' We fear there are a large number of parishes in England and Wales where there is neither a school board nor sufficient elementary school accommodation, and if our voice may reach the ratepayers of those places, we beg to give them a friendly warning of the exciting days in store for them."

Planning and Fitting-up Schools.—The Committee of Council on Education have issued a number of rules to be observed in planning and fitting-up schools. In the preliminary remarks it is said:—"Before a school-room is planned—and the observation applies equally to alterations in the internal fittings of an existing school-room—the number of children who are likely to occupy it, the number of classes into which they ought to be grouped, whether the school should be 'mixed,' or the boys and girls taught in different rooms, are points that require to be carefully considered and determined, in order that the arrangements of the school may be designed accordingly. Every class when in operation requires a separate teacher, be he only a monitor acting for the hour. Without some such provision it is impossible to keep all the children in a school actively employed at the same time. The apprenticeship of pupil teachers, therefore, is merely an improved method of meeting what is, under any circumstances, a necessity of the case; and where such assistants are maintained at the public expense, it becomes of increased importance to furnish them with all the mechanical appliances that have been found by experience to be best calculated to give effect to their services." After stating that the common school-room should be planned and fitted to realise the combined advantage of isolation and superintendence, without destroying its use for such purposes as may require a large apartment, the Committee of Council do not recommend that the benches and desks should be immovably fixed to the floor of any school, but be so constructed as to be easily moved. The master of a school should never be allowed to organise it so as to provide for carrying out the entire business of instruction without his own direct intervention in giving lessons. "He must, indeed, at times leave himself at liberty to observe the manner in which his assistants or apprentices teach, and to watch the collective working of his school."

Natural Science Teaching.—The *Echo Agricole* complains of the neglect of this branch of instruction in France. "Why," says this journal, complaining of the importance attached in most schools to a semi-mythological teaching, "when an intelligence is just opening to the light, should it be led through the delusive labyrinths of the marvellous instead of showing it the truth in all its splendour? Let that young intelligence be accustomed to the observation of natural phenomena, and it will be seen to develop itself normally, because to all the branches of activity which it is called upon to exercise it will bring the spirit of methodical order which it will have been obliged to employ in the study of nature. We therefore demand that the Minister of Public Instruction should introduce into our primary schools the elementary teaching of natural science applied to what children see daily in the country. M. Jules Simon has ordered that a geographical class should be held every fortnight in the colleges and lycées; now we would have the minister complete this measure by requiring the students not only to mention the principal products of such and such a country, but, as regards

France especially, to take account of the natural produce of the land, and to know what sort of soil these different products affect. This would be geography applied to agriculture. . . . Further, we would require that all sciences relating to agriculture taught in the lycées and colleges should be followed by practical application to the soil, such experiments to form the basis of special examinations."

The Half-time System in Denmark.—A lady who has recently visited Copenhagen sends the following to the *School Board Chronicle :* — " In Denmark, in order to meet the difficulty of combining school hours with hours for work, the plan is adopted of building and furnishing a school-house for a thousand children, and opening it for two schools. Thus, in the morning, a thousand children attended from eight o'clock to one, with, of course, an interval. A little after one o'clock, another thousand children attend till six, also with an interval. Both schools are worked on one time-table, and under one superintendent. By this plan the children in the morning-school can work in the afternoon, and those who attend in the afternoon may work in the morning; the superintendent is free to arrange the time of attendance according to the parents' convenience. The economy of teaching two thousand children in a school-house built for one thousand is self-evident, and by the arrangement of a permanent staff of teachers in each group of schools, and of a body of visiting teachers between two groups, four schools can be taught by three sets of teachers. I saw the plan at work, and it seemed to me that the adoption of such a half-time scheme, in crowded districts, might be useful."

The Education Question in New Zealand.—The Education Bill for this colony was introduced into the Colonial Parliament by the Premier on the 1st September last, and it is expected to pass with a few amendments. It adopts the principle of compulsion, and the conscience clauses of Mr. Forster's Act are inserted *verbatim.* It, however, allows Bible reading at stated times in the government schools, and allows denominational schools, under certain restrictions, to claim a government subsidy. Mr. Fox, the Premier, in his introductory speech, acknowledged in terms of the highest eulogium the assistance he had derived from Mr. Forster's experience in framing the measure.

University Examination of Women.—The Cambridge Syndicate appointed to conduct the Examinations of persons not members of the University, report that "Examinations for women above 18 years of age were held in July, 1871, at six centres—Cambridge, Cheltenham, Liverpool, London, Manchester, and Rugby. One hundred and twenty-nine candidates entered for examination, and of these 20 withdrew before the examination took place. Of the remaining 109 candidates, 25 had already passed in group A in previous years. In July, 1870, the examinations were held at three centres —London, Manchester, Rugby—and there were 84 candidates, of whom 71 presented themselves for examination. It appears that all candidates for a place in the Class List are required to qualify themselves by passing "group A"—that is, in Divinity, Arithmetic, English History, and English Literature, Language, and Composition. In this group, however, out of 84 candidates, as many as 36, or 43 per cent., failed to pass. In Mathematics only five candidates offered themselves, and all passed. In Languages, including French, German, and Latin, there were 65 candidates and all but 7 passed. Of these, moreover, only five offered to be examined in Latin. With the exception of Physical Science, the subject on which least satisfaction seems to have been given to the examiners were English Language and Literature. It had " been greatly neglected," and "little or no study seemed to have been bestowed on the text-books recommended." The report of the examiners in French and German is far more satisfactory, showing a failure of only 10 per cent. The quality of the learning thus tested shows one remarkable characteristic—a want of thoroughness and accuracy. The main exceptions are where exceptional pains have been bestowed upon special subjects, such as Latin, political economy, history, and geography. But otherwise, as expressed by one of the examiners, " the dominant fault which runs through the replies is vagueness; they are rather copious than exact, and reflect general impressions rather than any considerable amount of precise knowledge." On the whole, however, the result is certainly creditable, but it brings out most clearly the great deficiencies in female education, which are, want of thoroughness, care, logical strictness and precision, and it is to remedy these evils that the efforts of those interested in the education of women should be directed.

Education in India.—There are entirely distinct races, nationalities, creeds, languages, customs, and stages of civilisation in the different provinces of India; but, from reliable sources, it has been ascertained that the school-going population of British India is larger than the entire population of Great Britain, and is calculated to be at least twenty-five millions. English is taught at 2,769 schools, and the total number of pupils learning English is estimated at about 166,000. No native has yet been appointed a director of public instruction in any province, but many are qualifying for such appointment in the subordinate ranks of inspection and instruction. In Bombay, Madras, and the Central Provinces, considerable payments are annually made on the system of "payment by results." Scholarships and prizes were given in 1870, to the amount of £22,173. There are altogether 37,064 colleges and schools in India, some of these are government institutions, some are aided institutions, 32 are returned as unaided schools, and 1,868 as indigenous schools.

NOTES ON SCIENCE.

The recent opening of the annual exhibition of the Photographic Society in Conduit-street, suggests the making of some observations on the latest discoveries in photographic science and practice. Some important experiments, made by Dr. Budde, have been published, from which a new theory of the photographic latent image may be deduced. Chlorine gas is passed into a tube closed at one end, and the gas is confined by a column of oil of vitriol saturated with chlorine. This must be done in comparative darkness. A beam of light is then decomposed by means of a prism, and the several coloured rays of the spectrum are allowed to fall in succession on the tube containing the chlorine, an arrangement having been made by which any alteration in volume that might take place in course of the experiment can be detected and carefully registered. When the red rays fell upon the tube, the effect produced was very slight, the increase in the length of the gas column being only the $\frac{1}{25}$ of an inch. According to the degree of refrangibility by the ray to which the chlorine was subjected, so did its expansion increase, until when under the action of the violet, the effect was at its maximum, the expansion being ten times greater than what was caused by the action of the red rays. What is ascertained from this experiment is, that the expansion of the gas is not due to heat, for were that the case the red rays would have exercised the most powerful action, this point having been further ascertained by delicate thermometers. To further establish the fact that the expansion is due solely to the action of light, and not to a decomposition of the sulphuric acid by the chlorine, there was substituted for this acid, saturated with chlorine, the tetrachloride of carbon, the same result being obtained. The result of the experiment appears to warrant the conclusion that the violet rays of the sunbeam act by decomposing the molecule of the chlorine, setting free the two component atoms of which the molecule is supposed to be built up. The two atoms occupy a greater space when separate than when combined, and are also in a favourable condition for entering into combination. From the experiment just described, the editor of the *British Journal of Photography* believes that a clue is obtained to a sound theory of the latent image, which shall serve to explain the phenomena relied on by the supporters respectively of the present vibratory and chemical hypotheses. Accepting Dr. Budde's conclusion for chlorine, he believes it clearly follows that all the cases known to photographers in which light brings about change of any kind, may be explained on the hypothesis of the partial or complete separation of the atoms by which the molecule of a given compound may be built up. Taking the case of iodide of silver, an atom of silver is known to be equivalent to an atom of hydrogen, and no more; but the atom of iodine is equivalent to three of hydrogen, though in most compounds only appearing to be equivalent to one. Experience leads to the conclusion that, in many cases, the action of violet light chiefly consists in the severance of the union of dissimilar bodies held in combination by comparatively feeble affinity, and the experiment recorded alone proves that the same kind of action is inimical to the exercise of the still more feeble attractive force which tends to unite the atoms of like matter in molecules. By extending this to the union of bonds in a single atom, as in the case of iodine, one gains a clear conception of the nature of the action of light upon iodine of silver, and the cause of the difference in chemical relations between the exposed and unexposed silver compound. By luminous action, two of the three attractive powers of the iodine are freed from each other's control, and are ready to enter into new combinations. Having occupied so much space in giving an account of the newest and most plausible theory of photographic action, the account of novelties in photographic practice is deferred.

A paper on the "Estimation of Fluorine," was read at the last meeting of the Chemical Society. Its author, Mr. Liversidge, of Cambridge, decomposes the fluoride by means of strong sulphuric acid in the presence of silica, and passes the silicic fluoride formed into solution of ammonia. The amount of silica having been then estimated, the fluorine is calculated therefrom. The powdered mineral is introduced into a platinum retort, with the requisite amount of sulphuric acid and finely-divided silica. It is subjected to a heat of 160° C., and the gaseous silica fluoride thus formed is decomposed by passing it through a solution of ammonia, the last traces of the gas being carried over by drawing a current of air through the apparatus. The ammonia solution is evaporated until the gelatinous silica passes into solution, when it can be precipitated as silica fluoride of potassium by the addition of potassium, chloride, and alcohol.

One of the most sensational objects exhibited in the recent American fair, was the cutting out of holes, not merely into glass, but into solid emery by a current, or rather stream, of sand being driven against it with exceedingly great force. Several months have elapsed since it was discovered that a stream of sand, when forcibly ejected from a suitable nozzle against a plate of glass, would grind its surface in a few seconds. Among many suggested applications of this new mechanical grinding agent, not the least ingenious is the following:—Although the jet of sand will grind away the surface of glass, it will not do so if the glass be protected with a thin pellicle of gelatine. If, therefore, by means of printing or drawing, a figure be placed on the glass in gelatine, which may be done by the agency of gelatinous ink, when dry and exposed to the action of sand, the unprotected surface is immediately corroded, leaving the image in the original polish of the surface. As the production of photographs in gelatine is now a matter of comparative ease, it is expected, from the experiments that have already been made that the decoration of glass plates by these means, will soon be generally introduced. A small steam engine is employed to project the stream of sand, a great degree of force being required.

Mr. Joseph Sidebotham, F.R.A.S., read a paper the other day before the Manchester Literary and Philosophical Society, in which he gave an account of a microscopical examination he had made of dust blown into a railway carriage in which he was travelling near Birmingham. Having collected a quantity of the dust by spreading a newspaper on one of the seats near the open window of the carriage, Mr. Sidebotham brought his microscope to bear on it, and thus decribes the result:—"With two-thirds power the dust showed a large proportion of fragments of iron, and on applying a soft iron needle I found that many of them were highly magnetic. They were mostly long, thin, and straight, the largest being about ·150 of an inch, and under the power used, had the appearance of a quantity of old nails. I then with a magnet separated the iron from the other particles. The weight altogether of the dust collected was 57 grains, and the proportion of those particles composed wholly or in part of iron was 29 grains, or more than one-half. The iron thus separated consisted chiefly of fused particles of dross or burned iron, like 'clinkers;' they were all more or less covered with spikes and excrescences, some having long tails, like the old 'Prince Rupert's drops;' there were also many small angular particles like cast iron, having crystalline structure. The other portion of the dust consisted largely of cinders, some very bright angular fragments of glass or quartz, a few bits of yellow metal, opaque white and spherical bodies, grains of sand, a few bits of coal, &c. I think it probable that the magnetic strips of iron are laminæ from the rails and tires of the wheels, and the other iron particles portions of fused metal, either from the coal or from the furnace bars.

GENERAL NOTES.

Sanitaria in India.—The new sanitarium for the Central Provinces, at Puchmaree, has been found healthful and successful, so this may become a new centre of English enterprise, like Darjeeling and the others.

The Exhibition of 1851.—The will of Lady Paxton directs that the sheet of blotting-paper on which the first sketch of the Exhibition building in Hyde-park was made, shall be held as one of the heir-looms, and go with the family estates.

Instruction in Science and Art for Women.—The course of lectures by Professors Huxley, Guthrie, and Duncan, on the "Elements of Physical Science," will, by the permission of the Lord President of the Council, commence on Saturday next, in the lecture theatre of the South Kensington Museum, at half-past two o'clock, and will be continued every succeeding Wednesday and Saturday at the same time. These lectures form a part of a system of instruction in science and art, especially designed for women.

Photography in the Printing Press.—Mr. Ernest Edwards, who, it will be remembered, read a paper before the Society, illustrative of the heliotype process, has lately, by the alteration of some details, and the use of extra plates, succeeded in printing in colours. A copy of Cave Thomas's picture of the "Jeweller of St. Petersburgh," produced in this way, is now on view at the exhibition of the Photographic Society, Conduit-street, Regent-street.

Apprenticeships to the Sea Service.—The Board of Trade says, in a circular signed "Thomas Gray," just issued, that they have from time to time proceeded against persons, in London and elsewhere, who have been in the habit, although unauthorised by law to do so, of advertising employment for boys and officers for the sea service; and that they regret to find that, in spite of the warnings conveyed by these proceedings, and notwithstanding the penalties to which they render themselves liable, owners and masters of ships, as well as parents and guardians of boys, are often still so unguarded and ill-informed as to employ these unauthorised and unqualified advertising agents, instead of the officers duly appointed by law to enrol apprentices, and to facilitate their employment in British ships. The Board of Trade therefore thinks it right to point out to the friends and relatives of boys, and persons seeking employment at sea, as well as to the owners and agents of ships, that by the 141st section of "The Merchant Shipping Act, 1854," all superintendents of mercantile marine offices are required to give to "persons desirous of apprenticing boys to the sea service, and to masters and owners of ships requiring apprentices, such assistance as is in their power for facilitating the making of such apprenticeships." The Board of Trade regard this as one of the most important duties thrown by the legislature on superintendents; and, in order to carry the intention of the statute into effect, each superintendent is directed to keep two registers—one containing a clear and methodical record of the names, ages, addresses, and other particulars received by them with respect to boys seeking employment at sea, the other containing the names of owners who are desirous of obtaining boys for their ships. It is important that owners and agents should be aware of this arrangement, so that when they require the services of boys or youths, they may apply directly to a superintendent of a mercantile marine office instead of a slop-seller or other person not authorised by law to procure employment for seamen. To widows (who appear to be frequently deceived by persons styling themselves shipping agents, or agents for supplying seamen, but who, in reality gain their livelihood by plundering the unwary or ill-informed) and to all other persons having the charge of boys, and wishing to apprentice them to the sea service, the Board of Trade would point out that the authorised superintendents at the government mercantile marine offices (there is one at every port), who will register the boys' names as applying for employment have more facilities for finding employment at sea for a boy than any other person, and are, besides, the only persons who can legally receive any remuneration for doing so. The fee for each apprenticeship effected with the superintendent's assistance is limited to five shillings. Those of the public who continue, in the face of the caution issued by the Board of Trade, to employ and pay persons unauthorised to procure employment on board ship for boys, are not only wasting their money, and incurring a penalty in each case of £20, but are absolutely encouraging the breaking of the law, as well as aiding the crimp and slop-seller in setting aside those officers whose duty, under the law, is to enrol apprentices. Any parent, guardian, officer, seaman, or apprentice who has paid to any agent, slop-seller, crimp, or other unauthorised person, any sum for obtaining employment on any British ship in the United Kingdom, should at once communicate full particulars in writing (giving the names of the parties and of witnesses), to the Registrar-General of Seamen, 6, Adelaide-place, London-bridge, E.C., from whom may be obtained, free of charge, a printed list of persons authorised to engage or supply mates, midshipmen, apprentices, boys, and seamen for the merchant service, together with a list of the names of some unauthorised persons who have been convicted, but who still advertise in their own or in other names. The only person authorised to engage or supply mates, seamen, midshipmen, and apprentices, are the following:—The owner, the master, or the mate of the ship or some person who is the *bonâ-fide* servant, and in the constant employ of the owner; the superintendent of a government mercantile marine office, or an agent licensed by the Board of Trade.

Opium growing in the United States.—It is stated by the *Philadelphia Ledger* that in the neighbourhood of Nashville the poppy has been cultivated for the last three years, with a view to the manufacture of opium. Owing to the lateness of the planting and inferior value of the soil, the crop of 1870 failed, and to obviate this difficulty seed was obtained from Calcutta and Smyrna, at a cost, in gold, of 4½ dollars per ounce. This year's crop, it is announced, will yield from 60 to 75lbs. of opium per annum. Other persons who extensively engaged in the cultivation of the poppy in Tennesse report similar success. The best opium poppy seeds were obtained from Smyrna, planted in good land, and cultivated like cotton. When the capsules of the poppy are ready to scarify, an incision is made on one side, and in twenty-four hours the juice, which has the appearance and consistency of a thick cream, is scraped off. The opposite side of the capsules are then scarified, and the operation is repeated. The juice of the poppy, a few hours after it is gathered, turns a dark purple colour, which grows gradually darker until the particular opium colour is realised.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

November 22.—"On the Present State of the Through Railway Communication to India." By Hyde Clarke, Esq.

November 29.—"On Tramways and their Structure, Vehicles, Haulage, and Uses." By W. Bridges Adams, Esq. On this occasion Charles Hutton Gregory, Esq., will preside.

December 6.—"On Sewage as a Fertilizer of Land, and Land as a Purifier of Sewage." By J. Bailey Denton, Esq.

December 13.—"Observations on the Esparto Plant." By Robert Johnston, Esq.

December 20.—"On the Study of Economic Botany, and its Claims Educationally and Commercially Considered." By James Collins, Esq.

MEETINGS FOR THE ENSUING WEEK.

Mon. ....Social Science Association, 8. Mr. Thomas Hughes, Q.C., M.P., "On the Present State of the Co-operative Movement."
London Institution, 4. Prof. Huxley, "Consciousness" (Course on Elementary Physiology).
Anthropological, 8.
British Architects, 8.
Tues. ...Zoological, 9.
Charity Organisation Society, 8. (At the House of the **SOCIETY OF ARTS.**
Civil Engineers, 8. 1. Discussion "Pneumatic Despatch Tubes." 2. Mr. William Bell, "On the Stresses of Rigid Arches and other Curved Structures."
Statistical, 7¾. 1. The President's Address. 2. Mr. J. T. Hammick, "Suggestions for the collection of Local Statistics."
Wed.....**SOCIETY OF ARTS, 8.** Mr. Hyde Clarke, "On the Present State of the Through Railway Communication to India."
Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."
Royal Society of Literature, 8½.
Geological, 8. 1. Prof. T. Rupert Jones, "On some Devonian Fossils from the Witzenberg, South Africa." 2. Dr. Alex. Rattray, "On the Geology of Fernando Noronha." Communicated by Prof. Huxley. 8. Mr. J. W. Hulke, "Note on some Ichthyosaurian Remains from Kimmeridge Bay, Dorset." 4. Mr. Hulke, "Appendix to a Note on a Wealden Vertebra."
Thurs...London Institution, 7½. Mr. P. L. Simmonds, "Science and Commerce: illustrated by the Raw Materials of our Manufactures."
Antiquaries, 8½.
Sat.......Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."

Journal of the Society of Arts.

No. 992. Vol. XX.

FRIDAY, NOVEMBER 24, 1871.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 22nd, 1871; Lord Henry Gordon Lennox, M.P., in the chair.

The following candidates were proposed for election as members of the Society:—

Edwards, Rev. R. G., 103, Oxford-street, Stepney, E.
Graham, John, 27, Charles-street, St. James's, S.W.
Gwyther, J. Howard, Chartered Bank of India, Australia, and China, Hatton-court, Threadneedle-street, E.C.
Harris, Joseph, 41a, Bull-street, Birmingham.
Heinemann, Dr. Richard Nathan, 21, Northumberland-place, Bayswater, W.
Nelson, Charles, Crackley-hill, Kenilworth.
Port, H., 10, Old-square, Birmingham.
Schneberger, John, 2, Sussex-place, Onslow-square, S.W.
Smith, William Henry, 212, Westminster Palace-hotel, S.W.

The Paper read was—

ON THE PROGRESS OF THE THROUGH RAILWAY ROUTE TO INDIA.

By Hyde Clarke, Esq.

(Late Cotton Commissioner in Turkey.)

In 1868, I addressed the Society of Arts, and also the United Service Institution, on the subject of the daily mail route to India. My paper, which will be found at p. 276 of Volume xvi., refers to the history of the subject, and it is therefore not necessary to deal with it. I then called particular attention to the project of the Turkish government for raising funds to carry on the European system of railways in European Turkey.

Since then above three years have passed, and it is desirable to consider the present state of the matter. Great events have in that time occurred, which have a more or less direct influence on the route to India, China, Japan, and Australia; for when we talk of a through-route to India, it is only a phrase for denoting communication with half the world.

The opening of the Suez Canal is undoubtedly one great feature. It has materially affected the transport of goods to the East, and will affect that of passengers and mails. At all events, it facilitates the working of the route through Egypt. To some extent the Egyptian route is a rival with that overland; but the overland route cannot convey the bulk of goods, which will be left, under all contingencies, to the Egyptian line and that by the Cape. The Suez Canal is, however, so far from being a fatal rival to the through railway route, that it is a promoter of it. By increasing the commerce of Bombay, it makes still more necessary quicker postal and personal communication with Bombay. By the facilities it has given for intercourse with Bagdad, Bassorah, and the Persian Gulf, on its Persian and Arabian shores, it is creating new resources for the direct line of connexion with those countries. It is one great benefit of the Suez Canal that it has opened to the world regions formerly most productive, and so long shut off from intimate connection with the western world.

In estimating the ultimate power of the Egyptian line, we must not lose sight of that great extension of railway to the south which will enable Egypt to run a line from Alexandria to a port on the Red Sea, expediting the conveyance of passengers and mails. The completion of railways from Bombay to Calcutta and Madras creates sections forming part of a railway line from London to Calcutta, and thereby to the eastern regions beyond, which define and mark out for enterprise the unfinished gap between.

Next to the Suez Canal must be placed the Brindisi route and the opening of the Mont Cenis Tunnel. Upon this head complete information will be found in Captain Tyler's reports. This line not only concerns the Egyptian route, but any section of the through railway route which may be opened between the Mediterranean and the Persian Gulf. It has a decided tendency to promote this latter enterprise. Indeed, this is well enough seen by the appointment of the Select Committee of the House of Commons on Railway Communication between the Mediterranean, the Black Sea, and the Persian Gulf. This committee may or may not recommend our government to make any pecuniary contribution towards railway lines, but it will do great good by stimulating public attention, and preparing the way for active measures. This committee has already collected valuable evidence from Sir H. Rawlinson, Mr. Ainsworth, Mr. Telford Macneill, Mr. Maxwell, &c., and in the coming session further information will be obtained.

The establishment of the Russian telegraph route to China, and of our submarine lines by the Mediterranean and Red Sea to the East, must not be omitted in the consideration. Every arrangement which increases the disparity between the telegraphic dispatch and the full detail by mail letter makes the mercantile community at home and abroad more eager to demand and obtain postal facilities. Each costly telegram acts in promotion of more rapid mails.

Lastly, if we have named the Suez Canal and the Mont Cenis Tunnel, we must also refer to another great undertaking, the Pacific Railway. Nothing can well be more remote from the through railway route by Europe and Asia than that across the Rocky Mountains, but extremes meet, and they are rivals. San Francisco is now carrying passengers and mails to New Zealand, Australia, Japan, and Northern China, and this traffic must increase; but when the through railway from this side reaches Bassorah—and that we may look upon as an assured matter—then Bassorah will compete with San Francisco on the other side of the world. The more the commerce of such remote termini as Japan and Australia is stimulated by improved transport, the more are resources developed which afford a prospect of revenue for other undertakings.

The review of all that has taken place shows the more fully the desirability of continuing the railway line, which is now in full operation from England and the countries of the West to the Danube. The opening and working of the Varna and Rutchuk Railway, by quickening communication with Constantinople, may be named here as promotive of quicker communication with that capital. In this country, however, we have thought less of what has been done in continuation of the existing line, being chiefly occupied with the projects for the Euphrates, the Tigris, and the Persian routes.

After all, the matter depends less on what we may write and what we may discuss than upon the point who finds the money, and as yet the governments of England and India show no disposition to provide the requisite funds. From France, since the fall of the Empire, no prospect of contributions is to be looked for, as France has neither disposition nor resources to engage in an undertaking in which she has so little real interest. The burthen, therefore, lies upon Turkey and Persia. As to Persia, there is no immediate hope there. Our dependence is upon Turkey, the country next to Austro-Hungary. It is from that empire a guarantee must be obtained, although, in the present transition state of its financial arrangements, its resources are limited.

The continuous line must pass through Turkey in Europe and Turkey in Asia, and consequently Turkey must be consulted. This, it strikes me, is the point where most of our projectors are rather neglectful. Although Turkey is the country locally and mostly concerned, and which is to furnish the money, few think of consulting the wants and wishes of Turkey. Because we want to go to India at the expense of the Turks, or because we want to get a contract for making long lines of railway for which they are to pay, it seems to be sufficient reason why they should comply with our demands. It is this condition of affairs which has much retarded the progress of the undertaking, and which has ended in the works being confided to foreigners instead of to Englishmen.

Because we want to go to India, we set aside the consideration that the Turks want to connect Constantinople with the European system, and because we want to reach Bagdad and Bassorah, we are to forget that the Turks have their own need for communicating with those cities from their metropolis, and that they have political objects to accomplish, and local requirements of traffic to satisfy. It is in view of this state of affairs that I have endeavoured on former occasions, and shall do so now, to direct attention to the Turkish portion of the line, and to its present condition. Thus I shall direct attention less to the southern and eastern parts of the route, which have been the more discussed, and for which there are enough persons of authority to afford information.

The European system, as all are aware, reached Basiash, on the Danube, many years ago, and there it halted. In my last paper it was stated that the Sultan had, in consequence of his visit to this country, become urgent for the extension of railways in his empire, and had granted concessions for the European section and for the Asiatic section. As has frequently happened in these matters, the eagerness of the Turkish government has been deceived. They naturally wish to make the most economical arrangements, and they consequently fall into the hands of parties who profess to comply with their desires, and who have not always the means of accomplishing what they undertake. The end is embarrassment and delay. Both the concessions granted in 1867 have fallen to the ground.

Under the concessions for the European section works were indeed begun near Constantinople, but the financial combinations proved abortive, the concession was suppressed, and the concessionaires, as usual, made large demands on the Turkish government for compensation. The government, having failed in their expectations, still persevered, and devoted their attention solely to the European section, for which purpose they despatched the Minister of Public Works to the west. The result has been new financial combinations in Austro-Hungary and France, under which considerable sums have been raised on very burthensome conditions, and the works have been commenced at several points. Much of the time that has elapsed has been devoted to financial negotiations, and much of the remainder to surveys, &c., so that it is only of late the works have been in progress.

The main feature is, of course, the artery from the European or Austro-Hungarian lines and the Danube to Constantinople. With this are combined cross lines, one from Nish, south, to reach the Mediterranean at Salonica, another from Adrianople to the same sea for local purposes, and a line from Adrianople by the shore of the Black Sea to reach the Varna and Rustchuk Railway. It is one main transverse line with arms.

With this general description of the undertaking we must be contented, because the surveys are not complete, and even the point of junction with Austro-Hungary is not fully settled. This would naturally be through Servia, by or near Belgrade, but the government of the Servian principality naturally appreciates the military and political capabilities of the line, and is therefore unwilling to facilitate it. Such a line enables Turkey and Austro-Hungary to concentrate forces in Servia, and prevent that district from being made a post of Russia within the Danubian bounds. Servia wishes to divert the line for its own purposes, and prefers that its own lines shall be on a different gauge. On the other hand, the Roumelian railway directors threaten to leave Servia on one side, and to pass through Bosnia. Bosnia does not, however, present the same natural facilities. This matter consequently delays the arrangements, although ultimately there can be little doubt there will be lines through both Servia and Bosnia.

The tide of progress by means of the railway system is now flowing towards the east. Lines through Austro-Hungary and Russia make a connection by the south with Southern Russia, and the northern shores of the Black Sea are now in commercial relation with Western Europe. The Varna and Ruschuk Railway, already referred to, offers an extension of the system towards the east shores of the Black Sea. Thus there is, as it were, a prosperous flood ready to be poured over the southern provinces of the Danube the moment a connection can be accomplished. This is a circumstance which must not be omitted, because a continuous railway communication means the continuous transmission of western enterprise, habits of progress, artizans, agriculturists, industrial and agricultural machinery over the barbarous regions of Bulgaria and Thessaly, enabling them to raise produce for railway transport and revenue, and directly contributing towards the Turkish treasury. A mere local line, such as those opened from Smyrna to Aidin, and from Smyrna to Cassaba, although exercising a very useful influence, by no means brings about the same results. If one line be carried from Vienna to Filibeh or Adrianople, it means that these latter secluded cities will have the resources of Vienna available, and will have their commodities at the prices of Vienna, their imports reduced to Vienna prices, and their exports raised to the same rates.

These, therefore, are among the purposes of Turkish policy. They are not constructing a line solely for intercourse with India, which will give no immediate returns, but constructing, at their own expense, a line for local and imperial purposes, for which they can pay, and which will serve as a route for us. If they strengthen their political power, increase the wealth and efficiency of their people, and improve their finances, they are disposed to make the effort, and expose themselves to considerable sacrifices.

One great nucleus of the main Roumelian artery is Adrianople. Here works have been begun on both sides. On the eastern side, or on our side, the works are in active progress towards the city of Filibeh or Philippopoli. This line proceeds along the upper valley of the great river Maritza, towards the passes of the Balkan mountains. If it does nothing else, it will, on its opening, afford a local line for the ancient metropolis of Adrianople. The rails for this line are now being carried up the Maritza. Although so far inland, materials can be conveyed to Adrianople, as it is itself on the river Maritza, which is navigable from the sea by floats or rafts. On the western side the works are being carried to Dédé Aghij (Ahaj). On this section, most of the earthworks are completed, and the bridges, which are of timber, are being made, except one large iron bridge, at Oozoon Kyupru (Long Bridge), which is being manufactured in Belgium. At the present period all these works are in danger of being delayed by the rains and river floods.

At the Constantinople terminus there has been opened this year the little section of 15 miles, through the suburbs of Constantinople to Kuchuk Chekmejeh (Little Drawbridge). This line was begun by the first concessionnaires. Another small portion towards Benyuk Chekmejeh (Great Drawbridge) is ready for opening. These portions of the Constantinople and Adrianople line proceed along the shore of the Sea of Marmora, and will serve local purposes, step by step. Within Constantinople a large terminus is in progress, so as to secure a sea wharf, and it will be connected by the tramways. open and in progress, with other quarters of the city and the suburbs on the northern Bosphorus.

Of the Salonika line, as it is a subsidiary line, it will be sufficient to say that it has been vigorously pushed. By about this date the section to Uskhub has been opened from Salonika as far as Karasoole, 56 miles, a very fair proof of the energy employed. It is expected the connection of Salonika with the European system will take place before that of Constantinople, and as it is well placed in the Mediterranean, it is supposed it will become an important commercial port, and for transit will compete with Brindisi advantageously. It will accommodate Thessaly, Bulgaria, the middle Danube, Roumania, Servia, and even Eastern Hungary and Transylvania, as a harbour for export and import. It is looked to afford steam communication with Smyrna, Athens, Syria, the islands of the Archipelago, Cyprus, the coast of Syria, and Egypt. It is also proposed to be employed in connection with the Mediterranean terminus of any line which may be opened by the Euphrates or Tigris with Bagdad and Bassorah. Whatever may be its power of competing with Brindisi from this point, Salonika can certainly accommodate Germany and Austro-Hungary.

The funds appear to be sufficient, at all events, for the main artery, and that may be regarded as secured. Within what time it will be completed it is impossible to say, but apparently within three years. It will be observed that these works are being carried out by Austrian engineers, and by Austrian and Belgian contractors. The participation of the English is limited to that of a few sub-contractors. The cause of this is not far to be sought, for the course pursued in the conduct of railway works in Turkey by the English has been such as to cause well-grounded dissatisfaction. This is a circumstance which also seriously militates against our pretensions with regard to the Asiatic or Anatolian section. Although the Smyrna and Cassaba Railway has met with the approval of the government, that is not sufficient to counterbalance the mistrust created by the experience of English management of railways.

The Turkish government, having applied its energies to the Roumelian or European section, then turned attention to the Asiatic or Anatolian section. The Roumelian section is, however, such a burthen on the treasury, that the government is not yet disposed to encounter that of the Anatolian undertaking. It is, however, most anxious to promote it, and it has begun what may be called a trial work. The prime object of the government is not to pay for a line to India, with which they have little to do, nor for one from the Mediterranean to Bagdad, which is of secondary importance, but to provide for their own governmental purposes, and particularly so as to command the wild tribes, and to consolidate the empire, and thus the communication from Constantinople is of immediate importance to them.

With regard to a bridge over the Bosphorus, for which there are plans by Mr. McClean and others, that is not of necessity at this moment. The section selected is from the southern suburbs of Constantinople, or from Skutari to Ismid. The country is not very good, and there is steam communication in rivalry along the Gulf of Ismid. and hence there has been some objection to the undertaking and the suggestion that a section should be taken up farther on. It is, however, considered by the government to be important to develop the railway system in the neighbourhood of the capital, and this line is an essential portion of a through route.

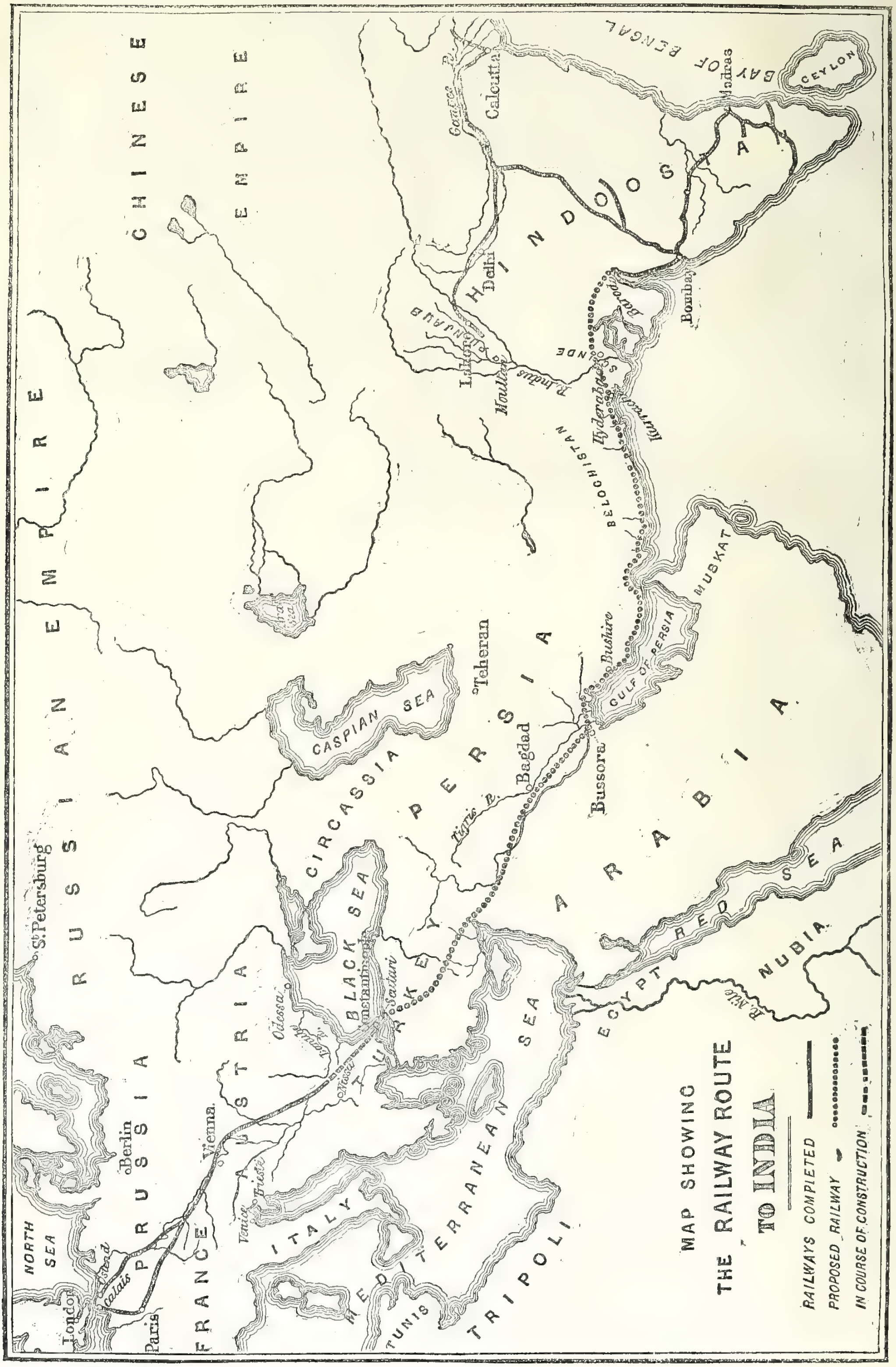
One chief object of the government has been to ascertain by experiment what is the real cost of work, and how far it is possible to carry on a system of railway construction under government supervision. If the government can succeed, it may apply to the earth works the labour of the soldiery, and, in some cases, the local labour rates. The work has been carried on with vigour, the earth works are of moderate cost and in a forward state, and the rails have been contracted for in Belgium, so that we lose the supply of rails, as well as the profit on the works.

At the point of Ismid begins the great question of the course of the line to the East. This I shall not attempt to decide, for my province has been rather to show what has been done. One route strongly advocated is by the east to Persia. This would have advantages were it immediately practicable to proceed through Persia and the unsettled countries beyond; and some day it will be possible of accomplishment. At the present time there are financial facilities, and, apart from other reasons, the Porte is not disposed to proceed with this undertaking. For constructive and for political reasons it is desirable, on leaving Constantinople and Ismid, to make for the corner of the Mediterranean and Gulf of Skanderoon. On the Persian line, the works must be continuous, and rails and machinery carried up from one terminus; but by touching the Mediterranean, work can be begun at that point in two directions. Then, besides working from the Constantinople terminus, it is possible at the other end to work from Bagdad and Bassorah. Thus, this line can be more readily proceeded with than any direct Persian line, and can be more economically constructed. This appears to have long been the policy of the Ottoman government, and, if persevered in, it will narrow the route to be selected. It settles, in fact, the question of a route, having many recommendations, that by Diarbekir and the Tigris. On the subject of the various routes from Constantinople and the Black Sea to Bagdad and Persia, interesting information will be found in the evidence given by Sir H. Rawlinson before the Parliamentary Committee.

The general disposition in laying out lines has been to work to the east, and thus the consideration of a more direct way by the south has been neglected. Information has been taken as to the caravan route, while the great river Sakaria (the ancient Sangarius) appears to offer a natural valley. If this can be followed up to the great table-land of the interior, then the way is comparatively easy, and Konieh (Iconium) may be reached. Once on the table-land, a great extent of branch railways, tramways, and roads to considerable cities and towns may be laid down. With regard to the route in the interior, I have received a memoir from Colonel O'Reilly, which will be printed in the appendix,

To the south of Konieh is to be found one of the great difficulties of the undertaking, the passage of the chain of Taurus, by the famous pass, now called the Gulek Boghazi, by which Cyrus and Alexander entered Cilicia. Upon this it is not needful to dwell, for there is no reason to consider this pass impracticable, though undoubtedly difficult and expensive. On emerging from the pass, the Mediterranean is in sight, and ports are available for the export of the produce of the interior. It has long been the desire of the government to carry any through line around the Gulf of Skanderoon, so as to cement all the neighbouring ports.

We have now come to the point where an intermediate port is to be found for working, temporarily or permanently, the railway from the Mediterranean to Bagdad, in connection with steamers from Brindisi. It will, however, be seen that another way will be opened from Salonika. Mr. W. P. Andrew long favoured Suedieh, and the restoration of the port of Seleucia, but is now, it is understood, ready to accept Skanderoon. The government have wished not to displace the old port of



MAP SHOWING THE RAILWAY ROUTE TO INDIA

Skanderoon for the creation of a new town. I accordingly obtained a survey of Skanderoon and the Beilan pass by Colonel Messoud Bey about the year 1865. The Colonel pronounced on its practicability, and this is confirmed by Mr. Telford Macneill and Mr. W. J. Maxwell, who, in 1870, spent a considerable time in the careful study of the district. It is, however, within possibility that the cost of getting over the pass may be much reduced. Colonel O'Reilly has made a suggestion which is of considerable value, that the port shall be at Ayas, on the north shore of the Gulf of Skanderoon. This would better accommodate the local traffic from the interior of Asia Minor, and it would be more accessible for Indian steamers than Skanderoon.

We have now to reach that portion which is known to the public as the Euphrates route, but where there is an alternative of a Euphrates route and a Tigris route. This it is not my business to describe in detail, nor to enter into advocacy of one course or the other. With regard to the Euphrates route, which was first designed by General Chesney, it has been indefatigably advocated and promoted by Mr. W. P. Andrew, who is again making vigorous efforts to secure for it the aid of the English government. If Mr. Andrew succeeds, undoubtedly this will be a most valuable encouragement to the undertaking.

Either the Euphrates or Tigris line will reach Bagdad, where there is river steam navigation, but this will hardly be of much advantage except in construction, at the continuation line to Bassorah, the steam seaport on the Persian Gulf, can be worked at simultaneously. From Bassorah we have a regular steamboat service to India.

In India itself we have now a connected railway system from the port of Bombay, and there will be another port of junction at Kurrachee. This system, as we have seen, is joined to Bassorah and Bagdad. At present this great section of the through line and this vast plant is only available for the local service of the decayed but newly growing city of Bagdad. If the through line reaches Bagdad, or if Mr. Andrew's instalment of it can be perfected, then there is all the machinery for bringing passengers from further India to the Mediterranean shore, and within about two days of a station of the European railway system. It is this large traffic of all India which is waiting for us, and to be augmented by that of Ceylon, the Netherlands and Spanish India, China, Japan, Australia, and New Zealand.

Such must, in the end, afford a remunerative return, not only on the whole enterprise, but on its accessories, and render possible many great yet subsidiary projects. which are now delayed for want of encouragement. Such are improved means for crossing the Channel, and the plans already referred to for crossing the Bosphorus. By establishing main lines, they will facilitate the lines with light rails and with light working stock, of which we hardly know the beginning, but of which the future extension must be so great. There will be, likewise, the means of establishing competing and alternative lines, such as some of those already spoken of, and that of Messrs. Low and Thomas.

If the prospects of a through route to Persia are not immediate, yet any line, through or partial, to Bagdad would be a means of stimulating railway enterprise in South Persia, and enabling the table lands to be reached by the Karoun, or by Bushire. That table-land once touched by railway or tramway, there would be a development of commerce which, temporarily passing by the Euphrates route, would be the means of ultimately promoting a through route to Persia itself, by furnishing traffic for it. In our own particular interests it appears very desirable to stimulate the development of South Persia, which lies nearest to our Indian possessions.

The political advantages of the works now in progress are very great. Within a couple of years, Turkey will be able to place troops on the Danube, and to receive in case of need the aid of Austro-Hungarian armies on the Danube, or even in Asia Minor. We can already afford military help to Bagdad, and confirm the Turkish power; but if there were a through line, we can send a contingent from India to give assistance even in Asia Minor. To Turkey, the value of the through line is that it enables her to secure Bulgaria, Bosnia, and Thessaly, and to keep down the tribes of Koords and Arabs, who have, until lately, resisted her supremacy, as they did that of the Greek and the Roman empires.

Such undertakings, bringing with them the blessings of prosperity, increase the guarantees for peace; but to us, besides holding out a participation in such advantages, they tend to promote moral objects in which we have a still deeper interest—the welfare of our own people in India, and the natives under our protection and tutelage. Much as the transit to India has been abridged, a railway will enable Englishmen to travel to and fro, and the natives in India to visit this metropolis, from which they take back the traditions of civilisation, to be propagated and perpetuated among the hundred millions who are being adopted as heirs to those institutions which have given us for centuries the enjoyment of liberty, and to other nations of the earth an example and an incitement.

It is by the promotion of this intercourse that the development of progress is, in our times, acquiring a celerity as yet unexampled. The post has distributed throughout the world organs of thought, which mould the minds of many nations. The telegraph gives a simultaneous participation in national and individual fortunes, in the happiness and the misfortunes of those men and those towns most distant in space. We have relieved the sufferers by a fearful conflagration before we have known the details of their sorrows, and weeks before, in our youth time, we could have become acquainted with sufferings which it would then have been too late to mitigate. It is, however, by increasing the possibility of personal communion that we shall more efficiently promote the union of mankind for good than we can by the books of past wisdom, or by the great organ of the public press, mighty as it is. The voice of man is more powerful than its symbols, and it is by overcoming the obstacles of time and space that we can bring together those who are removed by distance of abode, and still more alienated by distance of prejudice. We thus augment the common possessions and common associations of men and of nations, and join them not merely in the bonds of interest, but by moral ties, still stronger and yet more abiding.

APPENDIX.

My dear Mr. Hyde Clarke,—You have asked me to give you my idea as to what would be the best direction for the Asiatic railways of Turkey to take.

Being connected as you are with the body which has, after the Porte itself, the greatest interest in determining this question—the Association of Foreign Bondholders—I will endeavour to satisfy you, as far as my experience enables me to do so. Your association is co-interested with the Porte, because, as has been truly said, there are several nations in which a race is being run between railways and bankruptcy—and Turkey is certainly one of them.

All that Turkey requires is to get fair credit to enable her to set herself right; but that credit must not be employed merely to enable her to find the means for continuing a hand-to-mouth system of borrowing for the purpose of paying interest, while there is an increasing deficiency in every budget, and nothing is done to secure the employment of a portion of borrowed money in works which would be sure to increase its revenue. For years past no loan should have been made without a certain part of it being secured for the construction of railways, by being placed, not at the complete disposal of the Porte alone, but conjointly with a syndicate, composed of representatives of all her creditors.

In considering the proper direction for a trunk line in the Turkish Asiatic Provinces, we have not alone to consider the creation of a route over which will flow the going and coming tide of travellers from Europe to India, China, and Australia, we must at the same time take into consideration the interest which the Porte and her creditors have that the line should at the same time contribute as much as possible to the development of her provinces. The Porte being the owner of at least the eighth of all produce, is interested, perhaps more directly than any other country in the world, in producing for it cheap means of transport to the sea-ports, and thus increasing its value to the producers and to herself.

Taking into consideration the geological formation of Asia Minor, a great, though irregular and varied, plateau, nearly surrounded by high mountains, and having only one easy entry by the valley of the Sakaria, and the position of the principal centres of production and commerce, it appears that the single line of railway can do much, in proportion to the wants of the vast interior, in the way of supplying means of transport. The country can be perfectly developed only by a number of lines leading from sea-ports to certain towns, and considering that freight from the Mediterranean ports to and from the markets of Europe is less, it would be desirable to give as much outlet as possible to the interior on that seaboard. And it so happens that the best line for the section of the England and India Railway, which would traverse the Asiatic provinces of the Porte—the financial facilities for constructing which are the greatest—possesses this advantage in the greatest degree.

It has long, however, been a favourite project with the Porte to construct a great line up the centre of Asia Minor from Ismid by Angora and Yusgat to Sivas. There is a strategic object in view in this. In a long war for the defence of Anatolia against an attack from the north-eastern frontier, the primary base of operations would be on a line from Sivas to Diarbekr, the principal line of operations being from Sivas towards Erzingian, a point on the secondary base of operations. For strategic purposes, this line would be recommendable; as a line intended for development, it cannot be approved of, for Contantinople or Ismid is not the port to which produce should be carried from beyond a certain distance in the interior of Asia Minor. For places situated as far up as Angora, the Sea of Marmora may be the proper outlet; beyond that, the proper outlet should be on the sea-board of the Black Sea, or the Mediterranean. The position of the towns on the map indicates to which of the three seas the produce should go. In the north, Erzeroom, Sivas, Chorum, Yusgat, Kastamouni, by the Black Sea. In the centre, Angora, Boli, Eski-Shehr, Afioom Kara Hissar, Kutahieh, Bazarjik, to the Marmara. To the south, Konieh, Karaman, Yuzghat, Kaïserieh, Diarbekr, Mouch, Van, to the Mediteranean. The exportation of the two last districts is principally at present by the Black Sea, but the moment a railway reaches even the Euphrates, their commerce will take the direction I say. Beside the line to Sivas, a party at Constantinople is much in favour of another inland line from Ismid, by Angora, Kaïsarieh to Diarbekr, and down the Tigris, or from Ismid, by Kuniéh, Kaïsarieh, to Diarbekr, &c.

The disadvantage I see in all these entirely inland lines is the loss to the country from the unnecessary extra cost of hauling produce over hundreds of miles towards Constantinople, instead of bringing it to the nearest port for exportation. The value of the dime of Kaïserieh or Kouieh would be much greater to the Porte if the produce was brought to the Gulf of Issus (Skanderoon), instead of to Constantinople; the difference in the price of haulage and freight would be so much money the more in the pockets of producers and the treasury of the Porte. I have already said that a single line can do little for the development of Anatolia; that, place it where you will, it would not produce the slightest effect upon the greater part of its provinces; but the best effect would be produced by a number of lines tapping the interior, and leading direct to the coast of either of the three seas. But the Porte will find certain financial facilities for the construction of a first-class line, running right through her territory, from the Bosphorus to her eastern frontier, which she cannot find for separate lines intended merely for development, from the certainty of a through line becoming, at an early period, the highway between Europe and the great and populous countries of the East. If this line is placed completely inland, without touching the Mediterranean, its value as a means for development is lessened by the fact that the produce of the most distant provinces must be hauled overland hundreds of miles to Constantinople, and the financial facilities for its construction may vanish before the question, "Who is to pay for making a line through the heart of Persia?" Even according to Lowe and and Thomas's plan, Persia herself would have to pay a part, and we may well hope to see the Turkish section of the England and India line finished before we can see Persia in a state to do her share of it. Again, if the line by Kaïserieh, Diarbekr, and the Tigris were chosen it would be much better to spend the extra money which it would cost in constructing a narrow guage branch line, to connect the districts from which Diarbekr gets its importance with the Euphrates Valley line, which would fit into a line from Constantinople, touching at the Gulf of Issus. Thus it happens that the shortest and easiest line for the England and India Railway is also that which would do more for the development of the Asiatic provinces of Turkey than any other single line can do.

All the evidence of witnesses before the Committee of the House of Commons, relating to the line from Constantinople to Alexandretta, contained an error as to what its direction should be after leaving Ismid. They all say that it would pass by Kutayïeh. Messrs. Lowe and Thomas make the same mistake. The first person, however, who spoke of a line taking this direction was Mr. Latham, in a paper published some years ago. All, knowing nothing of the country, have followed in the same track, I believe, merely because the post-road from the capital to Aleppo and Damascus goes by Kutayïeh, and being ignorant of the fact that that post does not pass through Ismid at all, but being taken by steamer from Constantinople, is disembarked at Kara Mursal on the other side of the gulf; that the post doe not go that way because the route there is the easies but in order to give postal communication to districts o of the way of the central line of post through Anatoli starting from Ismid and arriving at Bagdad, passing Diarbekr, Mursal, &c.

All these projectors say that the greatest difficult on a line from Constantinople are between Ismid a Kutayïeh, not knowing that they need not go out of th way to seek these difficulties, if their object is to foll the easiest and shortest line for communication betw the south-eastern provinces of the empire and capital. The plain, natural, easy, and shortest way into the centre of Asia Minor, whether the object is to reach Alexandretta, or Diarbekr, is by the valley of the Sakaria, and you have really nothing like mountains to pass on the way, except in the sense of leaving them on your left and right, until you reach the Taurus. I am sure that when Messrs. Lowe and Thomas have caused to be made the preliminary survey which they have promised us, in furtherance of their great and admirable project, they will acknowledge that the route which I indicate is the true one.

From Constantinople to Ismid a line is now being constructed by the Porte itself, in order to find out what ought to be considered as a fair average price for a railway in Asia Minor. The Council of Public Works consider that its cost will not be beyond £5,000 per kilometre, (about £7,500 per mile) for a single line of permanent way, rolling stock and everything complete.

It may not be made so cheaply, for I imagine that there must be unrequired expense, from insufficiency of plant and other reasons; but I believe that the same length (about 60 miles) on any other part of the line from Ismid to the Persian Gulf, with the exception of a section including all the passage of the Taurus or of the Beylan-hills, would not be more costly that this portion from Skutari to Ismid, taking into consideration the cost of transport of material against the larger cost of labour far away from the capital. The cost of the portion, whatever it may be, may be taken as a fair average for the whole line from Skutari to the Persian Gulf. I am well acquainted with the first part of the line from Ismid inland, it having been surveyed for a line of road by engineers under my orders, while I was in these provinces as Comissioner of Public Works, at which time also the country, as far as Eski-Shehr, was surveyed for a line of railway.

The works for a railway would be of the simplest and easiest nature from Ismid up to the entrance of the defile of the Sakaria (Sakaria Boghäzi), a distance of 34 miles; there a large bridge would be required to bring the line over to the right bank of that river, on which side the ground is more favourable. The length of the defile is about 16 miles to the Bridge of Ghevé, below which the river would be repassed, and above which the plain of Aksar is immediately reached.

The passage of this defile would cost little extra beyond the expense for the two bridges, which might be between £12,000 and £14,000 for the two, the rest would be done by occasional short lengths of sustaining walls, generally not requiring the use of coffer dams, and a few side-cuttings, blasting being scarcely required, two-thirds of the line being over flat ground across the re-entering angles of the mountains. There is a waggon road the whole way, on both sides of the river.

The plain of Aksar produces the greatest quantity of cotton, known in the Constantinople market as Ghevé cotton. It is a level of nearly 30 miles—all that a contractor could wish for nearly the whole way; the ballasting could be taken from the side ditches. The plain of Aksar is separated from the plain of Lefka by another pass, not half the length of the Sakaria Boghazi, but a little more costly, as some mining would be required. There would be no places with similar difficulties until the Sakaria is left, near Sugud, to cross an easy country to Eski-Shehr.

It is probably some place between Sogud and Eski-Shehr that Angora, the greatest centre of commerce in Asia Minor, would be put into communication with the trunk line, by a feeder line of some kind; also about here similiar lines would join, bringing in the traffic from Bazarjik and Kutaïyah both considerable centres for the corn and wool produce of the country.

The question of what ought to be the nature of a secondary means of transport for the whole of Turkey is too important a one to be treated of casually.

I have passed by Eski-Shehr, and I never heard of, and believe that there is not a range of mountains between that place and the great plains of Konieh. There is, I believe, an undulating and varied country for some distance beyond Eski-Shehr, and the only serious question would be, whether a line should pass to the north or south of the great isolated range of mountains known as the Sultan Dagh. The easiest and shortest line is, according to the best information I have obtained, to the north of these mountains. Passing to the south, the distance would be longer and the country more difficult; but the town of Afioom Kara Hissar would be passed. I think, however, that the extra expense of passing by a town of this description would be better employed in making a feeder line of whatever description may be decided on. By doing this in all similar cases, a far greater amount of development is produced for the same money. And the great objects of the creation of a through line should not be lost sight of, viz., for the Turks, to connect their south-eastern provinces with the capital; for England and all Europe, to give the quickest means of transit for the post and passengers to and from India, China, and Australia.

The town of Eski-Shehr, which I believe would certainly fall upon the direct line, is a centre of commerce for wool and corn; but its chief wealth comes from the mines of meerschaum, bits of which are to be found in nearly every street in all the towns of Europe.

The line proposed by Messrs. Lowe and Thomas does not pass by Konieh, yet we may be certain that the Porte will consent to no line between Constantinople and the Gulf of Issus which does not pass that town. It is the residence of the Governor-general of a vast province, and of considerable importance politically, as being that also of the Tehelebees—the most direct descendants of the Caliphs, the eldest of whom comes to Constantinople on the accession of each Sultan, to gird on him the sacred sword, thus acknowledging and investing him as the Commander of the Faithful. These gentlemen have apparently chosen their line in order to avoid the Taurus, but in doing so they pass through a mountainous country of greater width, having to overcome several ranges, and after all go to a height very little lower than the point where the Taurus is opened by the pass of Gulek Boghazi.

From Konieh to the Taurus is a rich country, with isolated hills, which can be avoided by slight deviations. The highest points of the Gulek Boghazi can be reached with very little tunnelling, and the ascent and descent made with far lighter gradients than those of the Sœmmering or the Ghauts line. The town of Adaua would be on the line, which should reach the sea at the great natural harbour of Ayas, one of the best protected in world, the opening looking across the bay towards Alexandretta, to which it is far superior as a port. Thence the line would go round the Gulf, or rather Bay, and over or under the Beylan pass, and on by the Andrew line.

It is curious that in all the discussions on the through line to India, no allusion has ever been made to this port; yet it is undoubtedly here that the Euphrates valley line should have its terminus, even if considered as a finality, and not as a section of a future through line; for, supposing the sea to be used for communication with Europe from the Gulf of Issus, this port is farther on in that direction, and its climate is perfectly healthy, there being no marshes in the neighbourhood, nor hills to obstruct the breeze from whatever quarter it blows. Chalcedon was called the city of the blind, because its founders neglected the advantage of the Golden Horn, the glorious port on the opposite side of the Bosphorus. If an England and Indian line of railway is made, and Alexandretta becomes the port of India in the Mediteranean, then it should be called New Chalcedon.

I do not say this in disparagement of the pioneers employed by Mr. Andrew. They were employed at a time when there was little hope of having a through route to India; when getting over the Beylan was not to be thought of, and tunneling more expensive than it is now; and they were quite right, at the time they came to a decision, in chosing Seleucia as the place for a harbour and terminus. All that time the Euphrates Valley Railway was considered the best and final means of getting a quick passage to India, and it is now the best route from sea to sea, and the best section of a through line on that part of the Turkish territory. Attempts have been made to show that the Andrew project is inimical to a through line. But it is not so. Mr. Andrew, under the altered aspect of the question of complete rail communication with India, has adopted Alexandretta as the Mediterranean port, and he does not stick to Bassorah as the port on the Indian side; his project is from the Mediterranean to the Persian Gulf, and the terminus may be at the mouth of the Karoon, opposite Mohammara instead of Bassorah, the line following the left bank of the Shatt-al-Arab, instead of the right. At any rate, this would be the first section of a line shortening the passage to India, which would come into use, and after the completion of the whole it will always have more traffic than any other section, from certain peculiar advantages which it has.

The whole of these questions, however, as to the duration of the direction of the through line, position of terminal ports, &c., will have to be referred to the Porte, and I have little doubt of her deciding for the line I have indicated for Asia Minor—viz., on passing by Koniah, with the port for India and Asia Minor at Ayas.

The effect of this upon one of the most backward districts of the empire would be marvellous. Turkey derives enormous advantage from the impulse given to production by the commercial towns on her sea-board, and it is her interest to create as many new ones as she can. The port of Ayas would become the outlet for a great part of Anatolia, and by the Andrew line for Northern Syria, Koordistan, and the Tigris Valley it would undoubtedly soon rise to be a place of great commercial importance, and the rich plains immediately inside it would no longer remain as they are, uncultivated, the home of a few nomad Turkomans. I am sure that the government could, by the sale of town allotments along its quays, and farm lands in its interior, find money sufficient to construct a branch line to Kaiserïeh from above the Gulek Boghazi, or from the port to Marash. This is how things are done in America, and how she makes her railways and pays off her debt. In the mountains which surround Cilicia there is a population now living in semi-idleness which would be at once ready to descend and cultivate the plains, if the market for produce was brought near. I am sure that the Armenian community alone would find the money for either of the branch lines I mention, in consideration of grants of lands in the neighbourhood of Ayas.

E. O'Reilly.

DISCUSSION.

Mr. William Pare desired to say a few words on the great and interesting subject of the paper, as he had paid great attention to it for more than a quarter of a century, and might claim to be the earliest projector of a line of communication between Calais and Calcutta. One scheme had not been alluded to by Mr. Clarke, notwithstanding his very large acquaintance with the subject, viz., the scheme from near Trebizond, on the Black Sea, to the Persian Gulf. He believed this scheme was mentioned before the Select Committee who met last session, but was dismissed almost summarily, from the fact that it passed across the great range of the Taurus mountains, a very difficult country, and because it did not seem to have either the political, commercial, or geographical merits which such a scheme ought to possess. The scheme of Mr. Andrews was not for a continuous line from Constantinople to the Persian Gulf, for he, being more cautious, proposed to take his departure from Seleucia, on the north-east coast of the Mediterranean, running thence through the Euphrates Valley, which had been so thoroughly devoloped by General Chesney, thence to Bagdad and Bassorah. He agreed with this scheme so far as it went, but it seemed to him that if they could not get an entirely through scheme to Calcutta, they should have it to Bassorah, which, for many reasons, was to be preferred to that by the Tigris. For instance, it could more easily be made a link in the great line of communication whenever the time was ripe for its adoption, by putting on a line from Constantinople to Seleucia, and carrying it on from Bassorah by Ispahan, or along the southern coast of the Persian Gulf to Kurrachee. He thought, however, sufficient attention had not been paid to the really through route from Constantinople by Teheran and Candahar to Lahore, Mooltan, and Delhi, or thereabouts. This was the route which, nearly 30 years ago, he had ventured to suggest; or a more southern route by Ispahan, coming into India at Hyderabad or thereabouts. He believed it would be found, however, that the more northern route was preferable, politically, commercially, and geographically. It was of great importance to cultivate friendly relations with Persia, and endeavour to develop her resources, and he thought it was to the interest of England to do so, because, although she might not be in a position at present to afford material aid to such a scheme, she would be before it was ripe for execution. It must be borne in mind that whatever plan were adopted, entire dependence for remuneration must not be placed on the through traffic, for it was now pretty generally acknowledged that it was not this kind of traffic, but that from station to station, which paid a railway best. He trusted that if the Select Committee were re-appointed, its objects would be enlarged, so that it might not only inquire into the merits of routes from the Black or Mediterranean Sea to the Persian Gulf, but also into the entire scheme of improved through communication with India, by any route which might be suggested.

Mr. John Jones thought it was a good idea of Mr. Hyde Clarke's to direct attention to the European portion of the scheme for railway communication with India, for it was entirely unreasonable to imagine that the produce of India could ever be brought to England by railway with any advantage. When the freight from Bombay by the Peninsular and Oriental Company's ships, *viâ* the Suez Canal, was only 3s. a ton, it was not likely that goods would come by railway, which would cost at least, judging by the rates for the cheapest description of goods in England, such as dung for agricultural purposes, about £1 a ton for 150 miles. It was, however, a very different thing with regard to communication between London and Constantinople, which was of great importance, and he was glad to see attention drawn to it. The East Indian Railway had lost £300,000 this year as compared with last, and the government had been obliged to issue a commission to ascertain the cause of the falling off in the receipts; the evidence, so far as it had gone, seemed to show that the high tariff prohibited merchants and dealers using the railway, as they could send their goods cheaper by bullock cart or river; and if that was the case in the most populous district in the world, viz., the valley of the Ganges, there was not much prospect of remuneration from a railway across such a desert country as that referred to in the paper.

Mr. W. Austin, C.E., said this subject had had his attention for 33 years. He therefore offered his opinions as those of a purely practical man. He had always supported the splendid proposal which had emanated from Mr. Hyde Clarke. He had also had several long interviews with Mr. Andrew upon the subject of his scheme, which was nearly identical with Mr. Hyde Clarke's, and he felt perfectly satisfied, as a practical working engineer, that it was the most perfect route that could be devised. Mr. Hyde Clarke had clearly shown, by the line he had drawn on the map, that it was the nearest and shortest route to India. It was his deliberate conviction that it would be for the benefit of this country to have India brought into closer connection, instead of being at 28 or 30 days' distance. If this scheme were carried out in its entirety, including a tunnel across the Straits of Dover, which must come some day, notwithstanding the difficulties which some saw in the way, he was certain the line would pay. All railways had paid more or less, and would have paid better but for the enormous expenditure requisite for land. In the present instance, however, the line would pass through a great portion of territory where the land would not require to be paid for. He was satisfied that the line by Bassorah would afford the readiest and quickest communication with Kurrachee, and, at the same time, open up large districts of country which could not be attained by the line through Teheran and the centre of Persia. Teheran and Herat, and other great inland towns, no doubt required railways, but they should be branch, narrow-gauge railways, whereas the main line should run from Calcutta to Aleppo, Bassorah, and so on to Kurrachee. The works would then be complete, and there would be 5,000 miles fair running, which could be got over at the rate of 30 miles an hour, so that the whole distance would be performed in seven days.

Mr. Robert Rawlinson, C.B., said that railway traffic, to be carried, on must have some degree of security, and there must be some prospect of remuneration. It was quite true that Great Britain governed a great portion of India, and he thought a ready means of communication should be formed between Europe and India; but they knew the old proverb, "that gold might be bought too dear," and rapidity of communication also might be bought too dear. He knew something of the countries which Mr. Hyde Clarke had referred to, and he was sure Mr. Clarke would agree with him that the first necessity would be to have some stability of government, and some security for life and property. At the present time, every labouring man in the Turkish Empire went about armed to the teeth, and there was no security for either life or property. Until they could see civilisation progress so far as to give that security, it was of no use making these great lines of communication, which would have to be kept open by an army of occupation. He did not suppose they were going to occupy the Turkish Empire at present, and if not, it would be absurd to spend their money in making the proposed railway. In America such railways were made, but he thought that was no precedent for other countries, because in America there was security itself for property and land, as compared to the state of things in the East. That portion of Asia Minor which bordered on the Black Sea was, in ancient times, most densely populated, as was evident by the remains of ancient graveyards and; nothing on earth but the curse of an insecure government kept it in its present depressed condition. It was their duty, therefore, to foster, by all means in their power, freedom and security of government, without which all other blessings in this world went for nothing; and until there was some chance of that being reached, it would be better to let all ideas of making such a railway with British money remain in abeyance.

Mr. John Cheetham said he had felt some of the difficulties referred to by the previous speaker, that unless there was security in the different countries through which such a railway passed, it appeared to him very problematical how it would be beneficial to execute them. He thought, therefore, the argument at present was rather against taking any further steps in that direction, but, at the same time, it was a subject which must be kept in view. He was happy to say that the practical result of the Suez Canal had been exceedingly beneficial already to the trade of Lancashire, as it effected a considerable saving of distance in the carriage of goods, as well as of passengers; but there was no reason why they should limits their efforts with regard to direct communication with India to this route.

Mr. Alexander Carnegie said the public must be greatly indebted to Mr. Hyde Clarke for the information that within the next few months there would be direct communication with Constantinople. The quantity of rails being sent from Trieste for railways in Turkey would much astonish many English manufacturers. These rails were being made in Vienna, the reason for which was that the capital for the Turkish railways was also found there. On the other side it was to be observed that the continuation of the Bagdad line, which would be finished within the next six months, would place Constantinople in direct communication with Bassorah, except for the small district between Varna and Constantinople; and no one knew better than Mr. Clarke that that difficulty could easily be got over by bringing a line of railway along the shore of the Black Sea for 200 miles, where there were no engineering difficulties at all, there being already good postal and carriage roads. The next question was the safety of life in the Turkish dominions; and having travelled throughout nearly the whole of European Turkey, he could say he had never found his life endangered in any way. As to the route between Bagdad and the shores of the Mediterranean, the regularity of the caravan post was an answer to that question, for the mails arrived from Bagdad with the same regularity as from Alexandria, and the caravans were unaccompanied by a single soldier. His authority for this statement was the present British consul at Ruschuk. He felt much obliged to Mr. Clarke for getting over one great difficulty, namely, that the Turkish government insisted on having a line from Scutari; but this might be removed by going down to Skanderoon, thus meeting the Turkish government on their own ground. It was perfectly true, as had been said, that railways would pay if they were only made, and he was quite satisfied that if there were communication now it would pay very well to bring grapes by railway from Bagdad to the London market.

Mr. Gustave Soares said he had travelled over nearly the whole route from Calcutta and Bombay to London, along which the line was proposed to be taken by Mr. Hyde Clarke, and he could testify to what Mr. Carnegie had stated as to the perfect security of life in Turkey. He had travelled all over it, and had never been stopped, although he had gone in small carts without any protection whatever. The telegraph wires also were carried through the whole of Turkey without any difficulty. The best precedent that could be afforded for security of life amongst the wild tribes of any country was that afforded by the American lines, who passed directly through territory infested by wild Indians. When he crossed America, some four years ago, he had to stop for six weeks, because the party was not strong enough to do battle with the Indians; but now the railway was established it went with perfect security, and, as far as he had heard, had never been stopped for one moment. The chief difficulty in the undertaking, as it occurred to him, was that of backsheesh, which being translated into commercial vernacular, meant pull or plunder. The Turks were fully alive to the advantage of having backsheesh, and were ready to give all sorts of concessions, and so were the Persians and Arabians; but this additional difficulty of backsheesh came in the way, and he had known several schemes break down simply on this account. It was evidently the interest of the Turks to construct a line from Constantinople to Belgrade, for it was much more important politically to join Constantinople with Belgrade than with Bagdad; and if they had been so long about this—and even now the Servian difficulty was nearly insurmountable, not to speak of the bridge over the Danube—it did appear to him that the line from Constantinople to Bagdad would present still greater obstacles. He had been speaking that morning to Mr. Randolph Stewart, who much regretted he should not be able to be present that evening, and who stated he was decidedly in favour of the Tigris route to Teheran, and over the Cabul passes to Eastern India. He himself had travelled that route, and should imagine it would be the best. It appeared to him that the engineering difficulty would be much greater by the lower route than by the upper; for, though it was true the Cabul passes were very difficult to pass, they would not be much more so than Mont Cenis. The northern route was not only shorter, but would afford increased facilities for traffic with the tribes of northern India.

The Chairman, in proposing a cordial vote of thanks to Mr. Hyde Clarke for his valuable paper, said he would not discuss whether or not the views he had propounded were plausible or likely to be carried out. He could only say that anything which tended to bring our Indian Empire closer to ourselves was worthy of the deepest attention by every thoughtful man in this country, for so thorough an Englishman was he that he felt quite convinced that the closer any of our dependencies were brought home to us, and the nearer they could see our institutions, the more likely would they be to cherish the connections which bound them to us.

The vote of thanks having been passed unanimously,

Mr. Hyde Clarke said that one great advantage of reading a paper in that room was, that a man did not simply express his own views, but had also an opportunity of hearing them canvassed and discussed by those best competent to exercise a judgment. Of all that had been said on the present occasion he felt the more indebted to the few remarks, apparently in opposition to his own views, which had fallen from his friend Mr. Rawlinson, since he was entitled to speak with weight, and what he said was the result of his own experience. At the same time, he saw many gentlemen in the room who he knew were not prepared to concur in the opinions of Mr. Rawlinson, so far as they related to the undertaking in question. In the first place, he would disabuse his mind of the idea that this enterprise was dependent on English capital; people had been in the habit of looking at this as an English undertaking, totally disregarding what was going on in other parts of the world; but it would be remembered that he had not been talking that evening of the projected part of the undertaking, but had endeavoured to relate mainly what was in actual progress—of a line in European Turkey of which about 200 miles was being then constructed, a considerable portion of which would be opened in the spring, notwithstanding all the delays and difficulties which had occurred. He would pause here for one moment to refer to the backsheesh, which had been mentioned by Mr. Soares. There was an idea in this country that nothing could be done in Turkey without bribery, and there were gentlemen in Turkey who never conducted a single transaction without paying a bribe, and they had met with many difficulties in consequence. On the other hand, he had been connected with large operations there, and had never paid a bribe or anything in the shape of one. Of course individual experience, although extended over several years, did not count for much, but he could also refer to the leading English merchant and banker in Constantinople, who had been there nearly fifty years, and who had also never given a bribe. If persons choose to bribe, there were plenty of people in Turkey willing to accept it, as in London, if money were scrambled in the streets, there would be plenty of hands held out; but the man who, either in Turkey or elsewhere, attempted to gain his object by impure means was sure to create difficulties and obstacles for himself. Mr. Rawlinson's experience in Turkey was gained chiefly during the period of the war, when the country was in a more disturbed state than usual. Still there was no doubt, as he had stated, that large portions of the country were subject to the exactions and vexations of these predatory tribes, and it was on that very account that the Turkish government was anxious to follow the example of the United States, which had found railways the most effectual means of dealing with hostile Indians and extending the boundaries of civilisation. He saw around him several gentlemen who he knew were familiar with Turkey, and who would bear him out that, although some parts of the country were exposed to the incursions of Arabs and Khurds, there were other districts where you could travel as freely and as safely as in England. He himself hardly ever carried arms in Turkey, and the condition of many cities showed that this idea of insecurity had been greatly exaggerated. In Smyrna, for instance, though it had a population of 200,000, and, being a sea-port, was open to bad characters of all kinds, crimes of violence were very few, the people went wholly unarmed, and their conduct reflected great credit both on the Turks who governed it, and on the Greeks, who mainly composed the population. The great value of such an undertaking as he had described was that it secured a firm and strong government, and by so doing promoted and extended civilisation. He must also beg leave to say that he had not come there to advocate any particular scheme, and that none of the proposals he had brought forward originated with himself. They were the creations of such old labourers as Mr. Pare, General Chesney, and others, who had worked at the subject long ago, and he had only attempted to briefly describe what was now, under great difficulties, going on. Gentlemen engaged in conducting railways in Turkey were aware that travelling there was attended with no more difficulty than in England; no one dreamed of putting a pair of pistols in his belt when about to take a railway ticket at the Black Sea or at Smyrna, and he should have been glad if some gentleman whom he saw present had given their testimony on this point. They were also in a position to say that railways in Turkey could be made to pay, and did pay. He hoped he had now said enough to disabuse the mind of any one present of the idea that he had been endeavouring to bring forward a doubtful or impossible project; on the contrary, he had spoken rather of what was now being done. It was, in his opinion, a misfortune that England had not been in a position to contribute to the work, but that the capital for the Roumelian railways had been supplied in Austro-Hungary and France, the result being that Englishmen did not participate in the profits of the undertaking. He did not look with any jealousy on the raising of money for Turkey in the English market, which was, in fact, the money-market of the world; and if the Turks, or any other people, could bring forward a legitimate undertaking, Englishmen ought to be able to supply the means, as well as the people of Vienna or Paris. If they did not do so, the same result would follow with larger undertakings that had already occurred in the case of the Roumelian railways, that, having laid the foundation of railways in Turkey, gone through the experimental expenditure, and showed that the whole matter was practicable, we allowed ourselves to be cut out and excluded from the real profits of the great undertakings being carried on there.

ANNOUNCEMENTS BY THE COUNCIL.

THE LIBRARY.

The following works have been presented to the Library :—

A Handbook of the Mineralogy of Cornwall and Devon. By J. H. Collins, F.G.S. Presented by the Author.

The Monthly Reports of the Chief Engineer of the Manchester Steam Users Association. Nos. 114 and 115, for June and July, Nos. 116 and 117, for August and September, and No. 118 for October.

A Lecture on the Hindu View of Cholera. By Golaub Sing, M.D. Presented by the Civil Service Supply Association.

A Pamphlet on the Advantages of Gas for Cooking and Heating. By Magnus Ohren. Presented by the Author.

Nineteenth Annual Report to the Council of the City of Manchester on the Working of the Public Free Libraries, 1870-71.

Report of the Third Annual Meeting of Members of the National Education League, held in Birmingham, on October 17th and 18th, 1871.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

MEETINGS.

EDUCATION OF GIRLS.

On Friday evening, the 17th inst., a meeting was held at the rooms of the Society, to consider the formation of a National Union for Improving the Education of Women of all classes. The chair was taken by the Right Hon. **Lord Lyttleton.**

The Chairman, in opening the proceedings, said that the subject about to be discussed was one the importance of which everyone was ready to admit, and it was one which had long occupied public attention. He assured the meeting that the subject had not been lost sight of by the Endowed Schools Commission. It was true that Parliament had hedged the commission round with so many instructions and precautions that it could proceed but slowly, indeed very slowly, with the work; but, nevertheless, the question as to whether a portion of the endowments with which it had to deal could be appropriated to the purpose of female education had not been lost sight of. He did not wish to make any sanguine promises, but he had great hope that something ultimately would be done. The subject of female education was one which, to use the fashionable phrase, was now being thoroughly ventilated, especially in the pamphlets by Mrs. Grey, Mrs. Beal, and Miss Davies. There could be no doubt that there was great room for improvement in female education, but at the same time we should guard against undue exaggeration or depreciation of the present system of education, which, if it were wholly bad, could not have turned out so many good wives and good mothers as we were proud in acknowledging the possession of; but still a little change might be a great improvement. What was wanted was, not to change from bad to good, but from good to better, and, if possible, to best. The present notions respecting females required considerable modification, but it was impossible to deny that, although marriage should not be the only object thought of in bringing up a young girl, in the great majority of cases it would still be the end kept mainly in view. The fact was, that better systems of training for persons of both sexes were wanted, and the indifference of parents and the public remedied. What had already been the result of the efforts of women should not be forgotten. One good result had already proceeded from the efforts of the Endowed Schools Commission, for it had made manifest the inequality of position of the girls as compared with that of boys. It was to be hoped that provision would be made that women should take their places in the governing bodies of all, or nearly all, the educational endowments throughout the country, and further, that some of the larger endowments might be made available for the higher qualification and education of women. Endowments in the shape of scholarships and fellowships for the education of boys and young men, are so abundant in the universities of Oxford and Cambridge, that the authorities find them quite a drug, and would rather that no more were established, whilst at the same time there is nothing of a corresponding character to stimulate the education of young women. The case of Christ's Hospital had strongly attracted the attention of the commissioners. A short time ago, that institution afforded education for 1,100 boys and only 18 girls, and this must be regarded as a typical case, showing the advantages in the way of education which are given to boys and girls respectively. It would be a great benefit if advantages of a collegiate kind could be established in such places as the Hitchin College for women; and he hoped some means might be found for providing such endowments.

Mrs. Grey moved:—"That a National Union be formed to carry into effect the following objects:—1. To supply a common centre and means of intercommunication to all individuals and associations engaged in promoting the education of women, of whatever class. 2. To promote all measures tending to give to women generally the means of better intellectual and moral training. 3. To create a sounder public opinion on the subject of women's education, and thus to remove the great hindrance to its improvement, the indifference of parents and the public concerning it." She said that the object of the resolution was to establish an organisation founded on the principles which she had had the privilege of explaining in that place some six months ago, and she was happy to say that the principles then propounded had since received very general acceptation, and that now some of the best names of the country were given to the scheme which the resolution sought to establish. Not long since, a great meeting was held at Leeds, and at which the principles of educational union were warmly approved of, and there seemed to be a general wish for the establishment of an organised body, such as should be efficient in carrying out the principles which this resolution affirmed. The first part of the resolution proposed that there should be a common centre for all educational purposes. There were a great many individuals and associations engaged in promoting the education of women in various parts of the country, but of these, all, except in the north, act in an isolated and unconnected manner, and have no influence over the community at large. The wish was to establish a central committee in London, to serve as a focus, at which all necessary information might be collected, and an executive machinery established for the centralisation of intercommunication between female educational establishments all over the country. The establishment of such a focus would be a great gain to the cause of woman's education. It was not intended to imitate the foreign plan of centralisation, or of having but one body governing a vast passive machine, but to have a living organisation, leaving to individuals full power of local action, yet so combining them as to enable them all to work as if actuated but by one mind, and having certain defined and uniform objects in view. The second part of the resolution proposed to promote all measures tending to give to women generally the means of better intellectual and moral training, and this portion of the resolution recommended itself. The most important measures were, first, to obtain a supply of good schools at moderate rates of admission, to which the incomes of people of the classes immediately above those who send their children to the public elementary schools would reach. In such schools, England, Wales, and Ireland were very deficient, but Scotland was better off; speaking generally, the supply is exceedingly small. If good and cheap schools were wanted, we must not leave the matter to private enterprise. Women generally had little or no capital, and when they established a school it must be a small one for that reason, and it must also be an expensive one, in consequence of the necessary waste of the teaching power. For such schools, first-class teachers would be necessarily expensive, and for that reason the services of such teachers are only to be obtained by the wealthy. The present state of things presses heavily on the majority of tradesmen throughout the country, and also upon the clergy and other persons of small means, who try to give their female children a liberal education. The third portion of the resolution directed itself to the important subject of training teachers, a thing which can only be done in large schools by means of examinations and registration, the use of a fixed standard of requirements, and other tests of efficiency. It points to the creation of a sounder public opinion on the subject of women's education than exists at present. The public wanted to know what sound education really meant, whether for men or for women. There was a most singular confusion of ideas on the subject of education. Some people would confine it to instruction in what we called the "three R's." Others would not go beyond what is generally known as technical instruction. One gentleman wished to know how every girl was to be taught cooking and sewing. Another said that the humbler classes of women required improving, but above those classes there was no necessity for alteration. Others said their daughters had been very well educated. These mistakes arose from the want of knowledge as to what true education really is. It is not the mere technical instruction of either men or women, either of whom may remain uneducated although ever so well schooled. What was wanted was to have the reason of the young trained to a just judgment, to have their senses enlightened to a perfect recognition of the law of duty, to have their minds so well disciplined that that law shall be the supreme law of their lives, and that they shall learn to love what is good, what is true, and what is beautiful. That is what true education ought to be.

The Hon. G. C. Broderick supported the resolution, which was then put to the meeting, and unanimously agreed to.

Major-General Eardley Wilmot moved the second resolution:—"That a Central Committee be composed of the following members, with power to add to their number—Rev. W. Rogers, Rev. Stopford A. Brooke, Messrs. G. C. T. Bartley, C. A. Bartlett, James Bryce, M.A., William Cracroft Fooks, Douglas Galton, W. Ramsay, M.D., Joseph Payne, Leslie Stephen, Henry C. Stephens, Mrs. Baden-Powell, Miss Elinor Bonham-Carter, Mrs. Arthur Cohen, Miss Courtenay, Mrs. William Grey, Miss Mary Gurney, Mrs. Henry Kingsley, Mrs. Jerome Mercier, Mrs. Stair-Douglas, Miss Shirreff, and that they be empowered to frame a constitution and act as executive." He wished to say one or two words respecting the third portion of Mrs. Grey's resolution, namely, that portion which points to the creation of a sounder education of public opinion with respect to female teaching than exists at present. Every help that the Society of Arts could give in that direction would be given. Mrs. Grey, in speaking of the prevailing indifference, has struck at the root of the matter. The time had come when women should take a prominent part in educating their own sex.

Sir Henry Anderson, in seconding the resolution, said it had been his lot to watch over the development of a kindred association in India, and he felt great pleasure in doing everything in his power to forward the present movement. What had been achieved in India could surely be carried out here.

The resolution was unanimously agreed to.

Mrs. Grey moved—"That the thanks of this meeting be given to the Council of the Society of Arts for the cordial and generous assistance they have given towards forming this Union," at the same time expressing her personal gratitude to the Society for the assistance it had given her in bringing the present movement to its present advanced condition.

Dr. Ramsay seconded the resolution, which was carried by acclamation.

Mrs. Henry Kingsley, in moving a vote of thanks to the chairman, said she wished that the large number of ladies and gentlemen who were there that day would sympathise with the feelings of the downtrodden sex which she represented — feelings of gratitude to his lordship for coming forward and trying to give women what Emerson had described as "the possession of their faculties." She trusted that she might be allowed to say, as a woman, what it was they desired. They desired that the talents which they possessed should not be allowed to lie dormant, but should be called forth in the same way as the talents of men. They had no wish to trespass on the rights of men, but they thought it better for both sexes that every possible endeavour should be used to prevent the large mass of female talent and energy which was known to exist being allowed to lie hopelessly dormant and useless. It was melancholy to think of the number of women who passed over sixty years through the world without making any mark in it. She believed that men who had brains themselves would not go on for ever marrying women who thought only about the fashions, but would prefer educated women, who, when they came home, would give them sympathy for their toils, and intelligent communion and appreciation for their intellects. The time had passed when women were to be looked upon by men as mere toys. They were fitted for something higher and better.

Mr. Sheriff Bennett seconded the proposal. As regarded the question of education with reference to manufactures, he would point attention to the superior training given to women in Holland, in Belgium, in parts of France and Germany, and especially in Switzerland. Millions of pounds were now going to the support of our foreign rivals, especially in the watchmaking trade, which, if proper education were given here, might be distributed at home. What was wanted was a good, sound education; but the fact was that at present the foreign schoolmaster was driving us out of the market. At this time £1,000,000 was going to Switzerland alone, which might, if there were proper education, be distritributed here.

The Chairman, in acknowledging the vote, said that though the Endowed Schools Commission, like other bodies of the same kind, might be slow in its movements, yet he hoped that they would be able, before any very long time, to produce something which would be satisfactory to the present meeting. If any persons desired to contribute fresh funds, opportunities would be given to them.

It was announced that Her Royal Highness the Princess Louise, Marchioness of Lorne, had accepted the office of president, and that the following had accepted the office of vice-presidents:—The Countess of Antrim, the Right Hon. H. A. Bruce, M.P.; the Earl and Countess of Dufferin, the Bishop of Exeter, the Bishop of Manchester, Lord H. Lennox, M.P.; the Dean of Westminster, and Sir James Kay-Shuttleworth, Bart. The central committee meets every Tuesday, at 18, Cadogan-place, Chelsea, at 4 o'clock in the afternoon.

Social Progress in India.—"The Mohammedans of India" formed the subject of a lecture delivered by permission of the Council, in the Great Room of the Society, on Thursday evening, the 16th, by Syed Ameer Ali Khan. Mr. J. T. Prichard was in the chair. The lecturer gave a brief sketch of the early Mohammedans, rapidly passed in review the various causes which led to the decadence of the Mahommedan community under British rule, and then proceeded to explain what were the remedies required. He showed that at the first entry of the British into India, and for many subsequent years, that country was covered with educational establishments, endowed by sovereigns or by private individuals. These institutions gave instruction in Mussulman learning, at one time the best the world possessed, and even now, if the patristic lore which often encrusts it could be taken off, not lacking in depth and force and beauty. A wise government, animated with a desire of justice towards all its subjects, without distinction of creed, or class, or colour, would have seized on these ready-to-hand institutions, immediately have purified them of all their corruptions, and whilst keeping up a shadow of their old teachings, would have made them the vehicles of its own ideas, and a grand machinery for ruling the nation by the teachers of its youth. But whilst the British government were trying to utilise the Hindoo schools, and were trying to establish normal and training schools, they allowed the Mohammedan institutions to die off, by the decline of private support or the suspension of their endowments. The British government had established schools, more or less assisted by Imperial aids, for the proper education of its Hindoo subjects; the Mohammedans wanted the same, and they required assistance in transforming their old scholastic establishments, where they might be found existing, into primary schools, where the English language would be taught in conjunction with their own. But where separate establishments were not needed Mussulman teachers should be attached to the Hindoo institutions, for instructing Mussulman youth in their vernacular and Persian. Mohammedans also required training institutions for teachers, speaking their own language; they asked that a fair proportion of the money they paid into the State should be applied towards their education and social amelioration; and, above all, they demanded the funds of Mohammedan endowments to be utilised for the education of Mohammedans, and when they entered the government schools and colleges they expected that they should be placed on an equal footing with their Hindoo fellow-subjects. The British, in their capacity of peace-makers in India, could afford to be just and fair towards all. The Mohammedans did not wish to see the Hindoos thrust from all educational institutions; they did not wish the government schools and colleges should dispense Mohammedan learning only, to the exclusion of Western knowledge and literature; they did not ask that the money taken from the Hindoos should be spent on them; what they wanted was that the British in India should observe the strictest impartiality between the various races of the empire.

Charitable Organisation Society.—A meeting of this society was held in the Great Room, by permission of the Council, on Tuesday evening, when a paper was read by Mr. J. Macgregor, on "Street Traffic."

ANNUAL INTERNATIONAL EXHIBITIONS.

On Monday afternoon, the 20th inst., a special meeting of the Glasgow Chamber of Commerce was held to hear Lieutenant Cole, R.E., give information on subjects connected with the International Exhibition of 1872. **Mr. Patrick Playfair** presided.

The Chairman explained that articles intended to be exhibited next year included the fine arts, cotton fabrics, jewellery, musical instruments, scientific apparatus, paper, raw material, recent scientific inventions, and new discoveries of all kinds.

Lieutenant Cole stated that the course to be followed with regard to the exhibition next year, would be the same as that of the past year. The space would be limited, and only the best articles would be shown. Exhibitors were specially requested to put prices on all objects sent, and an agent would be appointed who would make sales. Articles themselves would not be allowed to be removed till the close of the exhibition. That applied only to the exhibition proper; but apart from it there would be a supplementary gallery, where articles could be sold and removed under certain conditions.

Professor Archer, Edinburgh, who has been deputed to see to the interests of the exhibition in Scotland, also addressed the meeting. He said that from the exhibition just closed many valuable lessons had been learned. Manufacturers from various active localities were found to take a liberal view of matters, many taking up their goods and displaying them with eagerness. Bradford and Rochdale were examples. Mixing amongst them he found that they were decidedly benefited even from a merely trade point of view. He was quite sure that if the Glasgow manufacturers took the matter up, they would in the end gain the benefit which it was intended these exhibitions should confer on the trade of the country generally. The Commissioners would, no doubt, have to work more before the end they had in view would be attained, but he was sure it would be reached at last.

Mr. Wm. Kidston remarked that if the next exhibition was to be got up in the same manner as the last, it would be very objectionable. To have a series of long narrow corridors was not the proper plan for an exhibition. It certainly did not attract the attention expected, and he believed that was partly owing to the fact that visitors did not know exactly where to find anything. Neither had it satisfied the promoters.

Lieutenant Cole said that the exhibition of next year would be an improvement on the last. It was under contemplation to bring it all within the same area, and to do away as much as possible with the long straggling galleries. That would be difficult to effect, but there could be no doubt that the exhibition would be found to be more convenient.

Lieut-Colonel Holms was sure the exhibition must have satisfied the promoters. He had occasion to visit it often, and he found that the working classes availed themselves largely of the opportunity given them.

Lieut. Cole stated that financially the exhibition had been a success.

Mr. William Arthur thought the exhibition was too much of a shop or warehouse. In regard to works of art, if a picture was for sale, of course it was desirable that it should be sold; but he did not think it fair that piece goods or silks should be bought or sold there. It was against the interests of the West-end tradesmen of London.

Lieut. Cole said it was a mistaken idea that the exhibition was to be a great bazaar. The exhibition was not a bazaar, and for the annexe or supplementary gallery very stringent rules had been drawn up. It could not compete with the London West-end tradesmen, as the space was too limited.

Mr. Wm. Kidston—Do you mean that what will be shown there will be only samples, and not the stock?

Lieut. Cole—Certainly; but the rules are that only duplicates of what is in the exhibition proper will be allowed to be sold.

Mr. John Matheson moved that, having heard Lieut. Cole and Professor Archer, the Chamber of Commerce approve generally of the exhibition.

Mr. Wm. Kidston seconded the motion, which was unanimously agreed to.

EXHIBITIONS.

Moscow Polytechnic Exhibition.—The Committee of the Society of Arts appointed to promote the interest of this exhibition, and facilitate the arrangements of exhibitors, have held several meetings, and they desire to point out that the exhibition embraces articles of all kinds, whether raw or manufactured goods, as well as produce, machines, and tools of every description. Parties desirous of exhibiting should at once apply for forms of application for space, as the time for preparation is short. The exhibition opens in May next, and the goods must be delivered in Moscow in the course of April. The Russian Steam Navigation and Trading Company takes goods, freight free, *viâ* the Mediterranean, to Odessa, a navigation open at all seasons. From thence, the Russian lines of railway undertake the transports at reduced rates of charge.

CORRESPONDENCE.

SANITARY PRINCIPLES OF SCHOOL CONSTRUCTION.

Sir,—The paper contributed to the *Journal* by Mr. Chadwick, on the "Sanitary Principles of School Construction," is admirably apposite to the time; and if men and women sitting at the school boards have brains in their heads, it should influence the formation of every structure applied to the purposes of education. We cannot obtain future generations of men and women strong in body and mind, equally in all classes, if we keep them during their youth in the condition of wild animals, exposed to inclement weather, without either natural or artificial covering and warmth—nay, worse than wild animals—in the condition of vermin.

Mr. Chadwick recalls to our minds the effective warmth and economy of fuel to be obtained by the old Roman and Chinese practice of heating the floors below our feet. To accomplish such an arrangement, however, in our present mode of building, is a difficulty, save with basements, for we cannot venture to dry our floor-boards, and timbers to a condition of tinder, with the lime of the plastered ceilings dropping from the laths, unless we risk constant danger of conflagration. At present, it is only the basements of our dwellings that are capable of floor-warming, and that with the risk of all manner of unwholesome vapours drawing upwards from the earth below.

But there is no difficulty of raising any number of incombustible and indestructible floors one above another, if we go rightly about it. The system of iron beams supporting concrete flooring will give us what we want; but we must take care that the concrete be of a quality that will not be affected by heat. Ordinary concrete might, by the constant application of heat at too high a temperature, be reduced to the condition of quicklime, and brittle stones be broken up; but if we use small nodules of burnt clay mixed with Portland cement, we may obtain a substance analogous to the fire-clay with which we line our furnaces. It would be possible in this way to warm the whole of our floors from bottom to top, communicating with each other, and by thermometrical valves, such as the late Dr. Arnott used for his stoves, to ensure the exact rate of combustion required for maintaining a given temperature. And walls as well as floors might be warmed, with the advantage that in warm weather currents of cool air might be passed through the same passages, keeping down the temperature.

But after providing for the health of the bodies, there is the larger question of the minds. Education in its high sense is more than cramming the mind with a mass of facts called knowledge. One of its objects is, how to utilise such knowledge; how the "Wis" may be subjected to the "Dom"—the knowledge usefully applied. Still further, there is the question of morals—not mere habits or customs—but the regulation of human qualities, all conducive to the general welfare; but when not under regulation, degenerating into mere selfishness and tyranny; self-worship by the individual, at the cost of the oppression of the many, or the crushing of the minority by the majority.

In the majority of schools it would seem to be forgotten that children and boys are actuated by the same feelings as grown men and women. The strong tyrannise over the weak; and to maintain this tyranny intact there has grown up a false code of honour, embodied in the axiom, "Never tell tales." The young tyrants encourage this, because it gives them impunity; the masters, because it saves them trouble. It is alleged that "knocking about" causes the boys to grow up more hardened to the difficulties and troubles of after-life; but, in truth, it is this very neglect that causes most of the difficulties of after-life.

The type of an arbitrary tyrant, at the beginning of this century, was a white West Indian boy, surrounded by slaves subjected to every caprice of the tyrant, and never daring to complain. The fag system of our large schools was practically the same, and the still existing remains of it exercise the same mischievous influence, making the weak boy a slave, and the strong a tyrant. Physical strength and skill, and mental cunning to uphold it, are held to be the type of superiority, the mark of boy sovereignty, and no attempt is made to set up a higher standard. The ordeal that a newly-arrived boy passes through in a school is not favourable to the cultivation of the higher qualities. The law—unwritten but imperative—"Never tell tales," prohibits him from making known his grievances, but really it is no other than the unwritten law amongst thieves, called "honour"—a necessity, to uphold the practice of preying on their neighbours. There is no wise system of laws in schools, and thus the poor boy suffering under oppression has no remedy but submission, sinking into a practical slavery, and losing the bold, free, joyous spirit which should be alike the attribute of boyhood and manhood. If of a strong, resisting nature, he fights his way to a kind of freedom, commonly ending in his becoming an oppresor in turn.

The small or weak boy has no right of property in anything the stronger may covet and can appropriate without risk of punishment. If the oppressor loses his books, he takes those of the oppressed, and his pencils, pens, knives, playthings and all go the same way. The little one is "born for his use," and kicks and cuffs are held in terror over him. The tyrant is the superior, and the little one is called a "cad." In some instances, blows and kicks are given gratuitously, for the mere pleasure of physical exercise and love of torture. It is said that this makes boys manly. So it does, in the sense that Red Indians teach boys to be manly in inflicting and bearing pain. But Red Indianism does not belong to the higher type of national character. Justice, generosity, industry, skill, humanity, self-sacrifice, and forbearance, are the qualities to be desired; and "the child is father to the man" in all these things as well as in inferior attributes.

We make laws to prevent this mischievous development of inferior attributes by grown people. Why should we not have a similar code of laws for schools? It is far easier to mould the young than the old; but to make laws effective, we must have publicity, without any false code of honour interfering. Mere tale-telling by little boys should be discouraged, but substantial complaints should be attended to. What if the thieves' code of honour could be enforced on their victims, that a man knocked down and robbed should not be allowed to complain to a magistrate, or that a physically weak man bruised by a strong opponent, should be held dishonoured if seeking redress from law? We should then come simply to a condition of private vengeance and assassination.

Can we then make a system of laws for the use of schools, and can we enforce them? Why should one boy be permitted to strike another without cause, more than we permit one man to strike another? We should make a code of morals, which are the basis of all laws—true laws of honour. To strike our neighbour, save in self-defence, is a cruelty and oppression. To call our neighbour names is a libel. To take and use our neighbour's property without his permission is a theft. To impede him in the exercise of his task is an injury; and to all these things there should be adjudged corresponding penalties. Young minds would absorb and be possessed by these laws, far more effectually than is the case with grown people—they would grow up in them as a habit to be continued in after life.

Who then is to be the judge? The schoolmaster!—the veritable master!—not the mere crammer of knowledge. The schoolmaster should have the faculties of a legislator, or he is not fit for his post. He should not be a mere dictator; he should be a judge, presiding over a jury consisting of schoolboys. There would be an end of all talebearing when fair complaints could be instituted and verified by trial, and there would be very few complaints when the evildoer came to be arraigned and condemned as a criminal law-breaker. It is hard on the oppressed boy; it is still harder on the oppressor, who is suffered to grow up in evil practices, and be punished in manhood for the faults of a neglected youth. Could such a system be established in our schools, we should become truly a law-abiding people, trained to obey laws the reason of which we could comprehend. This would be education in its highest sense; the true use of knowledge. Make such a code of laws as the boys can understand, and become emulous in obeying, and the higher instead of the lower qualities will take root and flourish.—I am, &c.,

Cosmos.

(TRANSLATION.)

Sir,—I read in the last number of the *Journal* the interesting article "On the Sanitary Principles of School Construction," and I find there expressed a wish to know something of the method of heating employed by the Chinese. I have taken advantage of the presence in Paris of two of my friends, who have been consuls in China, to question them on this subject, and I give below a *resumé* of what they have told me.

In the south of China they only make use of a brasier (*brasero*), the inconvenience of which is too evident to need being dwelt upon. The Chinese, besides, protect themselves from cold rather by the addition of clothing than by fires. In the north, however, they warm themselves by fire, but in a manner which will not bear comparison with European plans. In every house they have an arrangement, constructed of brick, forming a hollow seat or couch, warmed by means of the smoke passing under it from a furnace outside. On this seat or couch the people lie. The smoke, after circulating under it, passes off by a chimney in the usual way. This system no doubt supplies heat, but the air is stifling, and the heat is difficult to regulate. It appears to my informants to be injurious to health.—I am, &c.,

Dr. Leon Soubeiran, Honorary Corresponding Member of the Society of Arts.

Paris, November 7, 1871.

THEORY OF COLOUR.

Sir,—In attempting to show that certain conceptions and statements in reference to the science of colours which are commonly accepted as true are totally at variance with the generally accepted theory, I am not prepared to assert that the undulatory theory, as at present conceived, is adequate to explain the mechanical process by which the various sensations of colour are produced in the eye. It may be hereafter discovered that to the present conception of lateral flexion or vibration we shall have to superadd that of an action of condensation and rarefaction, as in the waves of air producing sound, *i.e.*, an alternate action and re-action in the direction of the ray; but even then, the vulgar notion of rays passing or travelling through substances, the prism included, would be entirely at variance with the accepted theory.

The denial of the old notion of primary and secondary colours is a legitimate consequence of accepting the wave theory. Leaving, therefore, the science of colour to be determined by ocular experiments, we are at once divested of that ancient impedimenta to the pursuit and clear comprehension of the physical section of the theory —the dynamics of undulatory action. Now, besides the denial of primary and secondary colours, there is another logical deduction from the main theory, viz., that if colours be sensations produced by waves of different periodicity, every different sensation of colour must be produced by a different wave period, and therefore that there must be a gamut of periodicity of every possible wave proportion, and between a certain maximum and minimum. Let this gamut and the maximum and minimum limits be represented, for the sake of argument, by the following series:—

0 1 2 3 4 5 6 7 8 9

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Mean 4½

In this series we shall perceive that there are five pairs of complementary terms, of which the sums are equal, viz., $5 + 4 = 9$, $3 + 6 = 9$, $2 + 7 = 9$, $1 + 8 = 9$, $0 + 9 = 9$, one term of each pair being as much in excess as the other in defect of the mean 4½. We shall presently see what bearing this calculus has upon the subject.

The present supposition is, that the simultaneous action of all the rays of different wave periods composing a beam on the elementary portions of the retina produces the sensation of whiteness; but, as a natural consequence of such a conception, there would be a certain arrangement and configuration of the rays in every beam. The vulgar notion, however, of a bundle of rays vibrating side by side, analogous in their placement to a skein of different threads, has no warranty in the phenomena of the spectrum; but the difficulties which beset us on every side, when we attempt to reconcile the vulgar notion regarding the composition of a beam producing the sensation of whiteness, are at once dissipated; if, instead, we conceive an external uniform vibratory action, and that this uniform wave period is resolved, broken up, into various wave periods by the prism, is it more difficult or unscientific to conceive this neutral or uniform vibratory action as existing externally, instead of produced and existing within ourselves? Whether this neutralisation occurs within, or external to the eye, the fact that it does occur is necessary even to the popular conception of the subject, and some of our store of accumulated facts do appear to support this novel conception of an external wave of uniform period being bifurcated at every point of the prism, and differentiated into two wave periods, the complements of each other, producing, when reunited, the sensation of whiteness. Let us revert to the series of numbers used as analogy and illustration, and let 9 represent the value of the initial wave producing the sensation of whiteness; then we should have five pairs of complementaries, 5 and 4, 6 and 3, 7 and 2, 8 and 1, 9 and 0. Now, we do find that certain binary combinations in the prism produce the sensation of whiteness. But the greater and more convincing facts, at present, to the truth of our conception, are to be obtained from the polariscope, and from the internal evidence of the phenomena of vision, in those of the ocular spectra; for instance, we find that every sensation of colour produced by external action is succeeded by a spectrum of its proper complementary colour, caused by a compensatory nervous reaction. This is convincing evidence that the infinite series of colour sensations may be linked in compensating pairs. But to this we also add important evidence derived from external experiment with the polariscope. For an experiment on chromatic polarisation, it is conceivable that plates of selenite might be so graduated in thickness that they would produce the entire series of complementary waves in those pairs which produce the sensation of whiteness, and separately every possible sensation of colour. Different refrangibility is a gratuitous assumption, and at variance with constancy in mechanical action. The elongation of the spectrum may, I firmly believe, be far more consistently explained, did space permit. My new conception would tend to show that the equilibrium of nervous vitality and of physical vibratory action are restored upon a similar principle to that I have illustrated by an arithmetical series.—I am, &c.,

W. Cave Thomas.

COLOUR VISION.

Sir,—Whilst approving generally of Mr. Benson's remarks in the *Journal* of the 17th inst., I beg to protest against his applying the term "blue" to what has hitherto been called "violet." I say it is not yet by any means decided how many colour sensations there are respecting which the term "primary," or some term corresponding thereto, may be applied, nor what precise colour sensations should be called simple or primary. I have produced continuous mechanical or rotation spectra from various triplets of simple colours, showing perfect gradation of shade; and the most brilliant and complete or satisfying to my eyes has been obtained with scarlet, green, and violet, by which last term I mean what many would term a bluish violet. In this spectrum, which is a complete circle, what I call yellow, blue, and purple occur in the intervals between the scarlet, green, and violet. In the purple one seems to appreciate violet (or blue) and red as each present, though conjoined; but in the middle yellow tint there is no suggestion of either red or green, although it is actually produced from them. As in the case of the yellow, there is between the green and the violet a middle tint, which suggests neither of its actual components, and if we are not to call this tint "blue" we must have some new name for it. I do not consider ultramarine to be a pure blue, although recent specimens of the artificial article have less red in them than in what was formerly made; but if its colour was really pure, it would not, as it does, look redder by gaslight than by daylight. The very large preponderance of yellow (or green and red?) in the purest daylight must very much affect the sensitiveness of the eye and its appreciation of colour.—I am, &c.,

Edmund Hunt.

Glasgow, 18th November, 1871.

BORING WITH A STREAM OF SAND.

Sir,—The interesting science note on boring holes by a stream of sand, on page 19 of last week's *Journal*, naturally raises the question whether this valuable discovery might not be turned to account to drill rocks, for blasting in quarries, tunnels, and the like, especially where water-power can be had to any extent, as in the case of the proposed St. Gothard Tunnel. I should be happy if this brief suggestion could induce those who have the opportunity to try the experiment.—I am, &c.,

T. T.

NOTES ON EDUCATION.

Education of Girls.—In a letter to the *Times* on this subject, Mrs. Grey, says, that "it has been proved on the authority of the Schools Inquiry Commission, that whatever may be the deficiency and the defects of the means of secondary education provided for boys, those for girls are very much worse. The tables published by the Commissioners show that there are, in the whole of England and Wales, only 14 endowed schools for the secondary instruction of girls, with a total of 1,113 scholars, against 820 for boys, with a total of 36,874 scholars, exclusive of the Charterhouse, Merchant Taylors', St. Paul's, Westminster, Winchester, Harrow, Eton, Shrewsbury, and Rugby Schools, with a total of 2,966 scholars. If these schools be added to the number given above, the total net income of the endowments for boys, including exhibitions, amounts to nearly £277,000 a-year, while the income of the endowments for girls appears to be under £3,000. Again, the same tables show that there are in England and Wales 86 proprietary schools for boys against 36 for girls." The writer goes on to say, that thus the larger proportion of girls of the middle-class are necessarily sent to "private adventure schools," in reference to which she quotes the report of Mr. J. G. Fitch, one of the Assistant Inquiry Commissioners, who says that, in the district to which he was appointed, he visited 125 girls' schools, and he considered it a fair statement of the case that of these schools five were very good, 20 middling, and the remaining 100 very bad. In conclusion, Mrs. Grey advocates the establishment of superior schools and colleges for girls, similar to those now existing for boys.

Earl Russell and the Education League.—Lord Russell has addressed a letter to Mr. George Dixon, M.P., expressing admiration of his speech at the meeting of the League on the 17th October, and adding:—"If I understand it rightly, the League insist that 'all schools aided by local rates shall be unsectarian,' but not that they should be secular. If I am right, I should wish to join the League, and subscribe £10 a year to its funds till its objects are attained." In his reply, Mr. Dixon says:—"We have always refrained from using the word 'secular,' believing that 'unsectarian' more accurately expressed our meaning. We have never advocated the exclusion of the Bible from the national schools by Act of Parliament; but we have expressed our opinion that, in order to insure the unsectarian character of the teaching in the rate schools, it would be advisable that the Bible, when read, should be read without note or comment." Upon receipt of this letter, Lord Russell replies that he has no hesitation in joining the League, and adds:—"I am not of opinion that the Bible, when read, should be read without note or comment; but I think this is a point of so much difficulty, and there is so much danger of slipping into sectarian comments on the part of teachers, that I do not wonder at the opinion expressed by the League. My wish and hope is that the rising youth of England may be taught to adopt, not the Church of Rome or the Church of England, but the Church of Christ. The teaching of Christ, whether dogmatic or not, is to be found in the Bible, and those who in their infancy read the Bible may, at their own choice, when they reach the age of 15 or 16 years, follow the teaching of the Church of Rome, or of any Protestant community they may prefer. In this manner Christianity may in time be purged of the corruption which, in the course of time and amid the conflicts of the 16th and 17th centuries, have stained its purity, and perverted its spirit of love and charity."

Sanitary Arrangements in Schools.—At the meeting of the London School Board, on the 15th instant, Mrs. Anderson moved—"That it be an instruction to the Works and General Purposes Committee to appoint a sub-committee to see to the necessary sanitary arrangements in the Board schools." The principal point insisted on in Mrs. Anderson's speech was, an abundant supply of air, the amount mentioned as necessary for each child being 800 cubic feet. Professor Huxley, in speaking upon the motion, said he was anxious that there should be no misconception as to this statement. Everything, of course, depended upon whether the child was to have that 800 feet all at once, or was to get it by the passage of air through the room, for if the 800 cubic feet was to be had all at once, and if every child was to have a square yard to stand upon (which was more than was usually allowed), then the room must be ninety feet high, to allow of the quantity of air being in the room in that proportion. If, however, the quantity of air was to be obtained by a current passing through the room, he took it that every requisite condition would be supplied. Ultimately Mrs. Anderson expressed herself willing to place the question in the hands of the Works Committee.

Music Teaching and the New Code.—Mr. Curwen, Principal of the Tonic Sol-fa College, has received a letter from the Education Department, to the effect that if none of the recognised staff of teachers employed in a school are qualified to give instruction in music, there will be no objection to the managers obtaining the assistance of a special teacher of the subject. Such teachers need not hold one of the certificates of this department, and will not be counted as part of the school staff." This notice, says the *Tonic Sol-fa Reporter*, is an exceedingly important one, in the present crisis of musical education in England. The schoolmasters are required to teach singing. But they reply, "We were not required to understand singing ourselves when we took our certificates. Is this fair?" Such a difficulty must arise whenever singing is introduced in the schools of the nation. It cannot be removed by lessening the singing acquirement down to nothing, and making it a *fiasco*. But it can be removed by allowing other teachers to come in for the purpose. School Boards and committees can now easily find music teachers in every town and village.

Educational Statistics.—From the report of the Education Department for 1870-71, it appears that in the year ending the 31st August, 1870, 10,214 day-schools were inspected, on the registers of which were 493,507 scholars under 6 years of age. 1,257,969 from 6 to 12, and 197,550 over 12 years. In England and Wales there are 14,881 parishes separately maintaining their own poor; in the metropolitan district there are 192; in the city of Oxford 19, and in the municipal boroughs 826. After allowing for the numerous cases which will probably occur of the union of one or more parishes into one school district, it may be inferred that when the Act is generally adopted throughout the country, there will be upwards of 14,200 parish boards alone.

NOTES ON ART.

A new process of ornamentation, under the name of *Xylotechnography*, was exhibited and attracted attention in the exhibition at South Kensington. The process is, in fact, staining by hand or stencil, a light-coloured, but not necessarily soft, wood with certain transparent colours, producing a result when polished similar to inlaying. It is not necessarily deceptive and seems to be capable of a distinctive style of decoration. The process is, it appears, patented by Messrs. Trollope and Sons, and it belongs to that branch of art which may be denominated the economic decorative. In some remarks made by Mr. W. B. Scott, in his report on miscellaneous art at the exhibition, he says, alluding to economy:—"Whatever simplifies the executive, and brings the designer into contact with the object to be decorated, and so unites in his hand the offices of artist and workman, is of value and importance. We are quite certain, moreover, that expensive processes in the arts throw the production out of the æsthetic, and into the commercial category. The appraisable value becomes that of labour and material, not that of design and beauty. Price, besides, is of fundamental importance in the spread of refinement, and where machinery, luckily, cannot be applied, any simpler and more direct executive means deserve attention."

Referring to the recent exhibition at the Mansion-house of articles in wood-turning, mentioned in a recent *Journal*, a suggestion has been made that the Turners' Company should further develop the art of turning, by getting some first-class designs of work required for various purposes, each candidate for the prize being obliged to produce two copies at least of the examples. This will be calculated not only to develop dexterity in turning from drawings, which is said by a writer in the *Builder* to be an accomplishment possessed but by few workmen in the trade, but it will be the means of improving the art workmanship, by bringing good designs to the intimate notice of the workmen. At the same time, every encouragement should be given to develop the originality of each workman; and as this movement of the Turners' Company has been successfully responded to, they may see fit to modify or enlarge their previous offer, and offer two medals, one on the same terms as last year, and one for the best work executed after a specified design.

The Parisians have set to work quickly to restore the heavy damage done to the out-door works of art. The restoration of the column of the Place Vendome is being carried on with rapidity. The injured bronzes have all been restored, and a tablet, commemorating the restoration of the Column, has been prepared. The statue of Napoleon will be replaced on the summit, and the column will be completed, it is said, by March, 1872. The works for the repair of the monuments on the Place de la Concorde are being carried on rapidly, and will probably be terminated by the end of the month. The fountain nearest the bridge is entirely demolished, the parapet of the basin, the bronze tazze, and the tritons and sirens having suffered severely from the firing on the entrance of the troops. The statues around the square also received some injury during the attack on the barricades at the end of the Rue de Rivoli and St. Florentin. Scaffoldings are erected around those of Marseilles, Bordeaux, Nantes, and Lyons, while that of Lille, of which only the lower part remained, has its pedestal surmounted by a sort of hut, to shelter the sculptor engaged in restoring it. The stone balustrade around the place had been also damaged, but is now completely repaired.

The Austrian Museum and Classes for Art and Industry was opened to the public at Vienna on the 4th inst. Eight years ago, Professor Von Eitelberger succeeded in interesting the Emperor, the aristocracy, and the clergy —the three most potent factors of the Austrian Empire —in the scheme for the advancement of art and industry, by means of a permanent museum in the capital; a provisional exhibition was arranged in the "Ball-house;" and, four years later, a system of art-classes was added to the institution. The Emperor then presented the site out of the privy purse; and, in 1868, Professor H. R. Von Ferstel was able to commence the building, which has just been completed, at a cost of £770,000, of which £12,000 was expended in internal decoration. The walls are of brick, with the exception of the external plinth and the main entrance, which are of "Wollerstorf" sandstone, and the mouldings round the window openings, which are of "Margarethen" stone. Internally, the thirty-two columns supporting the gallery round the central court have monolith granite shafts, and the corner piers are in Wollerstorf sandstone, but all other ornamental portions, such as capitals, bases, cornices, balusters, and even hand-rails, are in a red marble, obtained from the neighbourhood of Salzburg. The floors of the courts are asphalted, those in the rooms and galleries are of oak. The walls are richly decorated in stucco lustro, and frescoes will be added to those in the central hall. The style of the building is bold Renaissance, with large semi-round window heads on the ground-floor, and smaller coupled ones over; a frieze in *sgraffito*, enlivened by medallions in glazed Della Robbia ware, runs round the entire building at the point where the first-floor commences; this again occurs above the side wings, and more Della Robbia medallions are introduced in the spaces between the windows.

The value of the elements of Indian art in moulding English style has been commented on by Mr. Hyde Clarke in a recent number of *Art*:—"There are few things which are more national, in anything which is English, than a reference to our Indian empire, the interests of which now more deeply engage our Parliament and the public. An Indian detail, a panel of Indian style, if properly treated, would not be irrelevant; but, as said, truly characteristic. India is related to our national history, as is that New England in the western world which is so much like our own that it yields us few emblems. India, on the other hand, provides for us bountiful illustrations, derived from ancient civilization, having common ancestry with our own archetypes of art, affording sufficient means of contrast and sufficient symmetry for union. In India we sometimes introduce for special purposes good combinations of local styles with western treatment, and these become typical of the English epoch. At present, it is rather the silversmith, who in some presentation plate avails himself of such reference, than the general artist. There is a luxuriance in Indian panelling, in fretwork, in filagree, in shawls, a richness and harmony of colours in carpets and in stuffs, which has been well recommended to our designers, and why not to those practising higher art? A more liberal culture of Indian art would bear other fruits. Morally, it would do great good by bringing India more before us, which ever requires attention, and is in danger of being lost by simple neglect. The consumption of our manufactures would be promoted by a better acquaintance with the treatment of the Indian styles. There is many a public building where an Indian window, or iron work in Indian treatment, might be introduced. The many returned Indians would take an interest in such subjects, while those natives, now coming more freely, and it is to be hoped to arrive in crowds, would find some trace of sympathy, instead of all being strange. A freer use of Indian methods in carpets, furniture, fabrics, and wall-papers would tend to familiarise the application in larger works and greater structures.

Mr. Rothschild, of the Rue des Saints Pères, Paris has commenced publishing, in large folio numbers, a magnificent work upon the Trajan Column at Rome. A complete series of mouldings was executed in 1862, by order of the Emperor, for the Louvre Museum. A cast was taken of these mouldings in galvano, by the Procédé Oudry, and from these casts phototypographic plates have been done. There will also be many woodcuts interspersed through the work. The letterpress will be by M. W. Froehnor, the conservator of the Louvre Museum. It will be finished in 1873.

A complete collection of the etchings by Mr. Samuel Palmer, an English master in the art, will shortly be added to the Print-room, British Museum, as a gift from the artist.

Of paintings now to be seen in London, there is a collection of cabinet pictures in oil at the Dudley Gallery; the Loan Exhibition of High-class Water-colour Drawings, which was opened on the 16th ultimo, at the Institute of Painters in Water-colours, where, on the walls, will be found contributions from the pencils of J. M. W. Turner, David Cox (elder and younger), Copley, Fielding, Prout, Palmer, Duncan, Birket Foster, Rosa Bonheur, Burton, Prout, Sir Edwin Landseer, Mulready, J. F. Lewis, F. Tayler, F. W. Topham, J. D. Watson, and D. E. Rosstti—the proceeds of this exhibition are devoted to the National Hospital for Consumption and Diseases of the Chest—it will close at the end of November; at the French gallery, the exhibition of the present winter contains 208 pictures. The Munich and Düsseldorf schools, rather than those of Flanders and of France, furnish the greater portion of the contents, although English pictures are hung side by side with German paintings on the walls. There are also novel illustrations of English scenery by German artists.

It may be mentioned that the Royal Academicians intend to form the third exhibition of pictures by old masters and deceased British artists in their galleries in January next. There will be a large collection of the works of Reynolds and Gainsborough.

A further application of the steam sand-jets, described in the Notes on Science in the last *Journal*, to purposes of art, has been discovered by the inventors, in Philadelphia. They now use it for wood-engraving, the decoration of marble, and the cleaning of brass castings. From the description above referred to, the way in which a pattern can be produced on the surface of marble may be easily imagined, as also the cleaning of the cast metal; but as regards the wood-engraving, particulars have not yet been published. So far, however, as is known, a photograph of the scene or object required is taken on the wood-block, and this being placed, with certain precautions, in front of the jet, is speedily engraved. It is said that specimen engravings will shortly be published, which will give to artists and others opportunity to judge of the merits of the process.

GENERAL NOTES.

Colliery Disasters.—Mr. Hermon, M.P. for Preston, has offered to give £200 to the authors of the two best essays on the prevention of colliery disasters. Miners are invited to compete, and it is expressly stipulated that the decision of the arbitrator shall not be influenced by bad spelling or phraseology.

Suez Canal.—The receipts of the Suez Canal for the past month of October were 1,263,058 francs, against 554,183 francs for the corresponding period of the past year. In October of the present year 79 ships passed through the Canal; in October of last year the number was 39.

Land in New South Wales.—At the present time, and according to the existing laws, a man may pick out not less than 40 nor more than 320 acres of the best land in the country, at the nominal rate of £1 per acre, on certain conditions. He must pay down, at the rate of 5s. per acre, a price which, in some instances, is scarcely sufficient to pay for the survey, and the connection by survey of the situation with some other purchased land. The government, which pays large interest on its loans, permits the selector to withhold the remainder of the purchase-money for three years without interest, and for ever at an interest of 5 per cent. Conditions of residence and improvement, however, must be certified to by the selectors, and they must pay up their balances before they can obtain the fee-simple. Under this system a large number of people have taken up land. Some are doing a good work; some have made homes for themselves under the new Act, and a large quantity of land has been taken up by squatters, and men who were previously occupied in agricultural pursuits, and who had then more land than they could cultivate.

Revenue of Victoria.—The following table shows the the revenue of the colony for the year ending 30th June, 1871:—

Customs.		
Spirits	£445,830	
Wine, beer, and cider	53,938	
Tobacco, snuff, and cigars	140,509	
Tea, sugar, molasses, and coffee	189,242	
Other duties	518,644	
		£1,347,138
Excise.		
Spirits diluted in Victoria	£32,015	
Licenses	17,292	
		49,307
Territorial.		
Proceeds sale	£250,281	
Receipts for purchases	136,581	
Pastoral occupation	83,480	
Rents of licenses	243,080	
Miscellaneous	35,709	
		749,131
Public Works.		
Railway income	£546,148	
Water, telegraphs, &c.	107,613	
		653,761
Ports and harbours		16,483
Postage		125,371
Miscellaneous		181,192
Total revenue		£3,122,383

The St. Gothard Railway.—The works of this important railway will be very shortly commenced. The tunnel will be about the same length as that of Mont Cenis. The capital necessary for the construction of the tunnel is about 50 millions of livres, and that required for the junction of the new lines with the existing Italian and Swiss Railways will amount to 125 millions. Germany, Italy, and Switzerland have already voted subsidies, amounting to 85 millions, and the balance will be provided by a syndicate, by an issue of bonds and shares, the bonds bearing interest at 5 per cent. It is calculated that the whole of the works can be finished in eight years. The completion of this important work will put Italy in direct communication with Switzerland and Germany.

The Sugar Plantations in Queensland continue to give promise of very satisfactory returns. There are now eleven distilleries in the colony in full work. The total yield of sugar, during the past crushing season, was 2,854½ tons; the quantity of sugar imported during the same period, 2,090 tons; thus showing that the production is not yet equal to the demand. There were 76,311 gallons of rum placed in bond during 1870, of which 35,379 gallons were exported. The total average yield per acre for the cane crushed during 1870, was 1 ton 6 cwt. 0 qrs. 10 lbs. The Inspector of Distilleries states in his report that there is a prospect of a large increase in the areas of land under cane during the present year, especially in the northern districts, and that he estimates the crop of the season, to end of March, 1872, will be 3,750 tons of sugar.

Manufacture of Beer in the Austro-Hungarian Empire.—A pamphlet recently published by Herr Noback, of Prague, says that the total number of breweries in the Cisleithan provinces, which in 1860 were 2,794, in 1869 were only 2,471, and that, in spite of this falling off in the number of breweries, the annual production had increased from 11,495,723 eimers* to 13,984,132 eimers. Bohemia alone produces 5,650.085 eimers; Lower Austria, 3,435,953 eimers; Moravia, 1,463.310; the provinces on the Adriatic coast, 2,692. In Hungary, Transylvania, Croatia, and Slavonia, there were, in 1869, 318 breweries, producing 989,532 eimers; and in the frontier provinces, 31 breweries, producing 51,154 eimers. The total production of beer throughout the whole empire was 15,024,818 eimers, and the number of breweries 2,820.

Decimal Coinage.—The British Branch of the International Decimal Association has addressed a circular to the German Government, in which regrets are expressed that, in the scheme for the proposed reform of the German coinage, a new unit is adopted which is directly at variance with the recommendations of the International Statistical Congress held at Berlin in 1863, and with those of the International Decimal Association, which, at its meeting in 1867, resolved that it was advisable for international purposes that a single standard should be adopted in all countries, and that this standard should be gold; and that, considering the extensive use of the decimal system, and the time and labour saved in computation, the unit of money value in all countries should be decimally subdivided. While the International Decimal Association rejoices at the disposition of the German Government to introduce a gold coinage, yet it is of opinion that a single standard cannot be realised unless regulations are made to retain the others for subordinate coins only. None of the proposed gold coins offer any point of agreement with the pound sterling or the 25-franc piece. The 20-mark piece, which comes nearest, is less valuable than either. The mark, or the third of a thaler, is, in the opinion of the British branch of the International Decimal Association, too small a unit for the present requirements of commerce, and neither a good unit for reckoning, nor identical with any coin of other countries. Between the gold coins of 5, 6, 2, 3, and 10 thaler pieces, and between them and the silver coins, there is no true decimal connection.

Trees in Victoria.—Recent explorations show that the great Australian trees exceed in height, though not in circumference, the giants of California, though some of the Australians must be regarded as very respectable in girth as well as height, the hollow trunk of one of them being large enough to admit three horsemen to enter and turn without dismounting, while they led a fourth horse. A fallen tree, in the recesses of Dandenong, Victoria, was measured not long since, and found to be 420 feet long; another, on the Black Spur, ten miles from Healesville, measured 480 feet. The highest trees on the Sierra Nevada, California, yet discovered, reach only 450 feet, the average size being from 300 to 400 feet in height, and from 25 to 34 feet in diameter. The wood of these trees closely resemble red cedar, and the reddish-brown bark is sometimes 18 inches thick, and the age of some of the oldest has been computed at 2,000 years.

Native Meteoric Iron.—A letter from the Embassy at Copenhagen, transmitted by Earl Granville, was read at a recent meeting of the Geological Society. It mentioned that a Swedish scientific expedition, just returned from the coast of Greenland, had brought home a number of masses of meteoric iron, found there upon the surface of the ground. These masses varied greatly in size; the largest was said to weigh 25 tons. Mr. David Forbes having recently returned from Stockholm, where he had the opportunity of examining these remarkable masses of native iron, took the opportunity of stating that they had been first discovered last year by the Swedish Arctic Expedition, which brought back several blocks of considerable size, which had been found on the coast of Greenland. The largest, weighing more than 49,000 Swedish pounds, or about 21 tons English, with a maximum sectional area of about 42 square feet, is now placed in the hall of the Royal Academy of Stockholm; whilst, as a compliment to Denmark, on whose territory they were found, the second largest, weighing 20,000 lbs., or about 9 tons, has been presented to the Museum of Copenhagen. Several of these specimens have been submitted to chemical analysis, which proved them to contain nearly 5 per cent. of nickel, with from 1 to 2 per cent. of carbon, and to be quite identical, in chemical composition, with many aërolites of known meteoric origin. When polished and etched by acids, the surface of these masses of metallic iron shows the peculiar figures or markings usually considered characteristic of native iron of meteoric origin. The masses themselves were discovered lying loose on the shore, but immediately resting upon basaltic rocks (probably of miocene age), in which they appeared to have originally been imbedded; and not only have fragments of similar iron been met with in the basalt, but the basalt itself, upon being examined, is found to contain minute particles of metallic iron, identical in chemical composition with that of the large masses themselves, whilst some of the masses of native iron are observed to enclose fragments of the basalt. As the chemical composition and mineralogical character of these masses of native iron are quite different from those of any iron of terrestrial origin, and altogether identical with those of undoubted meteoric iron, Professor Nordensckjold regards them as aërolites, and accounts for their occurrence in the basalt by supposing that they proceeded from a shower of meteorites which had fallen down and buried themselves in the molten basalt during an eruption in the miocene period. Notwithstanding that these masses of metallic iron were found lying on the shore, between the ebb and flow of tide, it has been found, upon their removal to Stockholm, that they perish with extraordinary rapidity, breaking up rapidly and falling to a fine powder. Attempts to preserve them by covering them with a coating of varnish have as yet proved unsuccessful; and it is actually proposed to preserve them from destruction by keeping them in a tank of alcohol.

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* The Austrian eimer = 12·45 gallons.

Canadian Gold Fields.—Mr. Lindsay D. Simms, of Fort Garry, says the *St. Paul (Minnesota) Press*, who has just reached St. Paul, from Manitoba, brings information that intense excitement prevailed in Winnipeg, over recent gold discoveries at Lake Shabondawan. Many specimens of gold dust nuggets and gold-bearing quartz had been brought to Fort Garry, and hundreds at once repaired to the scene of the discoveries. The government of the Dominion of Canada is engaged in establishing a road through the country, between Fort William, on Thunder Bay, and the settlements of Red-river Valley, but all work on this thoroughfare has been entirely suspended, the workmen, to the number of several hundreds, having dropped their shovels, picks, and axes, and emigrated in a body to the gold-fields, where they were washing out with their hands four dollars a day and upwards. The early explorers of a route through the British Possessions discovered gold and silver in this vicinity, and later investigations have shown that vast deposits of minerals are to be found along both shores of the great lake. Lake Shabondawan lies about 40 miles due west from Fort William, and at least 400 miles from Fort Garry. This lake is only about ten miles in length, and but two or three in width, and forms one of many small bodies of water in that section. It is bounded on the south and west by a mountainous and broken country, through which flow several small and rapid streams. Lake Shabondawan is but a short distance from Silver Islet, in Lake Superior, said to be the richest silver mine in the world, and not over 150 miles distant from the copper-mines of Ontonagon. There are, therefore, reasonable grounds for believing that these discoveries may prove to be as valuable as they are reported, and that the extensive prospecting of experienced gold-hunters, which is sure to follow, may yet develop mineral resources north of Lake Superior as vast as those which have attracted hundreds of thousands of people to the western slopes of America and the islands of the Pacific.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

November 29.—"On Tramways and their Structure, Vehicles, Haulage, and Uses." By W. Bridges Adams, Esq. On this occasion Charles Hutton Gregory, Esq., will preside.

December 6.—"On Sewage as a Fertilizer of Land, and Land as a Purifier of Sewage." By J. Bailey Denton, Esq.

December 13.—"Observations on the Esparto Plant." By Robert Johnston, Esq.

December 20.—"On the Study of Economic Botany, and its Claims Educationally and Commercially Considered." By James Collins, Esq.

CANTOR LECTURES.

The First Course of Cantor Lectures for the ensuing Session will be "On the Manufacture and Refining of Sugar," by C. Haughton Gill, Esq., and will consist of four lectures, to be delivered on the following Monday evenings:—

Lecture 1.—Monday, November 27.

Sugar from "cane" and from beet-root is the same—Exists dissolved in water in the plant-cells—Some bodies can pass through moist water-tight membranes—Diffusion—Colloids and crystalloids—Solubility: limits of in cold and in hot water—Crystallisation from hot saturated solutions on cooling—Phenomenon of super-saturation—Evaporation—Boiling—"Boiling point"—Boiling point dependent on pressure on liquid—Solutions of sugar boil at higher temperature than water.

Lecture 2.—Monday, December 4.

Properties of sugar—Its ready decomposibility—Action of a high temperature—Action of dilute acids—Conversion into grape and fruit sugars—Other varieties of sugar; their properties—Winning of cane juice by rollers—Rough evaporation in open pans, and consequent destruction of sugar.

Lecture 3.—Monday December 11.

The sugar-beet—Extraction of juice by diffusion and by presses — Defecation — Carbonation — Preliminary filtration — Concentration — Refiltration — "Boiling" — Separation of syrup from crystals—Treatment of Syrup — Second and third products — Molasses — Nature of molasses—Difference between molasses from cane and beet—Estimation of the value of raw sugar.

Lecture 4.—Monday, December 18.

The refining of sugar, the complete cleansing of it—Melting or blowing up—Filtering, charcoaling, boiling, filling out, draining, liquoring, stoving—Utilisation of syrups—Treacle.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose have been issued.

INDIA COMMITTEE.

A Conference will be held on Friday evening, December 1st. Lieut.-Colonel A. Romaine Wragge will open a discussion on the subject of "Indian Forests and Indian Railways."

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lecture. Mr. C. Haughton Gill, "On the Manufacture and Refining of Sugar."
Social Science Association, 8. "On the Desirability of Re-introducing the Endowed Schools Bill. Part II."
London Institution, 4. Prof Huxley, "Smell, Taste, and Touch." (Course on Elementary Physiology).
Royal Geographical, 8½. 1. Capt. R. F. Burton, "Exploration of the Volcanic Districts east of Dasmacus." 2. Baron de Maltzan, "Journey in Southern Arabia."
Medical, 8.
Actuaries, 7. Mr. A. H. Bailey, "On Insolvency of Life Insurance Companies."

Tues. ...Royal Medical and Chirurgical, 8½.
Civil Engineers, 8. 1. Further Discussion "Pneumatic Despatch Tubes." 2. Mr. William Bell, "On the Stresses of Rigid Arches and other Curved Structures."
National Union for Improving the Education of Women of all Classes, 4. Central Committee Meeting, at 18, Cadogan-place.

Wed.....**SOCIETY OF ARTS, 8.** Mr. W. Bridges Adams, "On Tramways and their Structure, Vehicles, Haulage, and Uses."
Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."
Archæological Association, 8.

Thurs...London Institution, 7½. Mr. P. L. Simmonds, "Science and Commerce: illustrated by the Raw Materials of our Manufactures."
Royal, 4. Annual Meeting.
Antiquaries, 8½.

Fri.......**SOCIETY OF ARTS, 8.** India Conference. Lieut.-Col. Wragge, "Indian Forests and Indian Railways."
Philological, 8¼.
Archæological Institute, 4.
Geologists' Association, 8.

Sat... ...Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."

Journal of the Society of Arts.

No. 993. Vol. XX.

FRIDAY, DECEMBER 1, 1871.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, November 29th, 1871; Edwin Chadwick, Esq., C.B., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Biggs, S. H., Nuthurst, near Horsham.
Cole, Alan Summerly, South Kensington Museum, W.
Cole, Lieut. Henry Hardy, R.E., 10, Gloucester-terrace, Kensington, W.
Ellison, C. O., Adelphi Bank-chambers, South John-street, Liverpool.
Nunn, T. W., M.R.C.S., 8, Stratford-place, W.
Straight, Douglas, M.P., 1, Cloisters, Temple, E.C.
Thomson, T. D., 21, St. Augustine-road, Camden-town, N.W.
Zimmermann, F.A., 7, Fen-court, Fenchurch-street, E.C.

The following candidates were balloted for, and duly elected members of the Society:—

Armitage, William, Meal-street, Manchester.
Baggallay, John, Bridewell Royal Hospital, New Bridge-street, E.C.
Baker, Lawrence J., Haydon-hall, Eastcott, Watford.
Barker, Henry G., 15a, Grafton-street, Bond-street, W.
Beattie, Joseph, Joint Stock Bank (Limited), Birmingham.
Billinghurst, Henry, M.D., Redwood-house, Bromley, Kent.
Blackman, Rev. Edward Lewis, 29, Belsize-park-gardens, N.W.
Bluhm, Heinrich, Springfield, Lee-park, S.E.
Bolton, Major Frank, Junior United Service Club, S.W.
Breese, Edward, Morfa-lodge, Port Madoc, N. Wales.
Brocklehurst, William Coare, M.P., Butley-hall, near Macclesfield.
Brown, A. H., M.P., Richmond-hill, Liverpool.
Burstow, Edward, Horsham, Surrey.
Cantlon, Matthew, 143, Maida-vale, W.
Canton, Robert, 22 and 23, Aldersgate-street, E.C.
Carrington, Thomas, jun., F.G.S., Field-head-house, Sheffield.
Chappuis, Paul Emile, 69, Fleet-street, E.C.
Cochrane, Alexander D. W. R. Baillie, M.P., 26, Wilton-crescent, S.W.
Conrad, Herman, 4, New Basinghall-street, E.C.
Constable, George Sefton, Queen-street, Arundel, Sussex.
Dalrymple, Dr. Donald, M.P., Thorpe-lodge, Norwich.
Du Cane, Captain E., R.E., 44, Parliament-street, S.W.
Estall, Edwin Davis, 19, Sutherland-villas, Brixton, S.E.
Ferguson, William, 25, Albion-street, Leeds.
Fleming, Rev. Arthur Willis, Alfred-house, Alfred-terrace, Holloway-road, N.
Forbes, Peter, Aberdeen.
Forwood, William Bower, Hopeton-house, Seaforth, Liverpool.
Franklyn, W. Norris, Warnham-lodge, Horsham.
Fox, Thomas, Dover.
Gairdner, Charles, Union Bank of Scotland, Glasgow.
Goodall, Josiah M., 21, Fellows-road, Haverstock-hill, N.
Graham, T. B., 15, Warrior-square, St. Leonards-on-Sea.
Hart, John, Zetland-villa, Forest-hill, S.W.
Haseltine, George, 8, Southampton-buildings, W.C.
Jones, Henry, 136, Fulham-road, S.W.
Jones, William Bonner, 26, Westbourne-grove, W.
Kendal, Alfred, Oakfield-house, Dukinfield.
McMinn, Frederick A., Sandford-house, Fulham, S.W.
McPherson, Daniel, Cadiz, and 1c, King-street, St. James's, S.W.
Mortimer, Frederick, 36, Conduit-street, Bond-street, W.
Moses, Assur Henry, 34, Westbourne-terrace, W.
Offord, Thomas, 12, Philip-terrace, Tottenham, N.
Paget, Admiral the Right Hon. Lord Clarence, K.C.B., Plasllanfair, Anglesea.
Pitkin, James, 56, Red Lion-street, Clerkenwell, E.C.
Ravenscroft, Francis, Birkbeck Bank, Southampton-buildings, W.C.
Readman, George, Clydesdale Bank, Glasgow.
Richardson, William Henry, Springwell-mills, Jarrow-on-Tyne.
Saunderson, Charles, Stanmore-lodge, Kilburn, N.W.
Sclater-Booth, G., M.P., 15, New-street, Spring-gardens, S.W.
Scott, Captain Robert A. E., R.N., Portland-villas, Highgate-hill, N.
Seeley, Charles, jun., M.P., Stubbings-court, Chesterfield.
Smith, J. Moyr, 50, Walham-grove, Fulham, S.W.
Steele, James P., 13, Charlotte-street, Buckingham-gate, S.W.
Stevenson, James C., M.P., South Shields.
Stewart, George A., Braemar-lodge, Queen's-road, Kilburn, N.W.
Symons, Elias Octavius, 3, Wellington-square, Chelsea, S.W.
Taylor, George J., 12, Montague-street, Russell-square, W.C.
Thorne, Thomas H., Leamington Priors, and Warwickshire Bank, Leamington.
Veitch, Harry James, King's-road, Chelsea, S.W.
Waite, Henry, Adelaide College, Conyngham-road, Shepherd's-bush, W.
Warner, Nutford, 64, Essex-road, N.
Willey, Robert, Ludgate-chambers, 66, Ludgate-hill, E.C.
Wright, Joseph Henry, 104, Hereford-road, Bayswater, W.
Young, William, 19, Exeter-hall, Strand, W.C.

And as Honorary Corresponding Member,

Newton, Robert S., M.D., 104, West Thirty-eighth-street, New York.

The Paper read was—

TRAMWAYS AND THEIR STRUCTURE, VEHICLES, HAULAGE, AND USES.

By W. Bridges Adams, Esq.

It is now approaching a period of two years since I read in this room a paper on tramways, endeavouring to foreshadow therein the shortcomings of their proposed system, and pointing out the requirements needed. The desirability of their becoming State and municipal property was shown, together with misgivings as to any State origination, and the possibility that private companies, in the then condition of commercial ethics and governmental perceptions, would, on the whole, be a necessity, and might induce the smallest amount of waste with the greatest profit to both the community and the companies.

So far, the tramways have now been delivered over to companies, trammelled with conditions which will probably end in arbitrations, if at some future time it be found that the disputes between companies involve public inconvenience and inefficient service. As a commercial question, it is quite clear that directors must study the largest profit for their shareholders, and that they will only give in return for it as much service to the public as will prevent traffic from falling off. If a given sum is to be made annually, it will be less trouble to obtain it by a small traffic than by a large one, where no competition exists.

The tramways are popular, and, if we analyse the sources of their popularity, we find them to be threefold. First, greatly increased space for sitting and moving in the vehicles; secondly, a greater freedom from oscillation; thirdly, the larger number of passengers provided for—preventing disappointment in getting places. But, to set against these, there is the great waste and cost of haulage, not lessened but increased by the substitution of the rail for the pavement. The effect that should arise from the more even surface is neutralised by the grooves in which the wheel flanges travel; and the total resistance to traction is double that of the ordinary railway, on which the flanges of the wheels bear against only one surface with lateral freedom, while on the tram they bear on two surfaces, and act almost as a constant brake, as may be verified by the sound while riding, and the incessant vibration while in motion. There is no doubt that the ordinary omnibus, with its flexible construction, runs far more freely on the stones as regards traction, than does the tramway car on the rails; and when we come to the modern asphalte surface, which gets rid of the omnibus oscillation, the ease of movement reduces the resistance to traction nearly to the minimum. Were the interior of the omnibus as convenient as the tramway car, there is no doubt that it would be preferred.

But the rail has an advantage which the asphalte has not—automatic guidance. It would be exceedingly difficult to steer an omnibus as long as a tramway-car in sinuous courses without involving constant collisions. And, on the other hand, the tramway car, as at present constructed, has the disadvantage of not being able to leave the track when needed. It is helpless when off the rails, and constantly tends to run off when on curves, as may be seen in the process of placing the horses at an angle of forty-five degrees with the rails, in trying to keep it on.

Let us begin at the beginning. Tramways are, or should be, supplementary railways, not intended for high speeds, but filling in the links and breaks which impede free transit, and adapted for moderate speeds. Obviously, the road and street surfaces are the best adapted for their application. Upon all roads, the best and cheapest mode of transit is the first consideration. Beginning with our own feet and legs as the means of locomotion, we transferred our heavier loads to the legs of quadrupeds, till we discovered that the power of the quadrupeds could be used most economically in the haulage of wheeled vehicles, and that necessitated firm roads, and the absence of firm roads gave rise to the plank or timber tramway, gradually supplemented by the iron tram of the earlier times. As the iron tram, in its improved condition, permitted heavier loads, it was soon found that steam-power was far more economical, and capable of far greater development and utility than horseflesh.

Of all the sources of nuisance in transit through towns and along roads, horses are the worst. It is the dirt of the horses that makes them slip on asphalte as well as on stones, though the joints in the stones limit the amount of slip; and the contrivance of boys to pick up the dirt as it falls, is by no means satisfactory, albeit more cleanly. It is one of the many proofs of the force of habit, that we persist in the use of draught horses when the necessity for them ceases. If there be one advantage more than another in the use of tramways, it is to be found in their applicability to the use of steam as a tractive force. It is imagined that there must be an antagonism between a steam-engine and a horse, like a clan feud, to go on for ever, the engine being the frightener and the horse the frightened. Now, an engine may run away, as in the case of the road-roller in Pall-mall, tampered with by the boys, but it is always amenable to the turn of a handle, if the driver has wit enough to guide it; but the horse may take the bit between his teeth, in a fit of obstinacy beyond control; and even staid, respectable brewers' horses are not superior to occasional frights. Upon the whole, the horse is more mischievous than the steam-engine, eight times as costly, and far more dirty. If the legislature would look at the question fairly, giving the engine its due, as they have given horses more than their due, no long time would elapse ere we should behold the extinction of horses in our cities as instruments of drudgery by a similar process to that taking place on farms.

On a well-laid street, with a sufficient depth of solid concrete, and a surface of elastic asphalte, there would be no difficulty in applying light traction engines, always subject to the condition of steerage by hand. But to form general road surfaces in this mode would be too costly, unless in cases of a large remunerative traffic. A branch line will not bear the same outlay as a main line. Of the value of the general surface of asphalte there can be no doubt, in its freedom from blows, and noise, and dirt, other than those of the horses, but it can only be adapted for comparatively slow traffic, unless with automatic guidance.

We must, therefore, come to the rail, not necessarily in all cases, for it would be a disadvantage in narrow, crowded streets, unless the vehicles were adapted to leave the rail when needed; but for the larger and general purposes of suburban transit we possess nothing, in our present state of knowledge, comparable to the wrought-iron rail, as a smooth, even, tough, and unbreakable substance. If we are to attain this condition, we must resort to some mechanical process for obtaining a really permanent way, in the employment of our iron.

We must have such a mode of construction as will permit the laying the rails, when needed, in sharp curves, as sharp as 35 feet radius, in order to take advantage of street corners and narrow streets as easily as the existing horse omnibuses. We must also so amalgamate the rails with the road surface that they will mutually support each other, and prevent separate sinking or wear. And as rails can only be made in short lengths, the joints must be so constructed as to make them equivalent in strength to the solid portions of the rails. Now let us examine the existing structure.

A pair of timbers, some 21 feet in length, six inches in depth, and four inches in width, are laid in trenches in the road, bedded on concrete, which may or may not be solid. To keep these timbers to guage, a pair of iron castings or saddles are made to clip each timber. Into these castings a dovetailed iron bar is made to drop, keeping these timbers to a specific width. The space between and outside the timbers is packed with paving stones, or other material, to form the road surface, and enclose the rails, which are flat bars 4 inches wide and $1\frac{1}{2}$ inches in depth, a groove being rolled in their surface an inch in width and $\frac{3}{4}$ inch in depth, leaving an interior rib 1 inch in width, and an outer rib 2 inches in width, for the wheels to run on. The inner rib is notched on the surface, on the supposition that it will prevent horses from slipping, though the notches are below the general surface. A plate of iron, $\frac{1}{2}$ in. thick by 4 in. wide, is laid under the joints of the abutting rails, and iron spikes are driven into the timber, through the rail grooves, to hold them down and keep them in position.

It must evidently be a very difficult thing to lay such rails into sharp curves. The rails may doubtless be bent laterally, but the timber will maintain its right of warping, according to its structure and growth, in any direction, unless used in very short lengths, resisted, doubtless, by the paving horizontally, but not vertically. But in the act of paving, it is quite practicable and common, to burst the cast iron chairs by too tight ramming, in which case the gauge becomes irregular. The load on each small wheel of the vehicle is close upon $1\frac{1}{2}$ tons when fully loaded, and if the timber springs up and down, a constant battering of the concrete must take place below. If the paving sinks irregularly, the rail projects above it, and is exposed to the blows of crossing vehicles; the rails are subject to bend vertically between the timber and the iron-joint plates, and the result is a constant rise and fall of the joints; and the verification of Mr. Haywood's remark, that "the advent of tramways is always accompanied by a condition of bad paving," is indicated by the men constantly employed in the "maintenance of way."

As yet, the tramways are only passing through what may be termed their "baby disorders," but which will yet grow up into chronic disease, only to be remedied by the process of removal at no distant date. They are in a condition of permanent "rickets."

We come now to the vehicles. Were they fixtures, nothing could be better. They are roomy, well seated, capable of good ventilation, convenient in access and exit, and accommodate a large number of passengers, But when moving, the structure is found to be radically vicious. To move at all along the inequalities and curves of the rails with four wheel flanges fitting too closely in the iron grooves, enforces the shortening of the wheel base to the utmost. The vehicle is, with its projecting entrances, twenty-four feet in length, and the axles are less than six feet apart. If, therefore, efficient springs were used, the result would be great oscillation, far in excess of that experienced in ordinary omnibuses, and so great as to be unbearable. To counteract this, blocks of india-rubber on the axle-boxes are substituted for springs, in which the motion is very small vertically, and *nil* laterally. Oscillation is thus removed, at the cost of incessant, sharp vibration, with a constant grinding noise, and a quick jump of the wheels when they pass over a pebble in the rail groove. Any observant passenger will be familiar with this. Side-yield to obstacles there is none, and the wear of the flanges and grooves, and disturbance of the rails in their sites is incessant. Where curves are necessary, absolutely the only mode of keeping the vehicles on the rails is to set the horses at an angle, pressing the wheels inward towards the centre of the curve. To allow the flanges anything like freedom would require a groove upwards of three inches in width, and correspondingly wide tires. An omnibus, with its wheels all free, rolls; the tramway vehicle, with its wheels all fast on the axles, and of very small diameter, and its axles always parallel to each other, can scarcely roll at all; it can only be a sledge during a large proportion of the movement, and the effect on the horses tells the tale.

In seeking for improvement on the existing tramway, an obvious advantage would be gained by placing the greatest width of the rail vertical, if the existing form permitted any mode of fastening it, as we should then get the greatest strength in the direction of the load borne on it. The quantity of metal in it is quite sufficient to obtain a good form, wholly independent of timber sleepers and fastenings. It should be a deep rail, with a wide upper table, to suspend it from the surface, and a lower table, to key it into the road, and elastic fishes bolted at the side channels at the joints, forming each line of rails into a continuous bar, equally strong throughout. The best form for the rail top would be an open shallow channel with splayed edges, not needing more than a quarter of an inch in depth in the centre, and dispensing with flanges to the wheels, which would thus run as easily as cab and omnibus wheels run in the iron side gutters of the streets, and would not run out without being purposely drawn out, but could with great advantage turn out when required. Such rails, with the heads four inches wide and the stems six inches in depth, would form two back-bones to the road, in the form of iron girders, preserving an even surface, and demonstrating that bad paving is not a necessary accompaniment of a tramway, but only a consequence of imperfect structure. In laying down such rails, the simple plan is to connect each pair of bars to a pair of cross timbers at their upper surface, as a temporary guage, which timbers suspend the rails at the right level in trenches dug out sufficiently wide and deep, to run in, first, a solid mass of concrete, forming a single block, and on that an inch and a half of asphalte, an elastic and tough bedding, without brittleness or tendency to crumble away, as do hard cements. Thus, the rails being solidly fixed, require no tiebars, which may be dispensed with. A pair of rails being thus fixed, a second pair are connected to the joints by the fishes, and the temporary timber bars then moved on, to repeat the process. When curves are needed, the rails are bent laterally by the machine, either at the works or on the spot, and there would be no warp or tendency to change of form, and no points or crossings would be needed, for any vehicle would be enabled to pass in or out of the shallow channel.

The only objection to such a rail has arisen from companies, and it is a very valid one from their point of view, viz., that such a rail would offer great facilities for use by the proprietors of omnibuses, cabs, and other vehicles who have contributed nothing to the cost of the rails. But the facility for making communications from one line to another, and round street corners, and through avenues at present unavailable, would be ample compensation, if made available, greatly facilitating operations, and diminishing outlay. The improved rail is shown by diagrams of double size section (Fig. 1, p. 44).

Supposing such tramways obtained, the next consideration is, the vehicles to run on them; for it is of no use to make curves of 35 ft. radius. and vehicles only adapted to two chain radius, or 132 feet. The first condition in the vehicles is that the axles shall be capable of radiation, *i.e.*, varying from parallelism to each other to such an angle that each axle will point truly to the centre of the curve they may be traversing. This may be done, either by making the axles traverse beneath the body, or by dividing the body with a central joint, not interfering with the passage-way through it; but, when this is done, it is essential also that each wheel should revolve independently on its axle, as do the wheels of ordinary omnibuses, or the vehicle will continue to be a sledge on curves. These two points being provided for, the axles may be placed at any distance apart, to guard against oscillation, and thus efficient springs become possible, with wheels of larger and more efficient diameter. The diagram (Fig. 2, p. 44) illustrates this.

There is yet another and most important point. At present, all wheels and axles are dead weight without elasticity; the springs being above the axles and not below. What is needed is to apply the elastic principle as closely as possible to the rails. Vibration, hurtful to the health and wasteful to the mechanism, is caused by blows between the wheels and rail, but if efficient springs be interposed between the wheel and tires, the blows will disappear and the vibration also. I have for many years advocated this principle with more or less success, and, with mechanical results giving conclusive evidence in its favour. Mr. Thompson, of Edinburgh, in his advocacy of india-rubber tires, has given a valuable impulse to the extension, but the object of Mr. Thompson has been their application to traction engines, as a flattening fulcrum on the road surface, to give better adhesion. Incidentally, such tires have been found to form very efficient springs, to save the machinery from damage. But there is a disadvantage in this external application. A very large mass of rubber, both in width and depth is needed, but as the adhesive pressure is only at the apex of the circle, it is essential to apply a chain and set of iron shoes to tighten it, and this involves cost and trouble. Moreover, it is necessary to use a hard quality of rubber, not so chemically durable. The true position for the rubber, is between the wheel and

Fig. 1.

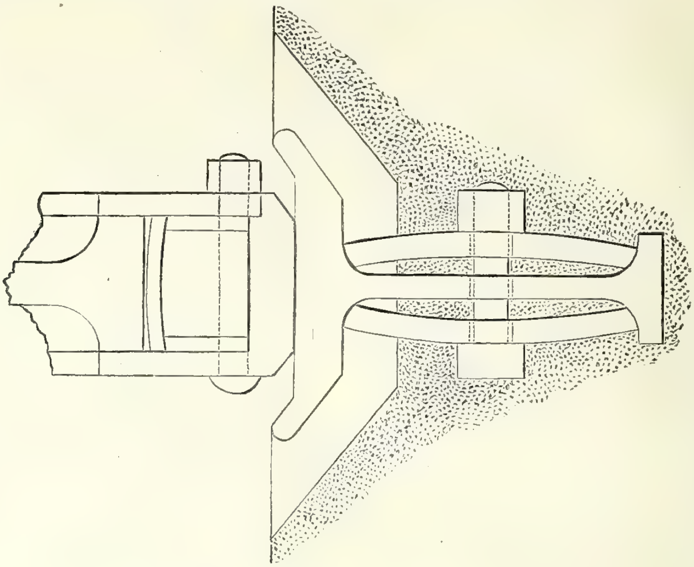


Fig. 2.

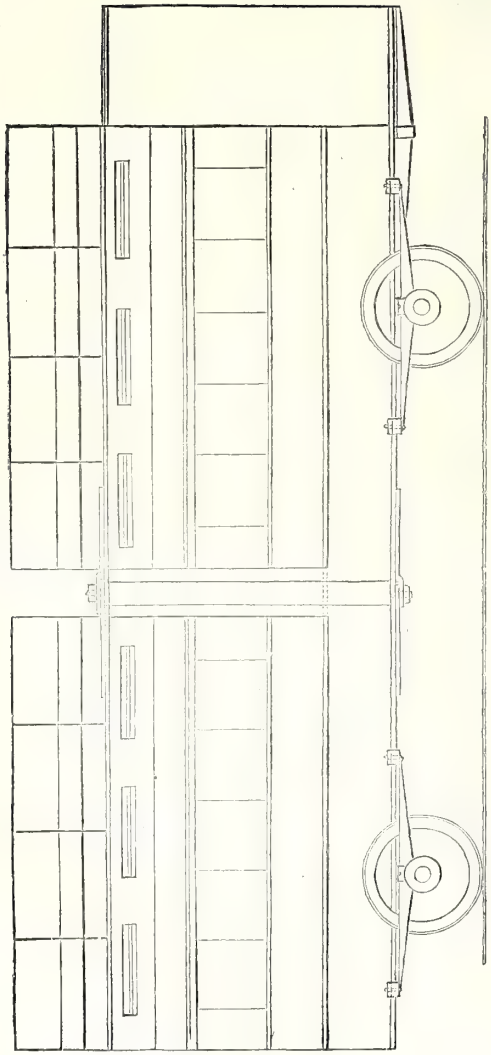
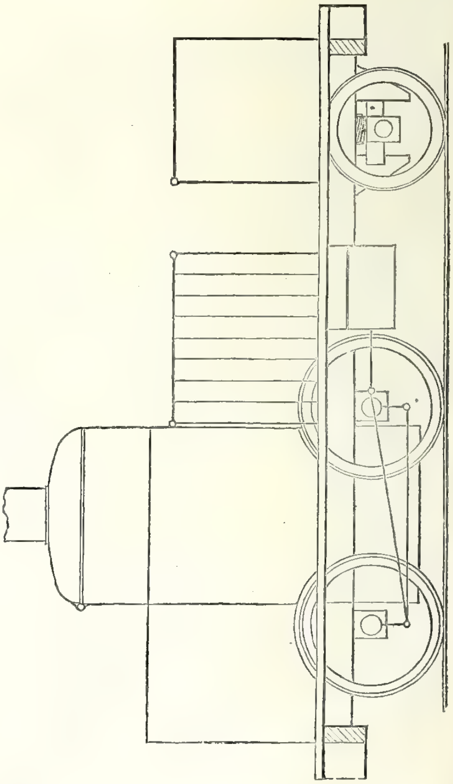


Fig. 3.



tire, in which case the adhesive pressure extends to half the diameter of the wheel. The value of rubber can hardly be exaggerated. It is practically artificial muscle of universal action, and inside the tire it may be used in the highest condition of elasticity, and at the same time protected against all external damage. A thin tire may be used with it, which will flatten sufficiently to ensure contact and adhesion in the case of driving wheels of engines. For the running wheels of vehicles, it is desirable that the tire should maintain a true circle. We may illustrate it by the action of two blown bladders—the one partially full of air, the other tightly distended. The former will not roll freely, the latter will. The former represents the condition desirable for the driving wheel, the latter for the wheel of the vehicle. Such wheels will prevent all blows, both vertically on the tread, and horizontally against the rails and flanges; and when the railway authorities awaken to this fact they will find a very considerable difference in the comfort of their passengers, with an equal reduction of the cost in transit. On a rough road the difference in haulage resistance between an efficient spring vehicle and one without springs, drawn at high horse speed, is as four to one in favour of the former; and on rails, where the resistance is largely increased by lateral in addition to vertical friction, efficient springs become a matter of paramount importance. Wheels of this kind, applied to a traction engine on the common road, obtained a silver medal from the judges of the Agricultural Exhibition at Wolverhampton.

Amongst other considerations not the least important is the possibility of speed. Other things being equal, time is equivalent to money; and to obtain great speed from horse traction, with heavy loads, is simply a question of horse killing—cruelty to animals. The average speed of the existing tramways is about four miles per hour, and that with serious distress to the horses. What we need is to be able to increase or diminish our speed at pleasure, according to safety. We cannot do this till we resort to the power of steam or elastic gases. Why we have not done this, is because we have not yet produced an engine combining simplicity and efficiency with tortuous transit. The engines of the railways are adapted only for straight lines, and if they run on curves it is at a great cost and waste of power, and they cannot run at all on such curves as are required for the ordinary purposes of streets and roads. Of course the steam power that can be made available must depend upon the load on the driving wheels, and that load must be governed by the capacity of the rails to carry it.

A system of rails such as described, would, without difficulty, carry a load of two tons per wheel. Four driving wheels could be used, making a load of eight tons. Taking the steam power as one-fifth of the insistent load on the driving wheels, that would give a traction force of 3,500 lbs. at the rails. With the resisting friction of the vehicles reduced to the minimum by the appliances before described, the resistance per ton on the level should not exceed 8 lbs., and, theoretically, such an engine should draw a load of 450 tons on the level at 20 miles per hour, or 43 tons up a gradient of one in thirty at ten miles per hour. Of course these speeds could not be used on sharp curves of very small radius, but the speed could be then reduced, and increased on the straight line. With the two axles of the four driving wheels four feet apart, and a pair of trailing wheels radial, making a total wheel base of ten feet, the tires of the driving wheels compensating on curves, such an engine would be perfectly adapted to work curves of 35 feet radius. See diagram Fig. 3, p. 44.

One of the purposes which such a line and engine would subserve would be the connection of railways with each other. The open-channel rail would permit ordinary railway trucks to run on it, the wheels bearing on their flanges. They would, it is true, run with considerable friction, on account of the wheels being fixed on the axles, but with the tires made revolving and elastic this would cease. But they would not work the extremely sharp curves without the axle being made to radiate. The advantage and economy of being enabled to deliver a truck-load of goods or materials from the supplier to the receiver direct, without shifting the load into road vans, would be found so great that all needful appliances would soon follow. The engine described would be far more powerful than needed for street and suburban uses, but it would supply a want on the great public roads of no small amount.

The steam coach of Walter Hancock weighed about four tons, but it had two large driving wheels, a bad road, and varying and uncertain gradients, and, moreover, insufficient boiler power. These difficulties can now be got over. An engine with a load of less than three tons, on four driving wheels—a load far less damaging than the existing tram cars—would give a tractive force at the rails of over 1,000 lbs., equal to a load of 125 tons on the level rails, at ten miles per hour, and could carry a supply of fuel and water for half a day; or could rise an ascent of 1 in 30 with 12 tons load, commanding all the heights round London with, say, 100 passengers, free from all risk or oscillation, and working the sharpest curves.

What then are the objections? Only superstition or prejudice? It is supposed that an engine must consist of a dirty-looking boiler, greasy machinery, volumes of smoke, hissing steam, and one or two very dirty men as driver and stoker. The objectors have before their mind's eye a colliery engine, or one of those used as a navvy's assistant. There is about the same resemblance between such an engine and what might be, as between a pleasure carriage and a dust cart. Both go on wheels; but the engine may be built as elegantly as a pleasure carriage. It may have ornamental form superimposed on its utilitarian structure. It may be painted and varnished, and adorned with utilitarian heraldry of modern times, quite as suggestive as the utility-based heraldry of the olden time—the ploughshares that won battle-fields, or the war-steeds, or cressets, or embattled towers, or iron crowns, or portcullises, or Dragons of Wantley, or Golden Fleeces, or ermined mantles, or barred helmets, or battle-axes, or swords, or scymitars. The fire-king, and the water kelpie, and the Undines, and the Northern gnomes working beneath the seated hills, and the dwarfs of the coal-mines, and Charles's Wain, and all the wheels, and valves, and tools of engineering, are at the behest of the modern herald who may wish to curry favour with horses and horse-owners, by showing pleasure-engines in competition with pleasure-carriages, and remove from sight those external indications that offend the aristocratic horse, accustomed to carriage elegancies. Every piece of unpainted metal might be polished as highly as a curricle-bar, and every oil-cap closed by tight valves, and the fuel hidden away, with an ample foot-plate, and every convenience for the driver and stoker, who might thus be quite as clean and smart in externals as the driver or conductor of an omnibus, or the fastidious ruler of a Hansom cab.

"But there is the risk of explosion!" cries another objector. No doubt that risk exists in proportion to the magnitude of the boiler, but it diminishes in proportion to the decrease in size, and to the simplicity of structure. The risk increases as the square of the diameter, supposing the same thickness of metal maintained, and in small boilers the thickness of metal may be beyond all risk. We have not yet culminated to the point of perfection in boiler structure, and the processes we have to take to may be easily indicated. In boiler-making, as in other things, we are apt to stick to the existing, and eschew the possible, under the nick-name of theory.

But how about the smoke? Nothing very difficult. Smoke is unburned fuel, and simply waste. Coke is a very inefficient agent in producing steam. Coal, which induces lambent flame impinging on the heating surface, is far more efficient. But coal badly burned may be as inefficient as coke. Every one who pokes a smoky fire knows that the rush of air induces flame, and when locomotive engines smoke we may be quite sure that it is from want of such poking as will give air to the interior mass of heated fuel. The fire should resemble, as nearly as possible, a large lamp, with the fire impinging through the whole fire-box and tubes. In making a fire, or lighting a lamp, the first thing we have to do is to establish a gas-making apparatus. We do so when we light a rushlight, as may be seen by the small blue flame at the bottom. The best fuel, therefore, is that which is most easily convertible into gas, a process which is carried on in every oil or paraffin lamp on our tables, and, if rightly adjusted, without any smoke or smell. The best fuel, therefore, for a street locomotive would be paraffin oil, or some equivalent liquid, which, passing gradually into perforated iron tubes in the fire-box, heated by a small fire of coke, would be evaporated into gas, instantly converted into flame by a sufficient supply of air. The question is only of cost, and it may be that effective fuel at a high price per ton is cheaper than low priced, if tested by the quantity of steam produced. In using solid fuel, the essential question is, how to mix the due quantity of air with the gas as fast as it rises. To accomplish this, interstices must be provided and maintained. With gas this is easy, and the quantity may be adjusted to the demand, by turning a handle, with the greatest facility, without opening the door of the fire-box.

With regard to interstices in solid fuel, there is a manufactured fuel now about to come into the market, formed from coal dust, which, rightly applied, bids fair to supply the want by ensuring the presence of air. This coal can be compressed into spheres of a convenient size, and which, when placed in the furnace, only touching each other at points, while the air rushes freely round them, the burning taking place on the surfaces, and the air passages can be maintained till the whole is consumed.

There is another source of annoyance, the noise of the intermittent blast; this is now got over in some traction engines by discharging the blast into a chamber, and thence into the open air, in a continuous stream. But the true method would seem to be by splitting it into several currents. The blast of a trumpet is induced by its expanded tube form. Were the opening intersected with wires, the sound would be modulated, and a similar effect might be produced in the steam blast.

In very small engines, the chances of explosion may be reduced to the bounds of a very small possibility, but that possibility may be reduced to an impossibility by varying the medium through which the heat power is used, substituting air for water. In the use of steam, a magazine or accumulator is needed, containing a large supply under pressure. In the use of air, the pressure required is obtained at every stroke of the piston, without any accumulation. Steam is used at a pressure of 100lbs. to the inch. Hot air does not exceed 15lbs. to the inch. Therefore, to obtain a given power, a much larger cylinder is required in the case of hot air than is required with steam, and the weight of the machine is increased; but to set against this the hot air requires no boiler. The blast of air driven through the fire intensifies the combustion, and swells its volume to the required pressure. The sound of the blast in escape is of course subject to the same conditions as the steam engine, and can be dealt with after the same methods. There would be no difficulty in constructing a hot air locomotive, weighing not more than three tons, to develop a traction force of 600lbs. at the rails—a force ample for the purpose of drawing a load of 600 passengers through the streets and suburbs of London.

Such an engine could no doubt be made to do its haulage equally well on asphalte as on rails, with the exception that it would cease to be self-guided, and must be provided with arrangements accordingly.

The outlay for such an engine would probably not exceed that required for the purchase of a stud of horses required for working an omnibus of equivalent load, with the advantage that the engine would work incessantly without falling sick, and that the cost of working it would be scarcely one-eighth that of the horses, and it would not be subject to dying. It would carry with it its fuel for a whole day, eating its carbon while working, instead of knocking off like horses to their oats or maize; and the rises and falls in the price of fuel would be less than those of the horse food. Moreover, the engine would not destroy the road with eight pickaxes, like the eight horse-shoes, and the gases discharged by the blast without smoke would leave no residuum like that marking the track of the horses with a constant nuisance. The source of quarrel and dispute between tramway and omnibus horse owners would cease, inasmuch as horse owners could not live under the competition of steam or hot air.

The better housing of the working classes, now imperatively urged as a necessary means of national progress, can only be accomplished in its most desirable condition by the aid of cheap transit, and it has been proved that the largest source of profit to transit companies is "third class," in other words, the great masses of working humanity. The humanising influence of gardens may be accessible to some of the families of working men as distance vanishes in mechanical facilities. If commercial stimulus induces a company to work in this direction, it will be a great advance on the morals, prosperity, and happiness of our great commercial and manufacturing cities; but till we can get mechanical power substituted for horseflesh as the means of transit, we shall be as far behind in the results as are omnibuses and stage coaches compared with railways,—at a given cost doing only one-eighth of the work.

DISCUSSION.

Mr. T. A. Masey, F.G.S., said—I have listened with the greatest interest to the very valuable paper we have just heard read, and have followed the arguments step by step; but as there are a few points on which I differ from Mr. Adams, and several points not touched upon, I crave a few minutes while I call attention to the same. Mr. Bridges Adams has only glanced at the desirability of tramways becoming State or municipal properties. Now, I take it that tramways, like the letter post, the telegraph, the railways, and the supply of gas and water, in fact all great organisations that affect the community at large, should belong to the State, to be worked for the benefit of all, and not exclusively to be enjoyed by the wealthy, who can afford to hold shares in such undertakings; but that the poor man should also participate in their benefits, either by a reduction in the price, or by the profits diminishing government taxes. Tramway companies at present receive their authority, either from a special Act of Parliament, or from a provisional order granted by the Board of Trade, and confirmed by the legislature. With respect to the latter course, myself and friends have found it a snare and delusion; for after being entrapped by its provisions to spend hundreds of pounds last year in preparing plans, and going through the whole paraphernalia of standing orders, we found at last, even after the Board of Trade had granted the provisional order, that a single member of the House of Commons could, by making the metropolitan tramways a party question, disregard every consideration for the public service around London. I hear that there are more bills this year than last for tramways, and I therefore trust that Mr. Bridges Adams's prognostication that the "baby disorders" that the various lines are now undergoing may result in their complete recovery, instead of the dire remedy of complete removal, which he predicts. I look upon the successful introduction of tramways as one of vast importance to every city in the world, but more especially to the rural districts of Great Britain, as all turnpike trusts not in debt are to be abolished next year, and the expense of maintaining the roads thrown upon the parishes. The expense of keeping up the turnpike roads throughout the whole of England and Wales is officially stated as £1,071,753 12s. 7d. Now, if a general system of tramways were adopted throughout the country, the greater part of this sum would be saved the ratepayer, as the tramway companies are obliged to keep two-thirds of the road in repair. It will be in the recollection of many that just previous to the introduction of railways our English roadmaking had arrived at an excellence that has never been surpassed, and rarely equalled by any other nation. But the intended traffic was diverted by the railways. These roads are now in a splendid condition, and are ready, without any engineering difficulty or much expense, to receive back that local wayside traffic, from town to town and village to village, that the railways have for a time intercepted, and which tramways are destined in the future to again replace. There are still many improvements wanted in the method of laying the lines, the form of rail, and the construction of carriages, and also a reduction in the present cost of works. I had hoped that from Mr. Adams's great experience, we should have heard more about the cost of the permanent way on an ordinary macadamised turnpike road. In constructing tramways in streets already laid with granite sets or asphalte, the expense is not very great, the material being on the ground, but if you have to lay a tramway along a road, the granite pitching alone will cost some £2,000 a mile. What is wanted is a cheap and efficient system of laying the rails along the turnpike roads without the need of this expensive paving —a permanent way that will cost about £3,000 a mile, everything complete. I can quite understand the necessity of something strong, that will resist the constant outward thrust of the wheels in the present narrow-grooved rail, but a great deal of this may be obviated by the manner of driving the horses. No driver that I have as yet spoken to understands this, or that it makes any difference in the traction, on and off, his endeavouring to keep his horses as straight as possible in the track. To do this effectually, the driver should be seated near the roof, so that he might keep his eyes in the centre of the way, as an acrobat does when walking on a tight-rope. At present, the tramway car guides the horses, and not the horses the car. One of the diagrams on the wall shows what is known as the "on and off system," which, as shown there, appears very good, but it was tried practically for some years in the East India Dock-road, for the heavy produce coming from the docks, but the difficulty is, with a large car carrying some 60 people, if you once get off the track you come to a dead stop, because the traction is so much increased, and you require eight horses to pull the car. In Paris, in 1854, they tried the on and off system by taking the flanged wheels off the cars and putting others on, but then it was found that four horses were required. I quite agree with Mr. Bridges Adams, that the time has arrived when steam might be advantageously used. The tramways are ready for it; the public are willing to see it adopted; the horses, I promise, will not shy at it if properly constructed. It, therefore, only requires a further enlightenment of our legislature for it to be successfully adopted. With respect to curves, I should think that the adoption of Mr. Fairlie's bogie system would be found most efficient. Our railways give us the means of quick transit to and from all the principal towns, but the fares are not cheap, nor the carriages comfortable. What we now want is the means of expeditiously travelling on the common roads from village to village, giving a systematic opening up of the whole country, which has been so long advocated by my friend Mr. T. L. Holt. I have the honour to be connected with two lines of tramway, one from London, through Acton and Ealing, to Southall, to be extended hereafter to Oxford, the other along the Edgware-road to Watford, being the first section of a line from London to Birmingham. In carrying out the first, as the line will pass through a district of large market gardens, it is proposed to adopt a plan of portable rails to be put down in the fields, to allow a truck to be loaded with vegetables or other produce, and then conveyed straight to London without further unloading. A similar plan is successfully carried out by a friend of mine at Tintagel, in Cornwall, in loading ships with slates on the beach. The carts bring down the slates to the sand, when a crane lifts the body of the cart off its wheels and places it on a flat truck, that runs along portable lengths of rails laid on sleepers temporarily fastened together. When the vessel is loaded, it is taken up and put away until wanted again. The other line north to Watford, the country being generally grazing land, permanent turn-outs will be laid down into the principal farm-yards, to receive the milk for London, calculated at 20 tons daily, for this short district alone. The promoters of these two routes have anticipated Mr. Bridges Adams' suggestion of cheap fares for the working classes, and have voluntarily undertaken to provide working men's carriages at cheap rates, with a view of facilitating the industrious artisan residing in the suburbs. If a cheap general system of tramway, under the supervision of the government, were laid along the common turnpike roads throughout the length and breadth of the land, who can foretell what would be the benefits to the community at large. Mineral properties and coal fields would be opened up; the many thousand acres of waste land would be brought into cultivation that now lie fallow; in fact, we might set our surplus population, instead of emigrating to distant lands, migrating and squatting upon the unreclaimed soil of Old England; for who is there, even among the poorest of the poor, that would not rather eat a dry crust in our glorious free England, than enjoy plenty at the Antipodes. In the outlying agricultural districts the farmer would get his produce easily to market, and have manure brought back in return. The industrious working man, who cultivated a garden in spare hours, and kept a pig and a few fowls, would always find a ready sale. The residents along the roads would get coal and every commodity wanted delivered at their doors. The parish authorities, instead of raising a rate for the repair of the roads, which in some districts will be very onerous, would have the roads kept in repair by the tramway. This is essentially an age of national progress and development, and I hold it to be not only the duty of the State, but also imperative upon every individual, to unite in promoting what is clearly demonstrated to be for the common welfare of the community at large. If men of position and learning would cease talking to the working man about abstract and republican theories of government, and just put their shoulders to the wheel—the tramway wheel—and assist in obtaining for the artisan (as Mr. Bridges Adams has this evening so justly pointed out) the means of cheap and easy transit into the suburbs or country, that he might cultivate his bit of garden, I venture to predict that discontent, poverty, and poor-rates would be matters of little moment in the future, and that we should have less of that much-vexed question, the equal division of land, for the working man would, in the enjoyment of his cottage and garden, feel a greater respect for himself, and thus cease to covet his richer neighbours' broad acres.

Mr. F. J. Bramwell, C.E., said he would not discuss the political economy aspect of the question, or say whether or no the government should take such enterprises out of the hands of companies, any more than they should interfere in a like manner with bakers' shops, which were at least equally necessary; but would confine himself to engineering questions, with which he was more familiar. Mr. Adams's criticism on the construction of the present cars was most valuable, for having had the honour of that gentleman's acquaintance for some years, and having served under him, he was able to say that, if there was one thing more than another, it was the question of the carriages, which had to roll upon any kind of road, rail, or otherwise. It was too much the habit of engineers to spend all their energies on the construction of the road, and overlook altogether the requirements of a good carriage, though this was of almost equal importance, both to the comfort and safety of the passengers and to the dividends of the company, because on it depended the greater or less tractive force required. Mr. Adams had pointed out the defects of the present cars when in motion, one of which was that the wheel base being only 6 feet, with an extreme length of 24 between the platforms, it was impossible, considering the curves which had to be traversed, to have efficient springs, otherwise the oscillation would be insupportable. The makers of these cars, for some reason or other, continued the unfortunate practice of makers of rolling stock, of having wheels which would not radiate, and which were fixed to the axles. It was almost incredible, after the years of persistence on the part of Mr. Adams and others, that this fundamental error should be persevered in; but so it was. They were told that on railways there was a mechanical difference in making work that would stand when the wheel was loose on the axle, and, therefore, the wheels must be keyed fast. He did not believe this was so, but thought it quite possible to make a railway wheel which would run forty miles an hour with safety, being loose on the axle, for it must be borne in mind that the axle would also revolve. Therefore, the revolution would not be as in the case of a common carriage wheel, but simply the differential revolution due to any curvature on which the carriage might travel. But when you came to a tram car going at the rate of 4, 10, or even 20 miles an hour, that difference, at any rate, did not arise, and it was idle to say that, in the present approach to mechanical perfection, it was out of the question to make a wheel loose on the axle. It was, however, a still greater mistake not to put the wheels on a radiating axle. (Mr. Bramwell illustrated the importance by a diagram on the blackboard.) In going round a sharp curve, with a radius of say 35ft. and a 6 foot wheel base, there would be a slip equal to one-twelfth, in other words, for every 12 feet which the carriage moved forward there would be a side-way slip of one foot by a sledge or skidding action. If at the same time there was a guage of 4ft. 6in., with the same wheel base and radius of curve, the slip arising from the wheels being fixed on the axle would be one-eighth for one wheel; or, supposing the outer wheel not to slip at all, but to go at the true rate of the carriage, the inside wheel would slip one-eighth of the whole motion; but, as the inner wheel only carried half the weight, that one-eighth slip would become one-sixteenth of the whole weight travelling forward. Therefore the sliding action produced by non-radiation in such a case would be 1-12th of the whole forward motion, whilst that arising by the non-looseness of the wheels would be 1-16th. If the wheel base were increased, the axles not being made to radiate, the slip would increase enormously, but the slip due to the fixity of the wheels would not so increase. Mr. Adams stated that tram cars could not leave the line, but on one of the earliest established, viz., along the docks in Liverpool, there was a flanged wheel on an eccentric, by raising which the driver could at any time leave the groove and drive off the line, so as to allow another coming in an opposite direction to pass. He was much pleased to see that Mr. Adams was not afraid to attack that stupid and dirty animal, the horse, whose interests and peculiarities were so much considered that we had to give up the use of steam on common roads. which 35 years ago was far more used than at present. He could not help thinking that a vigorous effort ought to be made to show the public that horse carriage was a mode of locomotion only suited to an infant state of society, and we ought to be getting past it. There was no doubt that Mr. Adams was quite right with regard to the india-rubber tires. What was wanted to get rid of was the successive blows arising from the rolling action not being perfect; and no doubt the best means of meeting this was to introduce the elastic substance at the nearest point to where friction took place. The india-rubber made an enormous reduction in the amount of wear and tear, and added greatly to the comfort of passengers. Thompson's engines with india-rubber tires had been alluded to, and he could confirm the good character given of them from having officially inspected and reported upon them. He had done the same with Mr. Adams's elastic tire, but not so fully as he could wish, for the engine was found so useful that it was taken away from the judges' inspection for active service. The primary object in Thompson's tires was to get great tractive force, but in so doing he also obtained a most useful elasticity, so much so that he used the same kind of tire for the steering-wheel, and in the case of the omnibus which was to be used behind one of these engines for the India mail service, which was also fitted with india-rubber tires, the motion was very easy indeed. Mr. Adams had stated that no engine had yet been made which would go round a sharp curve, but he presumed this only applied to railway engines, for 35 years ago Mr. Hancock ran his steam omnibus from Paddington to the Bank at a 6d. fare, and took any curve required on the road; and not only so, he had seen him take it into his own yard, and turn completely round in its own length, and come out again. Again, down at Stafford, when the Indian carriage was taken into the station-yard, it was run round and round in its own length for several minutes together. He did not think Mr. Adams was quite right in some of his calculations, because, although no doubt the traction power of an engine with four wheels would be what he had stated, he did not think an engine could be obtained of the requisite power of that small size. He believed also it was an error to say that Mr. Hancock had not boiler power enough, for he used constantly to ride in his steam carriage, and did not remember their being short of steam. The boiler was of a most ingenious construction, which had hardly been excelled since. Coke was said to be a bad fuel; but not only did Hancock and others use coke, but until about sixteen years ago all locomotive engines used it, and it was an evil day for the comfort of the public when it was discontinued. No doubt it was true that coke did not produce flame if you burned an isolated piece, but when there was a depth of coke in the fire-box the air which came in to aid the combustion produced carbonic acid at the bottom, which, rising up through the coke, produced carbonic oxide, which burned with a flame, so that, although using a non-gaseous fuel, you produced a gas flame. In the districts where anthracite coal was used in the copper smelting furnaces, the workmen very ingeniously availed themselves of the same property. By burning the anthracite coal, not upon open fire-bars, but by allowing a thick bed of clinkers to form thereon, through which the air found its way in such small quantities that carbonic oxide was produced, the upper air came in to mix with it, and in that way a long flame was produced. There were only two drawbacks to the use of coke: one was its cost, and the other was that the minute particles had a much more powerful effect in cutting out the tubes than particles of coal. Many discussions had taken place in that room, when lent to the Institute of Naval Architects, on the subject of liquid fuel, but a word or two more might not be out of place. Fuel might be either in the solid form, as coal or coke, in the form of an impalpable powdery liquid, or gaseous. Beginning with the latter, there was the system of Mr. Siemens, who made all his into carbonic oxide, and who could regulate the admission of air to a nicety, giving any requisite amount, the gaseous fuel being perfectly divisible. Then there were various methods of burning liquid fuel, which being also infinitely divisible, a large amount of surface could be exposed in a small space, and perfect combustion secured. Then there was a plan by Mr. Crampton, an old friend of his own, who had lately hit upon the expedient of reducing his coal to an almost impalpable powder and blowing it into the furnace. In this way also the air could be regulated exactly, and very good results had been obtained. Unless one of these modes were adopted, the old plan must be followed, of burning coal or coke in blocks so large that the air could permeate through them, whilst at the same time there should be enough surface exposed to do the work required. The great difficulty in this case was to avoid waste. Every one agreed that smoke was a waste product, but experience showed that unless you could get rid of it by mechanical firing, it was more economical to have a considerable amount of waste smoke from the chimney-stack than to admit air sufficient to consume it, for this could not very well be done without a good deal of unconsumed air passing through the fire, and abstracting the heat. For these reasons, either the use of liquid or gaseous fuel, or of Mr. Crampton's process, would probably be preferable for road-engines. With regard to external appearances and so forth, he could not help again referring to Mr. Hancock's carriages, which were really elegant vehicles: not a particle of the machinery was to be seen, there was no smoke, no waste steam, and no puffing from the exhauster, while the only attendant visible was one who would certainly bear comparison with an omnibus conductor of the present day. With regard to the danger of explosion, he thought it was a mistake to say that it was as the square of a diameter of the boiler, the metal being of equal thickness. The danger of a rupture was directly as the diameter, but assuming a rupture to take place, then the danger was as the square of the diameter, that being the proportion in which the contents increased. It had been said that steam engines required a reservoir of steam under pressure. which air engines did not; but he recollected about thirty years ago, a steam vessel working upon the Thames, in which there was no steam reservoir, and consequently nothing to blow up. It was called Howard's "quicksilver engine," which, however, was a misnomer. The fact was the boiler was provided with a double bottom, on which was an amalgam of quicksilver and lead, which served as a receptacle for the heat of the fire; there was no water at all in the boiler; to start the engine, you made one stroke with the feed pump, which put into the boiler just sufficient water to form steam for one revolution. The engine then started, and by means of an extremely ingenious contrivance, supplied the boiler at each stroke with enough water for the next, and no more. Therefore if the boiler had burst, there was nothing in it to do any harm. If there were any reason to fear the danger of explosion some such plan might be resorted to; but although there were about 14,000 locomotives on the railways in England, and an explosion was hardly heard of once a year, the statistics of boiler explosions were rather difficult to get at; but explosions were said to be 1 in 2,000; but this he believed to be an exaggerated estimate, since it was made on the assumption that there were only 160,000 boilers in the country, whereas, in all probability, there were a great many more, which would reduce the average accordingly.

Mr. Haywood said, as a matter of fact, he had ridden in tramway carriages drawn by steam-engines in the United States, passing along common roads; and it might be interesting to know that at Madrid, at the present moment, through one street, the cars were drawn by an engine. Although he confessed he did not like the idea of engines along common roads, he had always said the time would come for them, and he believed now it would come sooner than he had once expected.

Mr. Holt said almost all he had heard that night seemed but a reminiscence of what was said when railways were first brought out. The difficulties which Mr. Adams had suggested with regard to tramways were no greater than those which were made then; and when the tramways were once down, and fully in work, there would be no more difficulty with regard to them. Putting steam-engines upon the tramways was, he believed, but a matter of time. Captain Tyler had reported to the Board of Trade, he believed, that ultimately steam-engines must be used upon common roads, and Mr. Haywood had expressed the same opinion. But the difficulty at the present time was to get the tramways upon the common roads, not getting engines upon the tramways; and he believed the Society would best exert its influence in endeavouring to educate the members of the legislature with regard to matters of practical science. It was a matter of astonishment and regret that, in a commercial country, the government should be entirely in the hands of persons who knew nothing of commerce, and in whose education commerce had formed no part. What was wanted in order to encourage tramways was, to remove the restrictions which prevented their being laid down on the highways of the country. There was an enormous expense attendant on getting an Act of Parliament, or going before the Board of Trade, which was a great impediment to the development of this traffic, and many of the restrictions were utterly useless.

Mr. Gurley Smith said his experience of the tramway in the Greenwich and Deptford district was most favourable. It had done a great deal of good in the neighbourhood, for although it had only been opened on the 13th of September last, from his own personal knowledge he found that a vast number of houses which previously were empty were now occupied, and trade in the neighbourhood generally was much improved. No doubt there were difficulties connected with the system, such as the rigidity of the carriage and other matters, which mechanical engineers would no doubt soon remedy, but the comfort derived from them by the general public was so great, that it would be an immense misfortune if they were removed. The great difficulty which occurred in their neighbourhood was the narrowness of Deptford-bridge, which prevented more than one car passing at a time, so that they had to signal to one another, and very often two or three cars were kept waiting. He should be glad, therefore, if Mr. Haywood would turn his attention to what might be done to the improvement of the roads in their district.

The Chairman said—I have so recently and so fully explained my views on the subject of the pavement of towns, in its economical as well as in its sanitary aspect, that I deem it unnecessary to say much on the present occasion. When the subject of tramways was last brought forward here, I advocated the opinion that they ought only to be allowed to be laid down on behalf of the public as part of the public roadways, and not as a means of trading profit on the necessities of transit. It is only by dereliction of public duty and principle, so that, if not executed by the public authorities they will not be executed at all, that their execution, as trading monopolies, can be excused. As explained by Mr. Adams, it is necessary to the trading companies so to construct their tramways as to exclude from their use all vehicles that do not pay any toll. By such exclusive construction the tramways are made very much a nuisance to private vehicles. Mr. Hooper, a member of the Society, an eminent carriage builder, has been called upon to repair many private carriages on account of the injuries done to them by the tramways. The progress of carriage improvement is to make the wheels narrower, but he has been obliged to make them wider again, that they may not get into the tramway ruts, and sustain the wrenches they now do. It is to be borne in mind that the nuisance of the tramways (of which I have myself had experience), has not been confined to gentlemen's carriages, but is extended to all sorts of light vehicles, tradesmen's light carts, gigs, and the like. Certainly, impartially considered, I think it will be agreed that these exclusive trading tramways ought not to be allowed to go any further into towns. They are open to all the economical objections which the public now feel towards railway companies. They are open to the objection of exclusion, and the mechanical objection of injury and nuisance to all the excluded private vehicles, and, so far as relates to them, to their impeding the freedom of transit. Even if the parishes were at full liberty to use them, I do not see that they would in towns and urban districts be eligible, as compared with the extraordinary material that has been laid down in Cheapside, and that has sustained in so remarkable a manner its tremendous traffic of twelve thousand vehicles daily. A roadway of that peculiarly powerful sort of material, laid down of the space equal to a pair of tramways, may cost double the tramways, but then it will accommodate, not only double, but three or fourfold the amount of traffic, besides insuring those indirect economies which I have specified in my paper, of reduced dirt, noise, and vibration. It gives freedom to all, and to all very nearly as good haulage as on the tramways. I do not observe in the City asphalte-covered streets that difficulty of guidance of engines or vehicles experienced of which Mr. Adams apprehends. Nor do I agree with him that we must come to the rail, certainly not in cities, or in suburban districts of considerable traffic; and I question whether in rural districts, because for those districts a thinner asphalte surface, or naked concrete, will, with the lesser traffic, be available. The long demonstrations in Paris, as well as here in the City, have considerably altered my opinions on tramways, as I know they have those of very distinguished engineers. The paper of to-night displays the superior quality of most of Mr. Adams' papers, of advanced and refined suggestions. I am sure you will give him heartily the vote of thanks which I now beg to propose to him.

Mr. Adams said that, as the hour was late, he would reserve his reply to the various criticisms for the pages of the *Journal*.

A model was exhibited by Mr. George Gore, "Of an improved means or apparatus for guiding, breaking, and guarding the wheels of tramway cars and other vehicles, and the method of fixing and acting upon the same." The principle of this invention consists in combining a guide-wheel, break-block, and guard in one apparatus. The guide-wheel being for the purpose of enabling tramway-cars and other vehicles to leave or return to a line of tramway at any point. The break-blocks are fixed to the guide-wheel frames, and are acted upon by one and the same arrangement of apparatus. The frames to which the guides and breaks are attached are so arranged as to form wheel-guards for the purpose of removing any obstacle from off the line of tramway, and preventing persons being run over if accidentally knocked down. The guide consists of a metal wheel fixed in a metal break-frame, this frame being made in such form as to answer the purpose also of a wheel-guard, as hereafter described. When used before and behind a pair of carriage front and back wheels, they act in the threefold manner as guide, guard, and break, but when fixed between a pair of front and back wheels, as guide and break only. This apparatus is acted upon by means of a long metal bar or rod running the length of the carriage, and communicating with both driver and conductor, this bar or rod having what is termed right-and-left handed screws formed on it which act upon the combined apparatus in manner following:—By turning the screw bar in one direction the breaks will be applied and the carriage stopped, and by turning the bar in the opposite direction the guide wheels will be lifted or turned out of the groove of the rail, and the carriage can then run on to the ordinary road as long as may be absolutely necessary. In some cases, in lieu of the screw, a lever action could be adopted with equal effect. This combined arrangement of guide, break, and guard is fixed and framed to the bearings of the carriage wheels in such manner that the loading and unloading of the carriage does not in any way cause the apparatus to be raised or depressed.

Some blocks of patent fuel of the British and Foreign Patent Fuel Company (Limited) were exhibited, in which the small coal is so mixed wilh other substances that it acquires a hardness and consistence superior to that of ordinary block coal, and is not subject to melt or fly in pieces in the fire, but burns in a manner somewhat resembling charcoal, though with flame in addition. The odour resulting from combustion is not like that of coal smoke, but is very much like that of burning acid. The samples shown were in the form of ordinary bricks, and will pack very solidly for transit by sea or land. Of course, it might happen that an unskilful fireman might pack them too closely in layers in the furnace for the due admission of air. Moulded in a spherical form the combustion would be perfect, but they would of course be more bulky in transit.

[With reference to the use of steam on tramways, we are informed that a steam-carriage is in course of construction specially adapted for use on tramways.—Ed. *J.S.A.*]

ANNOUNCEMENTS BY THE COUNCIL.

CHANNEL PASSAGE.

The Council have appointed a Committee to consider and report how far the existing means of crossing the Channel can be improved, and to take evidence thereon, the Committee to consist of Lord Henry G. Lennox, M.P., Chairman of the Council, Mr. F. A. Abel, F.R.S., Mr. E. Chadwick, C.B., Captain Donnelly, R.E., Mr. Eboral, Captain Douglas Galton, C.B., F.R.S., Admiral Inglefield, Mr. C. W. Merrifield, F.R.S., Admiral Ommanney, C.B., F.R.S., Mr. E. J. Reed, C.B., Admiral Ryder, Captain Robert Scott, R.N., Mr. Seymour Teulon, Vice-Chairman of the Council, Sir Ed. Watkin, and General Eardley-Wilmot, F.R.S.

LONDON CABS.

The Council have appointed a Committee to consider and report what premiums can be offered for the improvement of London cabs, such Committee to consist of Mr. A. Cassels, Mr. H. Cole, C.B., Captain Douglas Galton, C.B., Admiral Ommanney, C.B., F.R.S., and General Eardley-Wilmot, F.R.S.

MOSCOW POLYTECHNIC EXHIBITION.

The following gentlemen have been added to this Committee:—Mr. Donald Nicol, Lieutenant Moukhanof, of the Russian Navy, and M. Gabriel Kamensky, of the Russian Consulate.

TRIALS OF COTTON GINS.

The Council have received the following letter from Dr. J. Forbes Watson:—

Queen's Hotel, Manchester, November 25th, 1871.

Sir,—I have the honour to inform you that arrangements have been made to conduct a series of trials in Manchester, for the purpose of ascertaining the best forms of cotton-gins for cleaning the various kinds of cotton produced in India. The trials will commence on Tuesday next, the 28th inst., and it is expected that they will last until about the 20th of December. A large quantity (upwards of 30 tons) of seed-cotton, of different sorts, has been procured for the proposed trials, and every care is being taken to ensure that the results obtained shall be trustworthy.

The Cotton Supply Association, in the general interest of the trade, has appointed a committee to assist me on the occasion, and to see that the programme laid down has been faithfully followed.

This subject, however, is one in which the Society of Arts is so likely to take an effective interest, that I feel I am at liberty to ask if the Council of the Society would have the goodness to arrange to be represented, at all events for some part of the time during which the trials are expected to last.

I may mention that all the principal cotton-gin makers in the country have entered machines for trial, that the number of gins entered amount to eighteen, and that these probably exhibit every kind of mechanical arrangement for the ginning of cotton which has up to this time been invented.

I have the honour to be, Sir, your obedient servant,

J. Forbes Watson.

To P. Le Neve Foster, Esq., Secretary, Society of Arts.

The following letter, addressed by Dr. Forbes Watson to the manufacturers of gins, describes generally the nature and object of these trials:—

India-office, London, 8th November, 1871.

It has been decided to commence the long and unavoidably deferred cotton-gin trials on Tuesday, the 28th inst., and they will take place in Manchester, where premises affording the necessary facilities for the purpose have been secured.

Upwards of thirty tons of seed-cotton—a considerable proportion of which was recently received from India—are available for the proposed trials, and the arrangements on the occasion will be such as to afford, it is believed, results of a thoroughly trustworthy description.

In the meantime, I have to inquire if it is your intention to enter one or more gins for trial, and, if so, to ask you to be good enough to fill up and return to me one or more of the enclosed forms as soon as possible.

The details of the various arrangements which it is intended to effect, with the view of obtaining reliable results, will be explained before the trials begin, and any suggestions which you may make will receive the fullest attention.

The requisite amount of floor space will be railed off and allotted to you, for the working within the same, of such gins as you may enter, and, as the "power" and the necessary driving pulleys will be provided, it will only be needful for you to arrange for their feeding and management during the trials. The speed at which the shafting will revolve will be throughout at, as nearly as possible, the rate of 140 revolutions per minute. The diameter of the driving pulleys presently on the shafting is 13 inches, but any size of pulley, up to 19 inches in diameter, which you may desire will be supplied.

The cotton for the trial consists chiefly of native or indigenous Indian cotton, and of American seed cotton grown in Dharwar. A considerable quantity of "Uplands" cotton from America is likewise available, as well as some Egyptian. It will, therefore, be requisite for you to indicate the kind of cotton which you wish to be used in testing such gin or gins as you may enter for trial.—I am, &c.,

J. Forbes Watson,
Reporter on the Products of India to the
Secretary of State in Council.

P.S.—I shall be happy to send you for present use a small supply of the chief kinds of cotton which will be used at the trial. I will also arrange for you to have the opportunity of fixing up and trying your gin or gins, as the case may be, within the space allotted to them, a few days before the trials are actually commenced.

J. F. W.

The Council have accepted Dr. Forbes Watson's invitation, and have requested Sir Wm. Fairbairn, Bart., F.R.S., Sir Joseph Whitworth, Bart., F.R.S., Mr. A. Cassels, Dr. F. Crace Calvert, F.R.S., with Mr. P. Le Neve Foster, the Secretary, to be a deputation, and represent the Society at these experiments.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

Exhibition of 1872.

It may be well, as the time is drawing nigh when exhibitors are to make their preliminary applications, to recapitulate of what the exhibition, which is to open on the first of May, is to consist, and to summarise the arrangements that have been made. The exhibition of 1872 will consist of three divisions:—Firstly, the fine arts, applied or not applied to works of utility executed since 1862; secondly, manufactures, varying every year, until in seven years we shall be brought round to the beginning of the plan; and, thirdly, recent scientific inventions and new discoveries. In the first division there will be seven classes, namely, painting of all kinds, in oil, water-colours, distemper, wax, and enamel, and on glass, porcelain, mosaics, or other surface; sculpture, modelling, carving, and chasing in marble, stone, wood, terra-cotta, metal, ivory, glass, precious stones, and any other materials; engraving, together with lithography and photography, if executed within the preceding twelve months; architectural designs, drawings, photographs, and models; tapestries, carpets, embroideries, shawls, and lace, shown not as manufactures, but for the art of their design in form or colour; drawings from all kinds of decorative manufacture, and, lastly, reproductions, or exact copies, of ancient or mediæval pictures, painted before 1550, with electrotypes, and other copies of old works of art.

The arrangements of the second division will always be marked by the greatest change; for this division is the one on which the Exhibition mainly depends for novelty of interest. Five classes of manufactures, subdivided, and independent of raw materials, machinery, and processes used in their production, will be included in this second division. First, there will be cotton and cotton fabrics. Then will come jewellery; every kind of trinket will be shown except watches.

The manufactured division next year will include musical apparatus and instruments, acoustical apparatus and experiments, and stationery. The sub-divisions of this last-mentioned class will be manifold, and all modes of printing are to be shown. Although the direct object of the commissioners is to show the advance which the most civilised nations have made in the power of diffusing knowledge by means of the printing press, their desire is to include a series of specimens illustrating the comparative state of paper-making and printing all over the world.

Supplementary courts or galleries may be erected on behalf of foreign exhibitors by their respective governments on the vacant ground on the east and west sides of the Royal Horticultural Gardens, for which a nominal rent will be charged. No object is to be removed from these galleries during the hours the exhibition is open, and if objects are removed in the evening or early in the morning, they must be replaced by similar objects before the exhibition is again opened.

The Commissioners have arranged with Mr. Fox, of the Royal Horticultural Society, that he shall undertake, on behalf of foreign governments, to inspect and note the condition of all objects unpacked at the exhibition buildings, at a uniform and very low charge for each case. Messrs. Chaplin and Horne are the carriers appointed for the conveyance of foreign goods from the wharves to the exhibition.

Preliminary Applications.—Persons desirous of taking part in the International Exhibition of 1872 are requested to obtain and fill up a form of preliminary application, and to forward it as soon as possible, but not later than the 31st of January, 1872, to Major-General Scott, C.B., Secretary, offices of her Majesty's Commissioners, Upper Kensington-gore, London, W. The information embraces name of the applicant, postal address in full, nature of the object proposed to be submitted for approval, division and class to which the object belongs. Her Majesty's Commissioners will be glad of the fullest information applicants may be in a position to give at once respecting the objects they desire to submit for exhibition in 1872, stating the division and class to which such objects belong. It is also suggested that an inspection of the arrangements made for exhibiting the various classes of objects included in this year's exhibition would be particularly useful to such artists, manufacturers, and inventors as may be desirous of taking part in 1872.

Peasant Jewellery.—Her Majesty's Commissioners have announced in the general rules, that a representation of all kinds of jewellery will be included in the programme for the International Exhibitton of selected works in 1872. It has been explained that jewellery embraces all kinds of ornament worn for personal decoration, except watches, which will be exhibited in 1875. Besides jewellery of a costly kind, the most complete and perfect collection of all kinds characteristic to the country in which it is produced, and especially that used by the peasantry, is desired. Such jewellery should have a direct connection with the native instinctive art, which has been handed down by long tradition. Thus Italy, Spain, Hungary, &c., may be instanced as each having a native jewellery, worn more or less by all classes, which to this time remains uncontaminated by the introduction of foreign forms based on the fashion of the day. Throughout India ancient types are preserved, but the Delhi jewellery of the Upper Provinces most commonly offered for sale to the better classes of Europeans is simply an inferior imitation of Parisian or European designs. Photographs of Delhi jewellery of purely native character, as distinguished from the former, which will serve to illustrate the classes of traditional ornament that her Majesty's Commissioners desire to have represented, have been prepared, and may be obtained on application to the Secretary. Collections of peasant jewellery have been made for the South Kensington Museum. Those from Italy are numerous and of all varieties, and owe their design to the peculiar instincts of thousands of years, preserved in different localities. To have a complete representation of international personal ornament it will be necessary to collect specimens at least of various objects from all parts of the world. Such an exhaustive series will be of great interest, and be appreciated by the public museums of the United Kingdom, as well as by the public at large. It is therefore hoped that all countries will voluntarily contribute collections of this nature; but her Majesty's Commissioners will be prepared to consider the purchase of specimens from such localities as are not likely to undertake their own representation officially, provided that an estimate is first sent to the Commissioners, and a definite amount authorised by them. In collecting such specimens it is necessary that characteristic design should, however, be of much greater consideration than intrinsic value, and that the price be very moderate.

Paper, &c. — Although the direct object of Her Majesty's Commissioners in exhibiting collections of paper, stationery, and printing, in 1872, is to show the progress which the most civilized nations have made in these arts, the commissioners wish to include a series of specimens illustrating the present condition of these arts in other countries, and they feel that it would be of interest and much utility to procure collections from all parts of the world, to illustrate the most primitive kinds of printing, the applications of different materials, and the modes of working them into paper. In Cashmere, for instance, a paper is made from silk; in Java a kind is made from bamboo pulp; in Canton some is made from rice; and in India varieties are made from plantain and hemp; whilst, both in India and China, papier mâché is turned to all kinds of uses. Her Majesty's Commissioners hope, therefore, that all varieties and modes of printing may be represented, and that collections of paper made from every kind of fibre will be sent to the International Exhibition of 1872 by foreign countries; but Her Majesty's Commissioners will be prepared to consider the purchase of specimens from such localities as are not likely to undertake their own representation, provided that an estimate is first sent to the Commissioners, and a definite amount authorised by them.

Communication with the Exhibition Building.—It is proposed to connect the Metropolitan District Railway, at the South Kensington Station, with the Albert-hall and the conservatory of the Royal Horticultural Society, by a short railway line. There is an alternative scheme, called the Exhibition Subway, for effecting the same object, with a tramway substituted for the railway.

Royal Albert Hall.—A new cantata, by Mr. William Carter, entitled "Placida, the Christian Martyr," and dedicated to H.R.H. Princess Mary of Teck, is to be performed, for the first time, on Tuesday evening next, December 5th, at this hall, conducted by the composer. A selection of sacred music will also be given, including Mendelssohn's "Hear my prayer," and "Judge me, O God;" Beethoven's "Hallelujah Chorus," &c. The principal artistes are Mdme. Lemmens-Sherrington, Mr. E. Lloyd, Mr. Frank Elmore, &c., with a choir of 1,000 performers.

Meeting at Edinburgh.

On Friday, at noon, the members of the Chamber of Commerce, Edinburgh, met to hear an address from Lieutenant Cole, R.E., as to the proposed arrangements for the Annual International Exhibition, 1872. The chair was taken by Mr. Josiah Livingston. Lieutenant Cole stated that the industrial department would comprise cotton, jewellery for ornaments, paper, stationery, and printing, musical instruments of all kinds, and acoustic apparatus. These departments would not be represented for another ten years. The fine art department would include pictures in oil and water-colours, sculpture, and miscellaneous articles; the third division would consist of inventions in machinery. The exhibition would be carried out on the same principle as last year. For the convenience of visitors there would be a supplementary gallery, where duplicates of the articles exhibited only would be allowed to be sold. Prof. Archer, of the Museum of Science and Art, spoke in favour of the exhibition as a means of stimulating commerce. The exhibitors from Scotland were not so numerous last year as he had hoped; but those who had exhibited were highly pleased, and told him they intended exhibiting at the forthcoming exhibition. Lieutenant Cole said certain inconveniences must necessarily arise in the getting up and carrying out of such a large undertaking. No advantage was given by the committee to the foreign exhibitors; but the explanation probably was that the French exhibitors alone applied for and obtained a supplementary gallery. Sir George Harvey spoke in favour of the arrangements of last year in regard to the picture collection, and trusted these would be adhered to next year. It was stated, in answer to Mr. Harrison, that the collection in connection with paper manufacture would include raw material of all descriptions from which paper is made. It was intimated that Professor Archer had been requested to make a collection of the kind referred to. Mr. Millar suggested the appointment of a committee in Edinburgh, to examine goods before being forwarded to London, so that on the recommendation of the committee the exhibitors would feel there was a fair prospect of the goods being accepted by the London Committee. This would give confidence to intending exhibitors, who did not like to run the risk of packing up goods on chance and sending them up to London, and then have them rejected. Lieutenant Cole thought this suggestion might be forwarded to General Scott. A general feeling was expressed in favour of some such arrangement being made, not only in Edinburgh but elsewhere. Several questions regarding details of arrangement were afterwards put, and replied to by Lieutenant Cole.

Peniche Lace.

With regard to a proposed exhibition of Peniche lace, Mr. Geo. Brackenbury, Her Majesty's Consul at Lisbon, says:—The inhabitants of Peniche have devoted their energies to fishing and to the manufacture of lace resembling either Honiton or guipure, or the black silk lace known as Chantilly.[*]

In this occupation from 900 to 1,000 women are constantly employed. They use a portable cylinder-shaped pillow, stuffed with wheaten straw, lined for the most part with red long-cloth or cotton, and having a cylindrical opening from end to end large enough to admit the hands, and in which are kept the scissors and thread, and, in the case of an old woman, the spectacles and snuff-box. Their other implements are a basket-work or wooden table to support the pillow, pieces of saffron-coloured cardboard with designs traced upon them, and perforated at the points where the pins are to be introduced; the bobbins and pins, which are always counted by dozens; silk, cotton, or linen thread, as the case may be; and finally a small pair of very fine scissors, and a metre or yard measure. The bobbins of the poorer workwomen are made of fine wood; those of a class a little better off of the heavier, and therefore better, Brazilian wood, and in rarer instances of ivory. . . . . .

The labour of these poor women is most miserably remunerated. One of the most skilful, for a whole day's work, can earn at most from threepence to fivepence, and even this is not paid her in money, as the abominable truck system is in full force in this remote corner of Europe. The "rendeiro," or lace-dealer, is a sort of middle-man, who makes advances to the workwomen in money and necessaries of life, receiving the lace in payment. When a certain quantity is collected, it is handed over to hawkers, who sell it all over the country, obtaining a commission of 10 per cent. on their sales. Besides the three classes already enumerated as engaged in the manufacture and sale of lace, there remain the "picadeiros," or tracers, women whose business it is to make and paint the cardboard, and trace the designs upon it. These are for the most part badly executed, displaying but little taste and less variety.

The Peniche lace was favourably mentioned at the Great Exhibition of 1851, although the quantity exhibited was very limited, and it obtained the silver medal at both the Oporto Exhibitions of 1857 and 1861. "These results," says Senor Cervantes, "are not altogether unflattering to an industry which is left to vegetate without direction, scattered about, and delivered over to the individual exertions of poor people, without protection, and without even the stimulus of self-interest." He then refers to a magnificent piece of Honiton lace which was shown at the Great Exhibition of 1862, and of which the design is given in the *Illustrated London News* of the 18th October of that year. The price of this piece was 200 guineas, "and," says Mr. Cervantes, "let one of the most skilled workwomen of Peniche be given a similar or as good a design, and thread of the proper fineness, and let her be offered not 200 guineas, but 100 pounds, a sum which would make her fortune, and see if she will not earn them quite as well as the Honiton lace maker."

My attention has been particularly drawn to this subject at the present time, by an English lady resident here, who takes a deep interest in the sad condition of the Peniche lace makers, and who is just now sending to her personal friends in England a large collection of specimens of this work. These she has kindly permitted me to see. Many of them are of great beauty; in all the work is admirable. Their great defect is poverty of design, but this is more evident in a collection of pieces than in a single piece; and such as they are I feel confident that could they be seen in England they would be greatly admired, and considered marvellously cheap at double the prices for which they are sold in this country. . . . . . .

I subjoin a list of some of the best of the Peniche lace specimens, with a statement of their width, and of their price per metre.

The descriptions given below are, however, only approximately accurate, as for want of proper patterns very few of the laces maintain a perfectly distinct character. This defect is easily remedied, since I believe the lace-makers would readily work to any pattern furnished to them. The particulars which follow refer entirely to specimens which I have myself examined:—

	Width (in inches English).		Price per metre.
Lace of several pretty and effective patterns	4 to 5	..	3s. 6d.
Point lace	6	..	4s. 8d.
*Chantilly..................	5½	..	4s. 6d.
Coarse, suitable for furniture trimming..................	4	..	1s. 7d.
Insertions varying from			6d. to 10d.
*Chantilly lace................	2½	..	1s. 4d.

Pocket handkerchief borders, 4½ inches wide, from 3s. to 4s. each; trimming for square-cut boddice and sleeves in a kind of Honiton guipure, 3¾ inches wide, 10s. per set; Maltese pattern for square-cut boddice and sleeves, 2½ inches wide, 4s. 6d. per set; low square boddice and do. small medallions, 6½ inches wide, 16s. 6d. per set; 9 metres of flouncing, sun flower pattern, in guipure style, 7½ inches wide, £2 12s. 6d. the piece.

EXHIBITIONS.

Exposition Universelle de Lyon, 1872.—This exhibition, originally intended to be held in 1871, but deferred in consequence of the war, will be opened on May 1st next year. The presidency of the London committee has been accepted by the Lord Mayor, and the first meeting will shortly be held at the Mansion-house. Intending British exhibitors should communicate with Mr. Edmund Johnson, 3, Castle-street, Holborn, commissaire-délégué and hon. secretary.

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[*] Senor Cervantes, in a work on the subject, reminds his readers that Honiton, and all that class of lace, is made on a pillow with pins, bobbins, or even spindles; that guipure is lace made with a crochet-needle; that blonde and Chantilly are white and black silk hand-made lace respectively; and that Brussels is lace of which the ground is made in the loom, and the ornaments by hand with bobbins.

[*] Any pattern of Chantilly lace can be made in black silk for a slight increase of price.

THE EDUCATION OF GIRLS.

On Monday evening, a meeting was held at the Infant School, Dulwich, "to consider the claims of women to educational endowments," as advanced at previous meetings by Mrs. Grey. The chair was taken by Mr. C. S. Roundell; and there were also present—Mrs. Grey, Lord E. Fitzmaurice, M.P., Mr. A. B. Dicey, the Master of Dulwich College, General Stuart, Colonel Macdonald, and the Rev. Mr. Bell, Master of the Blue Coat School. The Chairman, in opening the proceedings, said it might be expected that the Schools Commission would shortly have to deal with the endowments of Dulwich College, as a memorial had been sent in, signed by sixty of the inhabitants of Dulwich. The Chairman, in conclusion, briefly explained the object of the meeting to be the promotion of female education in every legitimate way. Lord E. Fitzmaurice, when moving the first resolution, impressed upon the meeting the practical advantages which would result from the increase of educational facilities for women. Better governesses would be obtained for our children; but, in addition to this, good education was valuable, not only as a means to an end, but as an end in itself. He was glad to see so many ladies there, because for all ladies the subject of education was one of serious importance. He alluded to the magnificent educational endowment which Dulwich was fortunate in possessing. They had the governors of that endowment ready to establish a school for girls, and therefore they had only to take time by the forelock, to seize the present opportunity, and thus to obtain both a blessing and a treasure for their children. The noble lord moved:—"That the present state of female education was very unsatisfactory.". Mr. Young seconded the motion, which was carried unanimously. The second resolution was moved by Mrs. Grey:—"That assistance from educational endowment for the education of women is necessary;" and that lady repeated at some length the arguments she had previously advanced at the Society of Arts meetings. Her observations were received with general acceptation and approval. As a reason why some portion of the existing endowments should be devoted to female education, she stated that in all England and Wales there were only 14 endowed schools for the secondary education of females, with a revenue of £3,000, against 1,300 endowed boys' schools, with a revenue of £277,000. The resolution was seconded by Dr. Cann, head-master of Dulwich College, who expressed his hearty sympathy with the objects of the meeting. He called upon the ladies to help the movement, assuring them that their co-operation would most probably lead to certain success. The third resolution was moved by Mr. Adams and seconded by Mr. Dicey:—"That this meeting is of opinion that the establishment in and around London of day-schools for girls, on the model of those already established in Edinburgh by the Merchants' Company, and with an equally moderate scale of fees, is urgently needed, and would be of great public advantage; and hopes that the Endowed Schools Commissioners and the Governors of Dulwich College will speedily take steps for the extension to girls of the benefits of the endowments of Dulwich College." This resolution was carried unanimously, as was also a vote of thanks to the chairman.

INSPECTION OF COAL MINES.

The Inspectors of Coal Mines report a large production of coal in Great Britain in 1870. They compute that 112,875,725 tons were raised in that year. The 991 deaths by casualties on and about the mines in 1870 were in the ratio of one to every 113,900 tons of coal raised. The number of male persons employed is computed at 350,894, being one to every 322 tons raised; and one in every 354 of these persons was killed. The lives lost were, 185 by explosions of fire-damp, 411 by falls of coal or roof, 129 in shafts, 186 from miscellaneous causes underground, and 80 by accidents at the surface. It is the first year since 1865 in which the lives lost in and about mines have been less than a thousand, and we must go further back than that to find so many tons of coal raised for every life lost. Nevertheless, the list of accidents is, as one of the inspectors says, discreditable; and it would be startling to see it divided into two classes, so that all might see and know how large a number of men perished in their work through want of reasonable care and caution. If we take up the report of Mr. Lionel Brough on the south-western district of England, we find him reporting three explosions, two of which were occasioned by sheer folly and ignorance. Among the non-fatal explosions in that district are the following:—A deputy actually went to a suspected place and examined for gas with unprotected flame; naturally enough, he was burned. An overman went on to the top of a "fall" with a naked light in his hand; the fire-damp immediately ignited. The inspector says:—"If the officers of a mine do these things, it is not surprising that the men follow their example." A chartermaster fired a shot which blew out without loosening the coal; seven men and boys were filling cartridges with gunpowder from an open can only nine yards from the shot-hole, and in a direct line with it; the flame caused the powder in the can to explode, and four men died of the injuries they received. A man had charged a drill-hole with powder to prepare it for blasting; while taking the remainder back to its place he actually carried the can of gunpowder and his naked light rattling against each other, and it is almost unnecessary to say that the powder exploded and he was burned. Another inspector, Mr. Higson, reporting on the West Lancashire and North Wales district, has to state that 24 lives were lost last year by explosions, which would not have happened if there had been proper care. A shot was fired without making any inspection for gas; and he has to speak of cases in which men went "rambling through the workings of a mine with naked lights as if they were in a wood." Explosions are a punishment which will inevitably fall on the men in fiery mines so long as they will run the risk of having open lights rather than suffer the inconvenience of a poor light. Mr. Wynne, inspector, reports a fatal explosion, and adds:—"It is painful to be forced to say that if the commonest care had been exercised, these four lives would not have been lost." Mr. Wardell reports eleven deaths by explosions of fire-damp, and says all might have been prevented had the rules been observed. A fireman allows colliers to be in a place while in an unworkable state, and permits open lights near to where the fire-damp is being displaced; an explosion follows. In a mine at Bloxwich workmen were engaged in restoring ventilation after a temporary suspension through fire, and a man went into an unventilated part of the works, in spite of remonstrance, in search of his cat, which had been left when the mine had been abandoned; he never returned alive. Mr. Brough protests against narrow passages, as precluding effective ventilation. Mr. Alexander, inspector for the western district of Scotland, has to call attention to the nature of the communication between shafts. There may seem to be a way of escape in case of one shaft being rendered unavailing, but he finds it necessary to observe that "an opening through which a person may possibly drag himself with much toil and trouble is not a roadway;" he seems to make a very moderate demand when he says, in view of explosions and emergencies, that the communication should never be less than 4ft. wide, and 3½ft. or 4ft. high. It will be observed that no less than 80 persons were killed last year by accidents on the surface. Such a loss of life, not in the darkness of the mine, but in the light of day, shows how regardless the men must have been of their safety and of the instructions and rules given to them, and how inadequately overlooked. A boy of fourteen was sacrificed by being set at that early age to the dangerous operation of oiling machinery in motion, and a child of ten was allowed to assist a man at a railway siding, and was killed by a blow from the door of a truck which was actually unbolted as he was trying with his little strength to push it into its place to be loaded. A very large proportion of the accidents in shafts are attributable to carelessness. But falls of stratified material are the worst peril. The owners find props, but the men too often omit to set them in time or to set a sufficient number. Mr. Higson mentions a fatal fall, and says that the man had set one prop only; and so it is generally; three more props would have saved his life. He notes the general absence of discipline, and says, "it is seldom enforced by men who have been raised from the ranks, and most of the underground superintendents have sprung from that source. It is too often the case that to have orders executed properly they must see them done, which in mines is not always possible. As the bailiff has to go from one place to another, men are unavoidably left to carry on the work by themselves in parties of from two to five or six." If an effort be made to establish strict regularity at one place, the men will leave and go to another; and hence by degrees many objectionable practices are established. "Timbering," says another inspector, "is apt to become a matter of chance, to be performed by any person who first sees danger, and has time to do it without stopping to turn." Severe competition forces cheapness and rapidity of production. Mr. Wynne, inspector for North Staffordshire, &c., makes the following remarks:—"I find that the managers, and more especially the underlookers, are more than ever inclined to remain above-ground, and allow the chartermasters or butties to carry on the workings in their own way, and the consequence is that the safety of the men is but little thought of, when it stands in the way of an ignorant man making a few shillings more profit by allowing his men to risk the danger. If the coal proprietors saw as much as I see of the waste in working, and the risk that is run, for the sole purpose of sending coals to the surface at a cheap rate, they would soon put an end to the present state of things, by appointing good managers, who would often go into the pits themselves, and take good care that the underlooker went down every day; for I hold that a colliery worked by charter requires more supervision than one that is worked directly by the owner, because the owner has a regular staff of day wagemen to look after the proper working of the pit, while in the other case the men are but little cared for beyond the kind admonition of the butty, 'Now lads, take care of yourselves,' and that intermittent supervision which an underlooker gives when he goes every seven or fourteen days to measure up what is called the 'dead work.' As there appears little doubt but an amended Act for the inspection of mines will be passed, the opportunity will arise for framing an entirely new code of special rules, which I trust will be made much more plain and more stringent; for in my opinion many valuable lives will be saved, if every man's duty be clearly defined, and good men employed to see that those rules are strictly carried out." This gentlemen gives it as his decided opinion, after the investigation of so many cases which have come under his notice, that fully half the falls of roof are owing to the carelessness of those who are in charge of the workings, and who, instead of seeing that the roof be propped as soon as the coals fall, allow them to be loaded up, intending that then, the work being done, the roofs shall get support. But the fault may be in the officers or may be in the men, and it is necessary to secure the co-operation of both in exercising care and caution. If there be one defective link in the chain it will break; the carelessness of one man may destroy scores of lives. A stricter enforcement of the colliery regulations might make habits of carefulness and thought the rule, and not the exception, and in fact without a complete system of discipline there can be no security. The great hope lies in the progress of education. Underviewers may now be found utterly illiterate; one is described as not knowing what many of the rules mean. If the new Education Act shall secure for miners that early training and development of the intellect which renders obedience to general regulations easy, by enabling those subject to them to see their necessity, then much will be done to raise up a more thoughtful class of miners. On the question whether boys should be prohibited from working in mines until they are 12 years old, it is remarked that boys kept too long from work acquire lazy habits. Mr. Baker, inspector for South Staffordshire, &c., considers that to prohibit boys from working in mines until the age of 14, or even 12, is open to grave objections. "Miners, like sailors, can hardly be too early initiated into the special calling to which they are destined." Besides, if other occupations are open to them earlier, they might be put to these, and there might thus be a serions hindrance to the supply of trained colliers. He says that with a system of compulsory education, the boys intended for our future colliers would be able, as a rule, to read and write well at the age of ten years. It is stated that at present boys are not generally taken underground in the thick mines until they are 12, owing to the unwillingness of the managers to saddle themselves with the responsibility of seeing fulfilled the educational provisions of the Mines Inspection Act; but in the thinner mines it is often found necessary to submit to this, and it is said that the exclusion of boys under 12 from these mines would could cause practical inconvenience. Mr. Wardell, inspector for Yorkshire, states that a vast amount of ignorance unhappily prevails among the mining community, as may be observed from the number of witnesses at inquests unable to write their own names. This state of things, he says, is not confined to the colliers themselves, but is often found among deputies, firemen, and overmen, to whom the possession of the rudiments of education is of vital importance. The "responsible" men are generally intelligent, well versed in the ordinary principles, and occasionally in the higher branches of knowledge; but it ought not to be endured that, among a body of men with responsibility varying in extent, there should be one single case of a man intrusted with only the slightest degree unable to read or write. Mr. Wardell believes that much is being done by the miners themselves to promote education, and in this they are cordially supported by colliery owners. Boys under 12 now working in mines, under the present Act will, when they become colliers, at any rate be able to read and write. Mr. Alexander states that a better educated class of managers is gradually being obtained. Mr. Brough remarks that the late Mr. Nicholas Wood advocated a curriculum for "viewers," at Durham or some other university. Mr. Brough suggests that some mode of study is very desirable. The scientific knowledge so valuable and so needful to those who have to direct operations underground cannot, he says, be obtained in grammar schools and private establishments; but there might be a college career of but moderate length, in which practice might be included. Continental mining managers, to a certain extent, he adds, possess the great advantages of this higher order of education; and the value of it in this country would quickly manifest itself in the improved condition and comfort of our mines, and, indeed, of all our other industries.

CORRESPONDENCE.

SANITARY PRINCIPLES OF SCHOOL CONSTRUCTION.

Sir,—A letter from Dr. Leon Soubeiran, inserted in the last number of the *Journal* of the Society, in reference to the floor-warming in China, says, "This system no doubt supplies heat, but the air is stifling, and the heat is difficult to regulate.” No doubt it may be made so, and the heat might be raised to that of a hot oven. But surely it does not pass ordinary skill to make it far otherwise, and to have the heat at discretion, and the preponderant testimony beyond that I have cited is that the warming is the most agreeable known. We have experience in Europe of the principle of warming by diffused heat from earthenware surfaces. In Sweden and in the north of Germany rooms are warmed by earthenware stoves of considerable size, reaching to the ceiling. Americans and others used to warming by iron stove surfaces have testified to the agreeableness and great superiority of the warmth diffused through the tile or earthenware surfaces. Now, the same results may be confidently anticipated from warming by *horizontal* earthenware surfaces that are derived from warming by *perpendicular* earthenware surfaces. It may be anticipated that better results will be obtained by warming with lower degrees of heat from the horizontal surfaces.

I am glad to learn that the principle I have recommended is in course of practical adoption in Holland.—I am, &c., Edwin Chadwick.

THROUGH RAILWAY ROUTE TO INDIA.

Sir,—If there is one obstacle greater than another to the desirable enterprise discussed in Mr. Hyde Clarke's paper of the 22nd ult., it is the prevalent idea of the difficulties, during construction and maintenance, of a line of railway in a half-civilised country, where it is supposed that, as Mr. Rawlinson expressed it, a whole army would be necessary to guard the line.

I meet this objection in many quarters, and more especially in the highest. It is an idea which must be shown to be fallacious before we can hope to have official support for the Indian railway.

For that purpose, I should wish, through the medium of your *Journal*, to relate what my experience in Asia Minor has demonstrated. But first I will venture to assert that the railway, if such there be, that has not created an augmentation of traffic in the country which it traverses, must be a singular exception to all others; and, in advance of this increase of traffic, must come a certain amount of civilisation to produce it.

Asia Minor is populated by a number of different races. Some, such as Levantines, Greeks, and Armenians, are employed in mercantile affairs; others, namely, Turks, and a few Greeks, cultivate the soil. Yeuruks and Kurds are nomades, men of resource, proprietors of flocks and cattle; and Zebeyks, Arnaouts, and Montenegrins, wanderers without resources, having only a precarious means of subsistence, eked out by depredations.

In the construction and maintenance of the Smyrna and Cassaba railway, individuals have been selected from these tribes in the following manner:—For the survey Greeks and Levantines were employed; but when the works commenced, separate gangs of Kurds, Turks, and wanderers were made to work in emulation of each other.

Our police were the Zebeyks and Arnaouts, and our commissariat the Yeuruks. They were all paid regularly in coin, and procured meat to eat, of which they soon felt the benefit. Regular work, regular pay, and regular food, made new men of them.

The railway is completed, and they look on it and protect it as their own creation. The only mischief perpetrated is the unscrewing and carrying away, by thoughtless shepherds, of nuts from bolts used as fastenings, the ends of which have not been properly burred.

I have wandered as far as Coniah, in Asia Minor, and mapped out every lane and highway on a zone of ten miles between that town and Smyrna. I have ridden through every lane and village within a like zone between Samsoon and Sivas, and have never been molested, although I carried no other arm than an umbrella, and, often alone, was seldom attended by more than one man for guard.

Some years ago, whilst exploring the country, I rode, in company with my interpreter only, into the village of Sebetlœ, near Amassia, inhabited at that time by a band of 300 Bashi Bozooks, who disavowed the Sultan's authority. I showed my firman and demanded a guide; was refused, but unmolested. These robbers several times came to look at the operations of my surveyors, but did not molest them or me. They were afterwards dispersed by the authorities.

I think, then, there is reason for my conviction that the very construction of a line of railway, through the most populated parts of Central Asia, would be the immediate means of producing a sufficient amount of civilisation to insure its usefulness; and I do hope that no half-measures will be taken in carrying out this great work.

To insure traffic usefulness, and more especially safety, the line must be carried through or near to the centres of population—near to the towns of Samsat, Diarbekr, Koom (for Teheran and Ispahan), Semnan‘ Herat, and Cabul, as proposed by Mr. Soares, who has, I understand, travelled along that line of country.—I am, &c., Charles E. Austin.

1, Westminster-chambers, Victoria-street, S.W.,
November 23, 1871.

Sir,—I have perused with much interest Mr. Hyde Clarke's able paper, read by him in the Society's Room, last Wednesday evening, “On the Progress of the Through Railway Route to India;” and, having formerly been assistant-manager of one of the Eastern railways, I may, perhaps, be judged competent to make a few remarks, as regards a more improved mode of communication with the East than that at present existing.

I think the first requisite should be, before any contemplated change, the aim of independence of foreign governments as far as that is practicable consistently with the shortness of the route, and, where this is not attainable, that there should be some stability of government and some security of life and property in those countries in which the lines would pass, which is not the case at present, and in this I agree with Mr. Rawlinson, C.B.

Communication by lines of railway for such great objects, passing through foreign territory and under foreign protection, would, in case of war, be subject to occupation in turn, thus doing away with the objects sought, viz., reliability of communication with India; and, even where it would be possible for the route to be kept open by an army of occupation, the difficulties, danger, and expenses would not compensate for any temporary advantage gained; and until this hoped-for security can be obtained, I do not consider there can be a better route, under the present condition of circumstances, than that *viâ* Brindisi. Mr. Hyde Clarke deals with the subject in a very exhaustive way, showing the advantages which would accrue by local intercourse in the provision of railway accommodation by the several governments, not only for commercial, but also for political purposes, which would afford the means of opening up vast resources between Turkey, Persia, and India, and between those countries and Western Europe. But the communication between our Eastern possessions and England in the transmission of passengers and mails requires some further security than can be obtained at the present moment in passing through those countries.—I am, &c., C. L. Brooke.

7, Gresham-street, E.C., November 27th.

THE PROPOSED NAVAL UNIVERSITY.

Sir,—My family having been connected with the maritime profession before the days of steam, and when courage and pluck, with the ability to handle a cutlass effectively, to fire a gun, and to fight or beat off a pirate or privateer, were as necessary on board our large merchant ships as a knowledge of nautical astronomy and practical seamanship, entertain a special regard for the commercial branch of our naval services, and have accordingly observed with regret the restricted application of that wide expression "Naval University," which is apparently adopted by the eminent ex-constructor, Mr. Reed, and by other able writers—officers, R.N.—whose letters have recently appeared in the *Times*. This proposed "Naval University" is in effect talked about, written about, and schemed about, as if it were to be a college attached exclusively to the Royal Navy.

Now, Sir, I have no claim to "burst blustering" (like a certain admiral) into the columns of the *Times*, nor could I expect (like Mr. Reed) to see my views in large type in the leading journal. I venture, therefore, to ask a modest space, if you can spare it, in the columns of your paper, feeling that the main object of my letter is in entire keeping with the efforts of the Society of Arts, to promote not arts alone, but manufactures and commerce also.

As might be expected, Mr. Reed regards that masterpiece of ingenuity and enterprise, a great ship, from the constructor's point of view; and I readily admit that the parent (so to speak) of such children—of so many floating giants—as he can claim to be, may be justly proud of his progeny, and be anxious alike for their success and the advancement and teaching of his noble art. Officers, R.N., on the other hand, although not underrating the science of "construction" or the mathematical principles which govern it, can and do appreciate the importance of it, and of its kindred questions of form, materials, strength and stability, flotation, behaviour, speed, capacity, and safety (as of their possible homes) in a long Atlantic roll or before an enemy; and they dwell, and rightly, upon the necessity of a more thorough, scientific, and practical training being provided by the country for their own order, so that, under all circumstances, whether 1,000 miles from land, or neighbouring a treacherous coast with dirty weather or with the wind blowing great guns—a captain, or his second in command, may know how to take care of his ship, and of the valuable lives depending for safety upon his presence of mind, knowledge, and judgment. Of these qualities, indeed, the country has just witnessed a right noble example in Captain Thrupp, R.N., of the *Megæra;* and it is to be hoped, after due investigation, that some public recognition of his eminent services may be accorded to him.

Should the projected naval university be established at Greenwich, the theory of construction, with its principles of form, strength, and tenacity of materials, immersion, &c., should undoubtedly be one of the faculties there, and such practical illustrations of shipbuilding be made use of as models on a large scale, which the neighbouring docks and yards (now that Deptford and Woolwich dockyards have been dismantled as regards shipbuilding) could supply. But I contend that this university should be a national institution, and be opened alike for students attached to either branch of the nautical profession. Mr. Reed is, I trust, too large-hearted to feel jealous of such an extended application of its teaching and resources, for he must know full well that to this insular and commercial country, a good ship, combining strength, speed, and a great carrying capacity, with general handiness, (and this, whether under canvas or steam), is of great value in our postal, passenger, and general merchant services, as in the Royal Navy itself.

"A Flag Officer's" letter, which appeared in the *Times* on the 25th October, like those of the other writers above alluded to, is founded too exclusively upon Royal Navy considerations; but its third paragraph expresses so admirably, in my judgment, the functions which ought to belong to a naval university, that I venture to reproduce it. The able writer says:—"The knowledge that we should seek to acquire is that which will enable us to handle a ship under all circumstances. This knowledge may be termed "nautical science," and it includes within its grasp a large proportion of the known sciences—astronomy, the science of navigation, hydrography, and marine surveying; physical geography, chemistry, many branches of mechanical science and marine engineering, hydrostatics, meteorology, magnetism, the science and art of gunnery, shipbuilding &c. Many other subjects could be added to the list, as either necessary or very desirable additions to a naval officer's education, such as acquaintance with modern languages international law, &c."

The statistics of lives, ships, and property annually lost at sea, as well as the "wreck chart," are too painfully known to need more than a general, although emphatic allusion here. Apart, those old and unseaworthy vessels, which cupidity or poverty on the part of owner, or an utter disregard for human life, will persist in sending to sea, and apart also those of original bad construction, it is certain that a considerable share of our disasters at sea are due to bad handling, to unreadiness and indecision, to the absence, in short, of that special knowledge which enables a man to discern and to do that on the instant which, ten minutes later, is either useless or impossible. How many a ship hugs a lee-shore, owing to her captain's ignorance of her position, of the force of winds and currents, and of the lee-way which she is making, and this as a consequence of inaccurate observations and reckonings, neglect of sounding, and bad sailing. How many a vessel comes to grief through shortness of hands, or from being badly "found." A large moral and economical question, indeed, lies behind all this, namely, that of marine insurance, and its influence upon the character and responsibility of the nautical service; but upon this I do not now propose to dilate. I would, however, express an opinion that, if a higher social status were given to merchant captains as a class, if stricter tests of competence were exacted from them, including that of a degree obtained at a naval university, and if a more complete examination and survey were made of ships immediately after discharging cargo, and again just before stowing cargo for a fresh voyage, a very considerable diminution would be soon observable in our annual catalogue of disasters. The first-class merchant captain of the present day has often under his command a magnificent structure, of a tonnage exceeding that of four, five, or six large ships, as ships were reckoned 50 years ago, and carrying hundreds of lives—passengers and crew—besides cargo, value in bullion, and specie, but these palatial vessels, although possessing some special elements of safety from their superior build and trim, the employment of steam, either as their principal or auxiliary power, and the rapidity of their voyages, cannot, owing to their draught of water and immense length, run for shelter into many roadsteads or harbours which are easily accessible to ships of lesser pretence. Considering, then, the important functions of a naval commander in relation to his ship, his passengers, crew, and cargo, together with the really magisterial character which during the voyage belongs to him, I can hardly imagine a more responsible position than that which such an officer fills.

I would say, therefore, let degrees and honours be conferred upon students, after strict examination, at the proposed "Naval University," and let such distinctions mean recognised fitness, by attainments, earnestness, and character, for the high duty of commanding a large merchant or packet ship. Of course, some preliminary and intermediate training afloat would be exacted as a guarantee of practical knowledge and of general and physical aptitude. With regard to officers in the Royal Navy, I would say, let analogous distinctions be conferred at the proposed university upon them; and further, let no officer be entrusted, after a certain date, with the command or navigation of a ship, who had not at least taken the degree of "M.N." (Master in Navigation) thereat.

By means such I have endeavoured to describe, the nation would have some better assurance than at present of the competence and worthinesss of officers in actual command, as well as of those immediately below them, and would feel a more complete reliance that the ships of the royal and commercial navies alike were in trustworthy hands. And, would not such a system, in the event of a great naval war, provide a body of skilled officers in the mercantile marine, prepared, under proper regulations and inducements, to lend a very effective support to the Royal Navy? A further question which may be put is this:—How much of the difficulty of manning our ships may be due to a distrust of their personal safety on the part of otherwise would-be sailors, owing to the doubtful competence of commanders or the doubtful quality of the ships?—I am, &c.,

A Salt's Son.

Dryelande, 6th November, 1871.

NOTES ON MANUFACTURES.

A special course of instruction in the manufacture of silk has just been opened at the Technical Institution at Como, and will occupy a period of two years. Lectures will be given by competent professors in sericulture and natural history as applied to textile materials, mechanics applied to silk throwing and spinning, chemistry applied to dyeing, and, lastly, on silk weaving. Besides these special subjects, the students will receive instruction in drawing, foreign languages, book-keeping, and industrial economy.

The manufacture of opium in the United States seems likely to succeed. It is stated by the *Philadelphia Ledger* that, in the neighbourhood of Nashville, the poppy has been cultivated for the last three years, with a view to the manufacture of opium. Owing to the lateness of the planting, and inferior value of the soil, the crop of 1870 failed, and to obviate this difficulty, seed was obtained from Calcutta and Smyrna, at a cost, in gold, of four dollars and a-half per ounce. This year's crop, it is announced, will yield from 60 lbs. to 65 lbs. of opium. Other persons who extensively engaged in the cultivation of the poppy in Tennessee report similar success. The best opium poppy seeds were obtained from Smyrna, planted in good land, and cultivated like cotton.

Last year, attention was directed to the progress Russia has been making in the manufacture of cotton fabrics. From the display of these goods, at an exhibition held at Moscow, we are told that the cotton mills are not the expensive structures that they are in England, and we are also informed that the managers and foremen in the factories are Englishmen. To what extent Russia may supply cotton fabrics to the marts of the world hereafter, or whether the goods manufactured by native industry are and will be confined to home consumption, it is not easy to foresee, but it is evident that vast strides have been made in this one branch of manufacture within the last quarter of a century. It is scarcely thirty-five years ago since the first spinning mill was erected in Russia, and now it has close upon 400,000 spindles in full activity, which produce upwards of 350,000 poods (36 lbs. avoirdupoise to the pood) of yarn. This yarn is generally of very low numbers, varying from 20 to 30 for the woof, because there is a large market for coarse fabrics. The principal seat of the manufacture of the coarse goods is Central Russia, especially in Moscow, Wladimir, Kalouga, Kostroma, &c. The peasantry receive the yarn from contractors, and occupy themselves in weaving it into cloth during the winter, at very trifling wages. The goods thus manufactured in the villages may be divided into three classes, according to the quality of the yarn. The first includes those of the lowest quality, and which are sold at 18 to 24 copecks the arsheen (about $2\frac{6}{10}$d. to $3\frac{1}{2}$d. per yard). The warps are formed of No. 28 yarn, and the woof of No. 30. The fabrics of medium quality, valued at 25 to 28 copecks the arsheen (about $3\frac{1}{2}$d. to 4d. per yard), are formed of Nos. 34 and 36 warp, and 38 to 40 woof. The better class of fabrics are made of foreign yarn; Nos. 38 to 42 for warp, and 44 to 48 for woof, and sell at 29 to 42 copecks the arsheen (about $4\frac{1}{4}$d. to $4\frac{1}{2}$d. per yard). Besides the factories producing the classes of goods just named, there are from 140 to 150 for the superior articles, without including cotton velvets and muslins. The former branch of manufacture has been greatly developed during the last ten or dozen years, the chief market for which is China. The manufacture of printed cottons is said to have arrived at great perfection. The chief seat of this branch is St. Petersburg, where it is chiefly carried on by Swiss. The quantity made is estimated at about three and a-half millions of pieces, which is sufficient to supply the consumption of the whole empire.

Russia is also very anxious to see the manufacture of sugar introduced in the Caucasus. This desire has a chance of success, as it is founded on considerable protective duties. Those persons who establish sugar manufactories in the Caucasus are, according to regulations issued, to be quite free of the duty levied on sugar for the first two years; the following two years they will be taxed with one-third of the proposed duty; and for the next two years they will have to pay two-thirds of it. Thus not till the end of six years will the whole tax be imposed upon them.

According to a recent return, oak timber is rapidly disappearing from Europe. In France, since 1669, no oak has been felled until full grown, that is, until within 30 years of its probable decay. The consumption of oak timber in France has doubled during the last fifty years. In 1866, £170,000,000 worth was consumed, of which £500,000 worth was imported, against £5,000,000 worth consumed in 1820, of which £400,000 worth was imported. France requires every year 15,000,000 cubic feet of oak timber for wine casks, 600,000 for her fleet, 150,000 for railway cars, and 750,000 for building purposes. In 1826, the total value of imported staves was £800,000; to-day the total value is £5,000,000. A similar increase of the importation of oak for the next thirty years would probably double the price. France, after losing Alsace and Lorraine, contains 135,000,000 acres, of which 20,000,000 are covered with forest. In Norway, the Administration of Forests declares that it is necessary to stop the cutting down of timber. The same enormous consumption is going on all over Europe. Holland and Belgium are nearly denuded of timber, and are large importers. North Germany is rich in forest, but within half a century has began to cut down young trees. Austria has sold her forests at auction since railways have been introduced. Spain and Greece are almost absolutely woodless.

Copper mining in Cornwall has been seriously affected, during the last few years, by the heavy supplies regularly received from Chili, Spain, Australia, and other countries. The official returns for 1870 and 1871 show that the supply of copper ore and regulus have considerably decreased, especially from our great rival, Chili; but that much more comes in the guise of "wrought," or "partly wrought," copper. In ingots, cakes, and slabs, we have exported 179,609 cwt., as compared with 151,087 cwt. in 1870. British India only required one-third of what she did in 1870; but Belgium wanted nearly double as much, and France and Holland increased their demands. In wrought or manufactured copper, there was a great falling off. We only sent away 161,407 cwt. this year, as contrasted with 221,101 cwt. in 1870. Germany and some minor customers took more; Holland, Italy, Turkey, Egypt, and British India less. The disturbances with France reduced our exports to that country from 27,278 cwt., in 1870, to 1,897 cwt. in 1871, and British India fell in the first two-thirds of this year from 68,000 cwt. to 38,851 cwt.

The invention of our present lucifer match seems to be due to a happy thought which flashed through the brain of Mr. Isaac Holden, who so terms the idea in his evidence before the Patent Committee. Mr. Holden had to rise at four in the morning, to pursue his studies in chemistry, and experienced the gravest inconvenience from his tedious efforts to obtain a light from flint and steel. He was giving lectures at this time to a very large academy. He goes on to say:—"Of course I knew, as other chemists did, the explosive material that was necessary in order to produce instantaneous light; but it was very difficult to obtain a light on wood by that explosive material, and the idea occurred to me to put under the explosive mixture sulphur. I did that, and published it in my next lecture, and showed it. There was a young man in the room whose father was a chemist in London, and he immediately wrote to his father about it, and shortly afterwards lucifer matches were issued to the world." These early lucifers had two important faults, the first was, that after exposure, the phosphorus on them became useless; and the second was that they were dangerous to handle, on account of the easy ignition of the phosphorus. In 1845, the Society of Arts commended the improvement of a Mr. Barker, who placed the sulphur over the phosphorus, thereby keeping the latter free from the deleterious influence of the atmosphere. The Société d'Encouragement de Paris rewarded a similar improvement some years later.

Dr. Meyer, of California, is said to have invented a new alloy, composed of copper and iron, united in certain proportions, to form a substance which can be tempered to a hardness greater than that of steel, and can be easily worked. It is claimed that it can be used with great advantage in such articles as shoes and dies of stamp mills for instance; and, on account of its great hardness, will outlast by a very considerable length of time those now made of chilled cast-iron, while they can be manufactured just as cheaply.

Mr. Sproule, in a letter to the *Times*, points out the advantages likely to accrue from the introduction of beet sugar manufacture in England, in the following terms:—"The beet sugar manufacture, besides presenting an extensive field for the profitable investment of capital, has the further great advantage of localising employment, and providing it at the very time of the year when it is most required in the rural districts. The tendency of manufacturers generally is towards centralisation, the evils consequent upon which now so much attract the attention of our social philosophers. Providing healthful employment in the rural districts, may, in fact, be said to be one of the great problems of the times. This the beet sugar industry, without a single concomitant drawback, supplies. It would give an impetus to agriculture to supply the raw materials, while the careful cultivation involved in seeking to make quality an important consideration in the growth of the roots could not fail to lead to improved husbandry generally. The very period at which farm labour is slack, the sugar manufacture is in operation. The production of the roots would again greatly increase the demand for farm labour. In every point of view, therefore, the introduction of the manufacture would be fraught with advantages of the most substantial kind."

In a paper lately read before the Paris Academy of Sciences, the author said that from all time it has been recognised that the oxidation of tin during fusion is destructive to the quality of bronze, but even up to the present time this has been opposed by the stirring up of molten metal with wooden rabbles. The oxide of tin, which of itself has no strength, separates the molecules of the alloy, and reduces its power of resistance. The employment of phosphorus as a reducer gives remarkably uniform results; the oxygen of the tin oxide is absorbed, and the resulting phosphoric acid goes to form phosphate of copper, which passes away in the scoria. Again, whilst ordinary bronze, submitted to the action of successively remelting, becomes more and more deprived of its tin, the phosphoric bronze can be cast over and over again without losing its proportion of tin. It appears to form itself as a fixed phosphate of tin, containing one equivalent of phosphorus and nine of tin. By a series of prolonged trials the properties which the phosphorus communicates to ordinary bronze have been ascertained. It appears the characteristics of the alloys change. The colour, when the proportion of phosphorus exceeds $\frac{1}{2}$ per cent., becomes warmer, and, like that of gold, largely mixed with copper. The grain or fracture approximates to that of steel. The elasticity is considerably increased; the absolute resistance under a fixed strain becomes in some cases more than doubled, whilst the density is equally increased, and to such a degree that some alloys are with difficulty touched by the file. The metal when cast has great fluidity, and fills the moulds perfectly, even to their smallest details. By varying the proportion of phosphorus, the particular characteristic of the alloy which is most desired can be modified at will. An experiment was made in phosphoric bronze with a 6-pounder gun, which was submitted to a destructive trial, in comparison with a similar piece in ordinary bronze, cast by the Royal Foundry at Liège. From the results of these trials, taken at various times during the firing, it appears that the durability of the gun of phosphoric bronze is very superior to that of the gun of ordinary bronze, and that with bursting charges, which reduced the latter piece to fragments, the former could be still fired with perfect safety. The bronze employed had been obtained by the addition of phosphoric copper to metal provided out of the guns. The new bronze, prepared under suitable conditions of composition and melting, can be rolled out and hammered with the greatest ease, without losing its tensile strength. Cartridges that can be loaded and fired fifty times may be formed from it. The mechanism of breech-loaders has also been made from this material. Six thousand rifles fitted in this manner have been supplied to the Belgian Civic Guard. Of the same material also are cast toothed gearing for rolling-mills, hydraulic presses, bearers, eccentric straps, piston-rings, &c. It is also specially adapted to the production of works of art and decoration. The ease of casting, the good colour, and its resistance to oxidisation, are the special qualities adapting it to these purposes.

GENERAL NOTES.

The Proposed Tunnel between Scotland and Ireland.—In his opening address to the Belfast Natural History and Philosophical Society for the session of 1871, the president, Mr. Joseph John Murphy, speaking of the Mont Cenis and other tunnels, said:—"A railway tunnel between Scotland and Ireland has been proposed, to go from near Cushendall to the Mull of Cantyre; and a detailed description, with estimate of the cost, has been published by the engineering firm of Macassey and Scott. If there were no special engineering difficulties, it might be worth while for the Imperial Parliament to spend many millions on a work which would practically make Ireland cease to be an island. There is nothing impracticable in the length of such a tunnel, which, at the narrowest part of the Channel, would be less than fifteen miles; but I fear, though I speak under correction, that the depth of water, which is very considerable, would constitute the almost insurmountable difficulty."

Tunnelling the Mersey.—Notice is about to be given of an application to Parliament for powers to construct a tunnel, or subway, from the bottom of St. James's-street, Liverpool, under the Mersey to Birkenhead, emerging in Argyll-street. The tunnel will be adapted to the construction of a railway throughout, worked at the termini, it is said, on the Fell principle of a central rail for the necessarily very heavy gradients.

Trade in Cattle between France and Italy.—The following returns of the number of head of cattle exported from Italy to France, from the 1st October, 1870, to the 1st October, 1871, are taken from a report of the Italian Consul at Chambery:—

	Via Mont Cenis.	Via Mont Genevre.
Bullocks	36,486	2,172
Sheep	39,129	10,760
Pigs	33,641	2,757
Total	109,256	15,689

Making in all a total of 124,945 head. A considerable number of head of cattle are annually sent to Marseilles, via the Col di Tenda, but no mention of this is made in the consular report.

The Channel.—We (*Economist*) are glad to see that one of the objects of a private Bill lodged by the South-Eastern Railway Company is to enable them "to enter into arrangements and agreements with the governments of France and England, and with the Northern Railway of France, for the purpose of facilitating and improving the communication between England and the Continent." We hope there is at length some prospect of a termination to the horrors of the Channel passage, although the grand projects of a tunnel or a bridge are not yet to be thought of. Deeper harbours on both sides of the Channel, and larger steamers to use them, will constitute an immense improvement on the existing arrangements, and should add sensibly to the dividends of the shareholders in both the English and French railways by which the communication between Paris and London is conducted.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

December 6.—"On Sewage as a Fertilizer of Land, and Land as a Purifier of Sewage." By J. Bailey Denton, Esq.

December 13.—"Observations on the Esparto Plant." By Robert Johnston, Esq.

December 20.—"On the Study of Economic Botany, and its Claims Educationally and Commercially Considered." By James Collins, Esq.

CANTOR LECTURES.

The First Lecture, "On the Manufacture and Refining of Sugar," by C. Haughton Gill, Esq., was delivered on Monday evening, November 26th. The remaining lectures will be given as follows:—

Lecture 2.—Monday, December 4.

Properties of sugar—Its ready decomposibility—Action of a high temperature—Action of dilute acids—Conversion into grape and fruit sugars—Other varieties of sugar; their properties—Winning of cane juice by rollers—Rough evaporation in open pans, and consequent destruction of sugar.

Lecture 3.—Monday December 11.

The sugar-beet—Extraction of juice by diffusion and by presses—Defecation—Carbonation—Preliminary filtration—Concentration—Refiltration—"Boiling"—Separation of syrup from crystals—Treatment of Syrup—Second and third products—Molasses—Nature of molasses—Difference between molasses from cane and beet—Estimation of the value of raw sugar.

Lecture 4.—Monday, December 18.

The refining of sugar, the complete cleansing of it—Melting or blowing up—Filtering, charcoaling, boiling, filling out, draining, liquoring, stoving—Utilisation of syrups—Treacle.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

INDIA COMMITTEE.

A Conference will be held this evening (Friday), Dec. 1st. Lieut.-Colonel A. Romaine Wragge will open a discussion on the subject of "Indian Forests and Indian Railways."

MEETINGS FOR THE ENSUING WEEK.

Mon. ....**SOCIETY OF ARTS, 8.** Cantor Lecture. Mr. C. Haughton Gill, "On the Manufacture and Refining of Sugar."
Inst. of Surveyors, 8. Mr. J. Clutton, "The Cost of Conversion of Forest and Wood-land into Cultivated Land."
London Institution, 4. Prof Huxley, "The Physiology of Bodily Motion and Consciousness." (VI.)
Social Science Association, 8. "The Means, by an improved organisation, of Accelerating the Business of Parliament."
Entomological, 7.
British Architects, 8.
Medical, 8.
Asiatic, 3.
Victoria Institute, 8. Mr. W. R. Cooper, "The Serpent Myths of Ancient Egypt."
Society of Engineers, 7½. Mr. Cargill, "On Floating Breakwaters."

Tues.....Civil Engineers, 8. Mr. William Bell, "On the Stresses of Rigid Arches, and other Curved Structures."
Pathological, 8.
Biblical Archæology, 8½.
Zoological, 9.

Wed.....**SOCIETY OF ARTS, 8.** Mr. J. Bailey Denton, "On Sewage as a Fertilizer of Land, and Land as a Purifier of Sewage."
Geological, 8. 1. The President, "On an old Shingle Bank on the Portsdown Hills, near Farnham, Hampshire." 2. Mr. Henry Hicks, "On some undescribed Fossils of the Menevian Group." 3. M. D. M. d'Orueta, "Further Notes on the Geology of the neighbourhood of Malaga." Communicated by the President.
Microscopical, 8. 1. Mr. J. Bell, "Fermentation and its Results." 2. Dr. Beale, F.R.S., "The Nerves of the Capillary Vessels, and their Probable Action in Health and Disease."
Pharmaceutical, 8.
Royal Society of Literature, 4¼.
Obstetrical, 8.
Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Lieut.-Col. Grant, "Botany of the Grant and Speke Expedition." 2. Mr. Robert Garner, "On a hybrid *Vaccinium* between the Bilberry and Crowberry." 3. Mr. Garner, "On the Formation of British Pearls, and their Possible Improvement."
Chemical, 8.
Numismatic, 7.
Royal Society Club, 6.
London Institution, 7½.

Fri.......Astronomical, 8.
Quekett Club, 8.

Sat.......Royal Botanic, 3¾.
Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."

Journal of the Society of Arts.

No. 994. Vol. XX.

FRIDAY, DECEMBER 8, 1871.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 6th, 1871; Harry S. Thompson, Esq., in the chair.

The following candidates were proposed for election as members of the Society:—

Baker, Robert, 107, Albion-road, Stoke Newington, N.
Brake, Rev. Charles, 19, Marquess-road, Canonbury, N.
Drew, Joseph, LL.D., F.R.A.S., Belgrave-terrace, Weymouth.
Goodman, John C., 3, Gilston-road, West Brompton, S.W.
Hardy, Ralph Price, London and Provincial Assurance Society, 21, Fleet-street, E.C.
Horne, Charles, Innistail, Beulah hill, Upper Norwood, S.E.

The following candidates were balloted for, and duly elected members of the Society:—

Edwards, Rev. R. G., 103, Oxford-street, Stepney, E.
Graham, John, 27, Charles-street, St. James's, S.W.
Gwyther, J. Howard, Chartered Bank of India, Australia, and China, Hatton-court, Threadneedle-street, E.C.
Harris, Joseph, 41a, Bull-street, Birmingham.
Heinemann, Dr. Richard Nathan, 21, Northumberland-place, Bayswater, W.
Nelson, Charles, Crackley-hill, Kenilworth.
Port, H., 10, Old-square, Birmingham.
Schneberger, John, 2, Sussex-place, Onslow-square, S.W.
Smith, William Henry, 212, Westminster Palace-hotel, S.W.

The Paper read was—

SEWAGE AS A FERTILISER OF LAND, AND LAND AS A PURIFIER OF SEWAGE.

By J. Bailey Denton, C.E., F.G.S.,

Hon. Member of the Royal Agricultural Societies of Norway, Sweden, and Hanover.

Having recently appeared as a correspondent of the *Times* on the sewage question, it may very reasonably be assumed that I have exhausted the subject, as far as I am personally able to do so; but the fact is, that having in the letters to which I refer explained the advances made by the chemist and the engineer, and shown that there has prevailed, up to this time, a disregard of the properties of different soils for the retention of the fertilising ingredients of sewage, and the purification of the water with which the sewage is mixed, I left the subject where I considered the agriculturist should take it up. Hence my appearance before our Society, at a season when many of its members connected with agriculture will be in London.

I will promise to condense the remarks I have to make as much as possible, in order that there may be sufficient time for the expression of opinions which I shall do my best to challenge.

Though large figures have been put forth, by sundry writers and speakers, of the immense loss this country suffers by casting the sewage of its towns into the rivers, and everybody acknowledges, not only that such waste ought not to continue, but that our rivers should be restored to their original purity, we have not yet brought to practical test the value of sewage to the farmer and the market gardener. Chemists have done their best to rouse public attention to the loss we suffer, and it now remains with the country to adopt those measures which will best conduce to its recovery.

Large as the intrinsic value of the fertilising matter has been shown to be by the chemist, the value of the water in which it is contained has been excluded from his consideration, though farmers and gardeners alike are prepared, after the experience of the recent years of drought, to put a high value on water for its own sake, irrespective of the fertilising elements it contains after sewage has been mixed with it, for they know how serviceable is timely moisture to the germination of seed, and for reviving and sustaining plant growth, independently of its special power of conducting to the roots of plants, in the most acceptable way, those fertilising ingredients which the chemist has valued so highly.

Hitherto, the benefit to be gained by a command of water has been more than counterbalanced by the disadvantages of excess, and the obligation of disposing of the liquid sewage at all times and under all conditions. In referring to water, therefore, I do so only to remark that, large as the theoretical value of the manurial properties of sewage has been declared to be, it may yet bear an increase when the practical mind of the agriculturist is brought to bear on its utilisation, and the disadvantages under which a new branch of industry always suffers are overcome.

A High Standard of Purity of Water essential.—But so slow and so naturally sceptical, in respect of new appliances, is the agricultural mind, that we must not wait for the recognition of the cultivator as the only thing necessary for the development of the value of sewage. We must rather trust to the obligation which will before long be imposed on all sewer authorities, so to treat the liquid refuse of towns that the effluent liquid shall conform to a recognised standard of purity; for it will only be by the most stringent enforcement of the law in this respect, that all the manurial properties of sewage will be rendered available for reproduction.

Taking this view, I think it is much to be regretted that the Conservators of the Thames have, without pledging themselves to any positive decision, recognised a standard of purity[*] in some degree inferior to that suggested by the present Rivers Pollution Commissioners in their first report, and that they have done so in the face of a statement by the Commissioners, that they made the suggestion with the "belief that, as science progresses, improved methods of purifying polluted liquids will be discovered, and that eventually standards of purity considerably higher than those recorded may, if necessary, be enforced." Without presuming to give any opinion upon the details of the standard suggested by the Commissioners, which I know is regarded by some chemists as objectionable, I am content to record the fact that their anticipation has already been in a measure realised. This is not mere assertion; it has been conclusively shown that when natural soil is so prepared, by properly designed deep drainage and deep surface cultivation, that the whole of the sewage distributed upon its surface is absorbed and percolates *evenly* through the soil, the effluent liquid passes into the arterial outfalls from the under-drains purified to a very high degree, and unobjectionable in every respect. Such, in point of fact, appears to be the purification effected by oxidation, resulting from the aëration of drainage and the intermittent use of soil for filtration, that it is not at all a too sanguine view to take, that, with increased experience, we may arrive at a power of restoring water, with which sewage has been mixed, to its original potable condition.

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[*] The following notes to and from Captain Burstal, the secretary of the Thames Conservancy, will explain the position of this particular question at the present moment:—

"Stevenage, 24th November, 1871.

"Dear Sir,—I presume I am right in assuming that the standard of purification recommended by Drs. Frankland and Letheby, and Professor Odling is that which your Board of Conservators recognise as sufficient to regulate the influx of liquid sewage from towns on the banks of the Thames. When answering this question, would you kindly tell me whether the standard applies equally to the towns above Hampton as below

"I am, dear Sir, yours faithfully,
(Signed) "J. Bailey Denton.

"Captain Burstal, Thames Conservancy."

"Thames Conservancy Offices, 41, Trinity-square,
Tower-hill, E.C., 1st December, 1871.

"Dear Sir,—In reply to your letter of the 24th ultimo, I beg to inform you that the Conservators do not recognise any standard of purity for effluent water from sewage from places on the banks of the river above Teddington.

"I am, dear Sir, yours faithfully,
"E. Burstal, Secretary.

"J. Bailey Denton, Esq., Orchard-court, Stevenage, Herts."

For the convenience of those interested in the matter, I here give the standard suggested by the Rivers Pollution Commissioners, and will add that which has been circulated by the Thames Conservators. The Commissioners suggest that the following liquids be deemed polluting, and inadmissible into any stream:—

(*a.*) Any liquid containing in suspension more than three parts by weight of dry mineral matter, or one part by weight of dry organic matter in 100,000 parts by weight of the liquid.

(*b.*) Any liquid containing in solution more than 2 parts by weight of organic carbon, or ·3 parts by weight of organic nitrogen, in 100,000 parts by weight.

(*c.*) Any liquid which shall exhibit by daylight a distinct colour when a stratum of it one inch deep is placed in a white porcelain or earthenware vessel.

(*d.*) Any liquid which contains in solution, in 100,000 parts by weight, more than two parts by weight of any metal except calcium, magnesium, potassium, and sodium.

(*e.*) Any liquid which, in 100,000 parts by weight, contains, whether in solution or suspension, in chemical combination or otherwise, more than ·05 part by weight of metallic arsenic.

(*f.*) Any liquid which, after acidification with sulphuric acid, contains, in 100,000 parts by weight, more than one part by weight of free chlorine.

(*g.*) Any liquid which contains, in 100,000 parts by weight, more than one part by weight of sulphur, in the condition either of sulphuretted hydrogen or of a soluble sulphuret.

(*h.*) Any liquid possessing an acidity greater than that which is produced by adding two parts by weight of real muriatic acid to 1,000 parts by weight of distilled water.

(*i.*) Any liquid possessing an alkalinity greater than that produced by adding one part by weight of dry caustic soda to 1,000 parts by weight of distilled water.

The following standard of purity for defecated water is that recommended by the chemists consulted by the Thames Conservators, and it will be seen that it is, as I have stated, less stringent than that suggested by the Rivers Pollution Commissioners. They say:—"1. It should be free from an offensive odour. 2. It should be free from suspended matters, or, in other words, be perfectly clear. 3. It should not be alkaline to turmeric-paper, nor acid to litmus-paper. 4. It should not contain per gallon more than 60 grains of solid matter dried at 260° Fahr. 5. It should not contain more than three-quarters of a grain of organic and ammoniacal nitrogen per gallon. 6. It should not contain more than two grains of organic carbon per gallon. 7. It should contain not less than one cubic inch of free oxygen in a gallon." It should be observed, however, that one of the eminent chemists who signed this recommended standard, Dr. Frankland, being himself a member of the Rivers Pollution Commission, added these words:—"The conditions under which fluid which has been contaminated with sewage may be admitted into the Thames, as prescribed in the foregoing report, will, I have every reason to believe, preserve the river from being offensive to the inhabitants upon its banks; but, whilst thus far agreeing with my colleagues, I wish it to be distinctly understood that, in my opinion, such fluid can only be safely admissible into the Thames on condition that the water is not afterwards used for domestic purposes."

The conservators of the River Lee, in the absence of any standard recognised by the government, have hitherto abstained from issuing one of their own, and the consumers of water in the metropolis are to be congratulated that they have done so, for the publication, limited though it has been, of the lower standard recommended to the Thames Conservators has already had the effect of encouraging results inferior to those which are to be desired. The Lee Board reserves to itself judgment until the towns discharging into the river have completed their purifying works, for which they have extended the time, at the expiration of which it is to be hoped that some positive action towards the establishment of standards to fit different circumstances will have been taken by the central local government authority. Until such is the case, we shall probably see, both on the Thames and on the Lee, the sewer authorities of towns disregarding, naturally enough, the higher standard of the Rivers Pollution Commissioners, and in spite of the protest of Dr. Frankland, and the general sense of the country, the inhabitants of London may be compelled to drink polluted water, and, as a natural consequence, the contamination of our streams will continue throughout the length and breadth of the land.

This point, however, is not that upon which I desire to dwell. It is of sewage as a fertiliser of land that I must speak, though it is right to repeat emphatically, what must be manifest to every practical mind, that so long as the pollution of rivers is permitted in a modified degree, by the recognition of any standard of inferior character, the fertilising ingredients of sewage will not be wholly recovered from the water with which they are mixed.

Sewage as a Fertiliser of Land.

To show what is the intrinsic value of the fertilising ingredients of sewage, I will, in the shortest manner possible, state the conclusion to which Messrs. Lawes and Gilbert came in 1866, in their very complete and careful paper on the "Composition, Value, and Utilisation of Town Sewage," read before the Chemical Society, and which, I believe, expresses pretty accurately views in which the majority of those who are competent to deal with the subject concur. Having adopted the case of Rugby as a fair sample of water-closet towns, the discharged sewage being equal to 36 gallons per diem, or 60 tons per head per annum, including surface and subsoil waters, they stated that, "looking to the average results of 93 analyses," they found "that the sewage contained about 87½ grains per gallon of total solid matter, of which about two-thirds was inorganic, and one-third organic. About half the total solid matter was in suspension, and half in solution; of the half in suspension, about four-sevenths was inorganic, and three-sevenths organic, and of the half in solution about four-fifths was inorganic, and one-fifth organic. Lastly, of the nitrogen, reckoned as ammonia, about one-fourth was in suspension, and three-fourths in solution. The mean of the 93 analyses showed about 6½ grains of ammonia per gallon, indicating a value of 1⅔d. for the total constituents in one ton of sewage." These figures, multiplied by the 60 tons of sewage per head per annum, resulted in showing "that 12½ lbs. of ammonia were contributed annually for each average individual of the mixed population of both sexes and all ages." This quantity of ammonia, at 8d. per lb., gives 8s. 4d., or 100 pence, as the value of sewage per head from water-closet towns. Various other estimates have been made of the sewage of water-closet towns. Dr. Letheby took samples, at noon and at midnight, from a number of sewers in the metropolis, and arrived at the conclusion that 7·24 grains represented the mean quantity of ammonia per gallon. Messrs. Hofmann and Witt, having treated one particular sewer, considered that 8·21 grains represented the quantity of ammonia. These two quantities would, if taken at the same price of ammonia, result in larger figures than those of Messrs. Lawes and Gilbert.

There have been several estimates made of the value of sewage, by modes of computation differing from that based on the whole sewage of towns as discharged by the sewers, and as they will assist us in considering what proportion of the excrementitious matter of the closet may be kept out of the sewers, with benefit to agriculture and profit to the ratepayers of sewered districts, I will shortly refer to them. Messrs. Hofmann and Witt, and Dr. Thudichum, having ascertained the amount of urine and fæces voided by individual persons, taking an average of both sexes of all ages, valued the urine at 7s. 3d. and the fæcal matter at 1s. 2¾d., which together, it will be observed, is very nearly the same amount as that put upon the whole sewage by Messrs. Lawes and Gilbert.

There is an anomaly in these estimates which has to be reconciled, inasmuch as it appears that the excrements of human beings alone, exclusive of the refuse from slaughter-houses, stables, cow-houses, and dog kennels, as well as that discharged from the kitchen, with its refuse of vegetable and animal food, is more valuable than the whole liquid refuse of a town, when the contents of the closet are discharged into the sewers as well as all other refuse. And the anomaly becomes more difficult of reconciliation when we have to consider a statement by the Rivers Pollution Commissioners to the effect that, comparing water-closet towns in which the whole of the sewage issues from the sewers, with "midden" towns, in which a considerable portion of the human excreta is detained and disposed of separately, there is a remarkable similarity of composition between the two.

I will not detain you by any endeavour to reconcile these analyses and statements, but will only remark that, assuming them to be correct, an important consequence follows, viz., that, in an agricultural view, it is desirable to treat the excremental contents of privies separately, for if no appreciable loss of fertilising matter is found to exist in liquid sewage when separated from that of the privies, it is manifest that a decided national gain is obtained by the maintenance of the two systems, inasmuch as the dry, portable manure obtained from the privy contents will be so much fertilising matter available for distant lands, in addition to the liquid sewage, which may be utilised by irrigation near at home.

But the realisation of the fertilising value of sewage in the liquid state depends necessarily upon two precedent conditions, the first being the obligation which should be imposed on all towns by the central local government authority, to *perfectly* cleanse their sewage; and the next, the preparation by the sewer authorities of the land designed to receive the sewage, in such a way that the whole may be *fully* utilised. With these two duties performed, and not otherwise, there is a fair prospect of at least a penny a ton being realised for liquid sewage of average strength, half of which (as I have stated on former occasions) should go into the pockets of the ratepayers, in repayment for the necessary works, while the other half will be due to the cultivator as a return for his industry and the employment of his capital.

Excluding from consideration the value of the water, which, I contend, will become a great item in the profitable treatment of sewage, the subject before us may be classified under three heads, viz.—(1) Where the whole of the sewage is treated by chemical process at the mouth of the sewer. (2) Where it is transported from the sewer mouth to land for distribution there. And (3) Where a part of the excrementitious refuse is treated separately from the remainder. The question which addresses itself, therefore, to the authorities of all sewered districts is, which of these methods of treatment will best enable them to effect the twofold object of purifying the sewage and utilising it to the greatest advantage; while the question which the agriculturist has to consider is, which method will place at his command, at a fair price and in the most productive shape, the fertilising matter which the sewer authorities must extract, in order to cleanse the sewage perfectly.

I.—*Chemical treatment of the whole of the Sewage at the Mouth of the Sewer.*

Leaving out of consideration all treatments which aim only at the purification of the sewage, without turning its fertilising properties to use, as irrelevant to my subject, I will confine my observations to those chemical processes by which both these objects are said to be obtained. Many processes have been before the public aiming at this end, and several have been patented, and afterwards brought forward by public companies.

The Native Guano Company, better known as the company possessing the patent of the "A B C Sewage Process," now stands very prominently before the public, in consequence of its shares being at a high premium, and because arrangements have been made by the authorities of Hastings, Leeds, Bolton, and Southampton, as well as by the Metropolitan Board of Works, to test, by comprehensive experiments, the value of the process, although it had been superseded at Leamington by irrigation. The initials "A B C" indicate the principal ingredients of the chemical mixture, viz., alum, blood, and clay, by which it is stated the polluting and fertilising parts of sewage may be precipitated and made available as a manure. I do not propose to enter into any details of the process itself, but will merely state that the specification of the patent sets forth that 4 lbs. of mixture are required for every 1,000 gallons of sewage treated; and that Mr. Rawson, the general manager of the company, tells me that 100,000 gallons of sewage of average strength—diluted to the extent of 30 gallons a day—will produce from 20 to 25 cwt. of dry manure; from which statement we see that, if the specified proportion of mixture to sewage were adhered to, 400 lbs. of mixture will be required for the production of a ton of saleable manure. The company declare that deodorisation takes place immediately on the first addition of the A B C mixture, and in proof of the purification effected, give the following analyses:—

Comparative Analysis in Grains per Gallon.

	Average of 50 samples Sewage.	Average of 50 samples Effluent Liquid.
Organic Matter....	17·2	1·4
Mineral Matter....	37·4	16·9
Total	54·6	18·3

I will now offer such evidence as I can of what the Native Guano Company can do towards the purification of sewage and the extraction of its fertilising parts, premising that Mr. Rawson has most courteously afforded me every facility for ascertaining the results arrived at by farmers and gardeners who have used the manure sold by the company.

The Rivers Pollution Commissioners, having made very careful experiments at Leicester and Leamington, state in their second report (dated 4th July, 1870), that the process removes a very small proportion of the soluble polluting matter from sewage, and that "the manure obtained has a very low market value, and cannot repay the cost of manufacture." Their analysis of the effluent liquid, made of samples taken on the 10th May, 1870, showed the following result, although the quantity of mixture used was increased very largely beyond the proportion prescribed in the specification (4 lbs. to 1,000 gallons of sewage).

Analysis expressed in parts per 100,000 :—

Total solid matter in solution........	123·05
Organic carbon....................	4·727
Organic nitrogen..................	1·892
Ammonia	8·060

These figures are very much in excess of those I have just quoted as given by the company; though, if the latter were compared with either the standard of purity suggested by the Rivers Pollution Commissioners or that recommended to the Thames Conservators, it will be seen that the condition indicated is not such as to render the effluent liquid admissible into running streams. How Leeds and the other towns mentioned will ultimately conform to a national standard of purity remains to be seen. As to the manure made by the Native Guano Company, the Commissioners said that "the so-called A B C manure is little more than the original suspended solid matter of raw sewage, plus the insoluble materials added in the A B C mixture, nineteen-twentieths of this being merely clay."

The chemists employed by the Metropolitan Board of Works state, through Dr. Odling (June 24th, 1870), when speaking of this process, that, after examination, they found "there was a great deal of putrescible matter in the effluent liquid; and in comparing this mode of precipitation with others, it did not seem that its alleged superiority had any foundation."

Dr. Voelcker, in the *Journal of the Royal Agricultural Society* (vol. vi., S.S., Part ii.), having analysed five different samples of the manure sold as native guano, stated the result to be as follows:—

	£	s.	d.	
No. 1 sample was worth....	0	18	6	per ton
2 ,, ,, ...	1	13	6	,,
3 ,, ,, ...	0	14	0	,,
4 ,, ,, ...	0	18	6	,,
5 ,, ,, ...	0	14	6	,,

basing his value on a comparison of the manure with phosphate of lime, at £10 a ton, and ammonia at £60 a ton.

Still, in the face of these adverse opinions, expressed by the highest chemical authorities of the country, the Native Guano Company is advertising its dried manure at £3 10s. per ton, and are finding customers at that price. Some farmers and gardeners with whom I have corresponded speak very favourably of it, and declare their intention of buying more, while others say they have not been able to distinguish any advantage from the use of it, and one farmer goes so far as to threaten an action for injury done by its use. On the whole, the replies I have received do not lead me to the conclusion that the sale of the manure will be very great after public curiosity is satisfied, for it is more than probable that the sales that have taken place have resulted from the desire to give the manure a trial, under a false notion that because Peruvian guano is advertised at £13 5s. a ton, and phospho-guano at £11 10s. a ton, "native guano" must be cheap at £3 10s. a ton. If, however, the sale should continue, the failure of the process to effect purification up to any recognised standard must act as a veto to its adoption, except in those cases where the authorities of towns may be content with clarified in the place of purified sewage.

The Phosphate Sewage Company, founded on a patent taken out by Dr. David Forbes, of which dissolved phosphate of alumina for precipitation is the base, aims at doing all that the A B C process professes to do, with the additional recommendation of being associated with irrigation where circumstances favour the adoption of the two processes, which, seeing that the separation of the coarser solid parts of sewage from the liquid is a desideratum in irrigation, may frequently be the case. The company state that, "if phosphate of alumina alone is used, the sewage is defæcated, the solid matter is precipitated, and the water is left still maintaining all its nitrogenous and valuable properties, plus any excess of phosphoric acid which has been added, and, therefore, highly useful for the irrigation of cereals and other crops, and at the same time perfectly inoffensive. This process will be adopted where it is deemed desirable to use the water as a fertilising agent for irrigation purposes, since it possesses advantages, both in an agricultural and sanitary point of view, above any system of sewage irrigation hitherto used. In the case of towns to which sewage irrigation is inapplicable or disadvantageous, and which are desirous of rendering their sewage water sufficiently clear and pure to return into a river or stream, this object can be effected by adding a small quantity of lime to the sewage after treatment by the former process." This company, in fact, declares itself able not only to purify sewage to a degree to render it admissible into rivers, and to manufacture a manure out of the precipitated matter, but to render the effluent liquid more suitable for irrigation than the sewage itself. These statements are made on the authority of Dr. Voelcker. The analysis of the effluent liquid discharged during certain trials at Tottenham gives the following result in grains per imperial gallon:—

Organic matter—		
In solution	5·74	
In suspension	none	
Total organic matter		5·74
Mineral matter—		
In solution	57·71	
In suspension	none	57·71
Total solid matter (organic and mineral)		63·45
Organic nitrogen—		
In solution	·47	
In suspension	none	
Total organic nitrogen..................		·47
Equal to ammonia	·57	
Saline ammonia	3·32	
Total nitrogen calculated as ammonia..	3·89	

Compared with the suggested standard of the Rivers Pollution Commissioners, this analysis does not show the requisite amount of purity.

I have endeavoured, from information supplied me by Mr. Lonsdale, the secretary of the company, to obtain some tangible proofs of the value of the manure manufactured by the company, but the number of instances are so few in which actual trial has been made on a scale affording any practical test, that I confess myself unable to draw any deductions whatever; and when stating there can be no doubt that a valuable manure may be made by mixing with the fertilising parts of sewage the phosphate of alumina, it must be borne in mind that there exists no proof that the manufacture will be attended with profit. It must also be remembered that the operations of the company depend upon the supply of phosphate of alumina, which, like all other foreign importations obtained from a distance, must be liable to vicissitudes bearing upon the fortunes of the company, and on the interests of those towns and districts having dealings with it. Associated with irrigation as a never-failing resource when the phosphate may not be forthcoming, or when the manure may not command a sale, such objections would not exist.

With certain seaboard towns, where the effluent sewage need only be clarified to be free from objection, this company, like the Native Guano Company, may probably do a large amount of work, if it should turn out that a saleable manure may be profitably made; though, with the experience we are now having of the power of a small quantity of natural soil to cleanse a large body of sewage by intermittent filtration, and to grow crops at the same time, so that the scavenging powers of vegetation may render their aid in purification (as I shall presently show may be the case), it will probably be found more economical to have recourse to that process which is attended with no nuisance whatever, than to establish manure-manufactories with all the attendant risks.

Not having any information to offer with regard to the Peat and Engineering Company, nor of any other chemical or chemico-mechanical processes which deal with the sewage at the sewer mouth, I have nothing further to add about that class of treatment. I will merely repeat that it is daily becoming more generally acknowledged, and acted upon, that "the present resources of chemistry appear to hold out no hope that the foul matters dissolved in sewage will be precipitated and got rid of by the application of chemicals to the offensive liquid," and that therefore we must look to the direct application of sewage to land wherever it can be obtained for the purpose, as the most desirable means of recovering from water those "ingredients held by it in solution and suspension which do not belong to it, and which render it objectionable and unfit for ordinary and domestic purposes."

II. Transport of the whole Sewage in its liquid state from the Sewer Mouth direct to the Land, for distribution on the Surface.

So much has been written and said recently on the practice of sewage irrigation, that I should be disposed to say very little on the subject, had not the special properties of the soil itself for appropriating the fertilising matter of sewage, and for cleansing the sewage itself, been, to a very great extent, omitted from consideration, and had not Boards of Health—the worst farmers in the world—been the principal cultivators up to the present time. Believing that, with a recognition that the soil will perform the functions accredited to vegetation as, or more, effectually than vegetation itself, and that the two in combination will obtain the best results, both as a means of profit and as a sanitary agency, I regard all calculations that have hitherto been made as to the number of persons contributing sewage per acre, and the rules that have been laid down on that score, as worth very little as a guide for the future, when the principle shall be fully recognised that the surface of land must be rendered so absorbent that no sewage shall pass off it into the river courses.

In the application of sewage to land, the local features will, in future, decide the question whether the purification of the sewage and its profitable use should be treated as objects of equal importance, or whether the purification should be the paramount object, and utilisation a subsidiary one. If sufficient land for wide irrigation is not to be obtained, or if obtained only at a price that shall place the application of the sewage, by way of irrigation, beyond the possibility of profit, it is manifest that we must call to our aid the cleansing powers of an ærated soil, and regard the land more in the character of a filter than we have hitherto been disposed to do; and by adopting intermittent application, the effect of which has been so admirably explained by the Rivers Pollution Commisioners, realise all the advantages to be gained from it.

The two processes of irrigation and filtration are already viewed so differently from the way in which they were regarded in their first introduction, that it is necessary to state how we stand with regard to them at the present moment. It will be remembered that, up to very recently, an opinion prevailed with respect to irrigation that, "the object of getting sewage on to the land was, not to let it percolate into the ground, but to keep it on the surface," and that subsoil drainage would not do for sewage farms, because the sewage passed too rapidly to the roots of vegetation, and descended downwards.

Under-drainage as Essential to Irrigation as to Filtration.—Some members of this Society may remember, on the occasion of my reading a paper on "The Water Supply of the Metropolis, in Relation to the Thames and its Tributaries," my friend Mr. Rawlinson, who has ever been the consistent and able advocate of the application of sewage to land, stated in this room, without giving any opinion himself, that some persons practically "acquainted with sewage irrigation would prefer, from their experience, to irrigate clay lands without under-drainage, if Italian rye-grass, which was the most profitable crop, were to be sown;" and the little difference of effect that was to be noticed at Norwood, where the land was clay, and the manager had actually plugged the drains in order to keep the land in a state of supersaturation, when compared with Croydon, where the land is free and is naturally drained, has often been quoted as a reason why sewage irrigated land should not be drained. I will not stop to condemn this view, which is repugnant alike to the sanitarian and the agriculturist, as it may be already observed that, with very few exceptions indeed, operators now disclaim the opinion that under-drainage is unnecessary. So decided has the appreciation of drainage become with the majority of sewage irrigators, that in the eagerness to secure rapid absorption, sewage farms have become filter beds of too rapid action, and by the adoption of inappropriate drains the purifying powers of the soil have been jeopardised. Short as the interval has been since intermittent downward filtration was first suggested by the Rivers Pollution Commissioners, that process has, like irrigation, undergone a change. The Rivers Pollution Commissioners stated—evidently under the impression that sewage would only be applied to a barren or fallow surface—"That with a properly constituted soil, well and deeply drained, nothing more would be necessary than to level the surface and divide it into four equal plots, each of which in succession would then receive the sewage for six hours. In this way the sewage of a water-closet town of 10,000 inhabitants could, at a very moderate estimate, be cleansed upon five acres of land, if the latter were well drained to a depth of six feet." They then go on to state that, nevertheless, there are three formidable objections to the general adoption of the process:—(1) "It is entirely unremunerative." (2) "The whole of the manurial ingredients of the sewage would be absolutely wasted." And (3) "The collection of solid fæcal matters upon the surface of the soil, with no vegetation to make use of them, would probably give rise to a formidable nuisance, especially in hot weather." The change to which I have referred has arisen on the proof which I have had the satisfaction myself of affording, that vegetation may be grown upon the surface of filtering areas, even when receiving sewage equal to the discharged refuse of 3,000 persons to each acre, thus adding, in the most apposite manner, to the cleansing powers of the soil the scavengering properties of vegetation. When speaking presently of land as a purifyer of sewage, I shall give the particulars of the instance referred to, which, though the first and only case in which intermittent filtration has been tried and modified by the growth of crops, cannot fail to prove that the objections anticipated by the Rivers Pollution Commissioners may be avoided.

Technical Description of Irrigation and Filtration.—With the general admission that under-drainage is essential wherever sewage is applied to the surface of land, it must now be generally understood that irrigation means the distribution of sewage over as many acres as it will wet without supersaturation, having in view a maximum growth of vegetation from the amount of sewage applied, and that any departure from this, resulting in excessive application, is a waste of fertilising matter. I think it may also be taken as proved that filtration through soil should not necessarily mean its application to a fallow or barren surface (as contemplated by the commissioners), but the concentration of the sewage, intermittently, on as few acres of land as will absorb and cleanse it, without excluding the production of vegetation at the same time.

Irrigation.—Having given the interpretation of irrigation as the application of sewage to as many acres as it will wet without supersaturation, I should point out that, owing to the absence of a proper apportionment of the sewage at command to a certain quantity of land, considerable waste has resulted in most instances of sewage farming. The Italian irrigators reckon that they lose half their water when carrying the other half forward for use; and having the advantage of enormous quantities of water to deal with, and a power of regaining that which was absorbed by the soil, by tapping it at a lower level, they are indifferent to loss; but in England, where we reckon the value of sewage by the ton, and have taken its intrinsic value at 1d. per ton, we cannot be content to follow such an example. We must, in fact, in this country reject any mode of distributing sewage which does not aim at the utmost economy, and which I may here state would not be attained, in my opinion, if the average quantity of sewage applied to each acre per annum exceeded 2,000 tons, which represents the sewage (proper) of 62 persons, with a water supply of 20 gallons a head.

Land may be too Porous.—To judge of the waste resulting from the present mode of applying sewage to the surface of land, we have only to look to the reports of the proceedings at the Lodge Farm, near Barking, published by Mr. Morgan, to whom the public are greatly indebted for the explicit way in which he has given the quantity of sewage applied and of vegetation grown, and we shall see that an average quantity of 4,435 tons of sewage per acre were applied during the year ending the 31st August, 1870, while the quantity used up to the 31st August last was 3,808 tons per acre. If we put ½d. a ton—which I have said sewer authorities ought to receive for their sewage—on each of these quantities, we find that the payment in the first year would have been £9 4s. 9d., and in the last £7 18s. 8d. Turning again to Mr. Morgan's report, it will be seen that as much as 21.488 tons of sewage have been applied per acre in one field of Italian rye grass. This at ½d. a ton would amount to £44 15s. 4d. This is the extreme of the year, but taking the whole of the Italian rye grass produced, it will be seen that the average quantity of sewage applied from the date of sowing was 288 tons for every ton of rye-grass produced and cut. At ½d. a ton the tenant would have to pay 12s. for this, which is the value of the grass when cut, so that he would suffer a loss of all outgoings in the shape of rent, rates, labour, seed, &c. The waste exhibited by these figures is clearly due to the extreme porosity of the soil, and its unfitness for irrigation on that account.

A proportion of Clay desirable.—With the limited time at command I must not enlarge upon the advantages certain soils have over others for irrigation. It may be sufficient to state that, if we desire to make the most of sewage, it is necessary that a proportion of clay should exist in the soil, and that, although very stiff clays, from the difficulty attending their management, should be avoided, it is much more likely that soils may be too free than too stiff; I am now, of course, speaking of the retention of the fertilising matter of sewage by the soil, and not of the process of filtration as a means of purification. That is quite another matter. That clayey land is more grateful for sewage is very distinctly shown by Mr. Morgan's report, for the same quantity of Italian rye-grass was produced from clay lands as from free soils, though Mr. Morgan informs me the former did not absorb more than 4,000 tons per acre, which is a little more than one-third of the sewage applied to the Italian rye-grass grown on the free soils. I need hardly point out that the rapidity with which land will absorb sewage must depend, not only upon the nature of the soil—its density and porosity—but equally upon the inclination of the surface over which the sewage travels, and the character of under-drainage beneath, and that, therefore, it is the duty of the engineer, when laying out land for absorption, to regulate the inclination of the surface, and the number, position, and size of the under drains *upon which the effect mainly depends* according to the degree of porosity of the soil, in order that a given quantity of sewage may go as far as possible.

Filtration.—Having dwelt upon the practice of irrigation, I ought now to explain the process of intermittent filtration as it may be carried into practice, but as I shall presently deal with it when considering "land as a purifier of sewage," I will only state that by adopting the process as technically described, the liquid refuse of from 1,000 to 3,000 persons—and probably more—may be cleansed by the soil of a single acre of land.

Return from Irrigation.—Up to this time, though sewage-farming has been practised for some years, we have not obtained sufficient data for the guidance of those who desire to follow it as a business. Although local boards and companies have had the farms in their own hands, no balance-sheets, showing the quantity of sewage applied to, and the money realised by the sale of the various crops grown, have been published. Still, the occasional results that have been obtained afford us positive evidence of what will be done under the management of men practised in the cultivation of land.

The following table exhibits certain results obtained at various places at different dates:—

Description of Crop.	Year of Production.	Place.	Value of Crop per acre.		
			£	s.	d.
Italian Rye Grass	1868	Norwood..................	22	0	0
	1869	Lodge Farm, Barking	25	0	0
	,,	Norwood	25	0	0
	,,	Edinburgh	32	0	0
	1870	Lodge Farm, Barking	37	0	0
	1871	,, ,,	22	0	0
	,,	Warwick.................	12	14	0
	,,	Banbury	13	16	10
Mangolds	1870	Lodge Farm, Barking	32	0	0
	1871	,, ,,	44	0	0
	,,	Warwick.................	26	5	0
	,,	Rugby......................	21	9	0
Swedes	1871	Warwick.................	26	5	0
	,,	Rugby	18	15	0
	,,	Banbury	14	6	8
Carrots	1869	Lodge Farm, Barking	38	0	0
	1870	,, ,,	45	0	0
	1871	Rugby......................	45	0	0
	,,	Warwick...............	35	0	0
Parsnips..............	1868	Lodge Farm, Barking	35	0	0
	1870	,, ,,	35	0	0
	1871	,, ,,	52	0	0
	,,	Warwick..................	35	0	0
Cabbages	1868	Lodge Farm, Barking	35	0	0
	1870	,, ,,	15	0	0
	1871	,, ,,	24	0	0
	,,	Banbury	21	11	6
	,,	Warwick..................	35	0	0
	,,	Rugby	15	0	0
	,,	Merthyr	20	0	0
Potatoes..............	1869	Lodge Farm, Barking	33	0	0
	1870	,, ,,	25	0	0
	1871	,, ,,	18	0	0
Onions	1869	Lodge Farm, Barking	38	0	0
	1870	,, ,,	62	0	0
	1871	,, ,,	104	0	0
	,,	Warwick........	35	0	0

From these instances sufficient proof is afforded that, with one crop per annum of a kind that will yield largely to the application of sewage, and command a certain and ready sale in the neighbourhood, a sufficient return may be gained to pay a full rent for the land and a halfpenny a ton for the sewage, besides, affording a good profit after paying all outgoings in the shape of rates, taxes, hand and horse labour, repairs and restoration of implements, seeds, interest on capital, &c. It is true that crops as large and even larger than those grown with sewage have been produced by good farming without sewage, and there would be nothing to say specially in favour of irrigation, were it not that the *united* advantages of manure and water ensure crops year after year under every vicissitude of season, and allow of two crops being taken from the same land occasionally. From the experience gained in the cultivation of Italian rye-grass, it is found that it may readily be grown in excess of the demand for it in a green state, and that, as this description of grass is most difficult to convert into hay, it is desirable to limit its growth to a narrower space. It absorbs and appropriates, however, a larger proportion of sewage than any other description of crop, and it is only because it thus helps to swallow up sewage that it is continued to be grown by those who seek rather to get rid of the sewage than to make the most of it. That speciality loses its force directly a fair value is put on the sewage, or when sewage is applied to land which is itself capable of absorbing and cleansing it, as in such case the manurial matter is stored in the soil for use by following crops.

Return from Intermittent Filtration.—The acreage return to the cultivator from the growth of crops on land used for intermittent filtration will depend upon the extent to which the intermittent principle is extended. If several series of filtering beds are adopted, as I have advised in the case of several towns, among which I may mention Birmingham, where the Sewage Inquiry Committee have declared their intention to adopt it, the return will be found to be quite as great, if not greater, than that to be obtained from irrigation; for with the land rendered actively absorbent by drainage and deep cultivation, and laid up in bouts or ridges, crops may be grown while the sewage is being applied without suffering from excess of wetness. By extending the filtering process from one series, as suggested by the Rivers Pollution Commissioners, to several series of areas, so as to give two or three years' rest from filtration, such lands become available for the growth of the greatest amount of vegetation that can be produced from the land; for with the sewage at command, any amount of watering that the crops require can be obtained by diverting the sewage for a time from the filtering areas in use. At Merthyr, the money realised by the sale of crops, comprising various roots and cabbages, grown between the 14th June and 31st August last, amounted, on an average of a day's sale by auction, to £17 15s. per acre, while the crops which were sold afterwards realised upwards of £20 an acre. These figures will bear comparison with the returns from irrigation proper; and I may here state that although the works have been very costly, owing in a great measure to their being the first of the kind carried into execution, and in being themselves the result of Chancery proceedings, the chairman of the Board (Mr. William Jones, of Cyfarthfa), says in a letter to me that much as the land and works have cost, "the filtering areas may yet pay;" adding that "had we obtained the land at a fair agricultural value, and the works been executed at the cost they would now be executed for, with acquired experience, I have no hesitation in saying they would be a source of great profit to the ratepayers of this district." These figures and the chairman's opinion are encouraging, and show a fair prospect of profit, if the authorities who have charge of such works abstain from growing the more refined kinds of gardeners' crops, which involve expensive hand-labour, and which are dependent on very fickle markets for sale.

Many considerations lead to the conviction that it will seldom be within the power of the sewer authorities of towns to adopt the widest use of sewage, which would result in the provision of one acre for rather more than 40 persons, if we adopt the rate I have before stated, of 62 persons to one acre, with an allowance of 50 per cent. additional land for increasing population. With constantly arising opposition based on a fear of a nuisance (which under proper management will not arise), the difficulty of obtaining land, and the high price to be paid for it, will always stand in the way of wide irrigation. To compensate for the limitation these obstacles will impose, it must not be forgotten that the produce of sewage farms loses much of its value directly it overreaches the home market, and with a large area used for irrigation in the neighbourhood of a town this may be easily done. Already we hear of the produce of the Warwick Sewage Farm being sent to Birmingham, and that of Romford to Liverpool, and various instances of a like kind might be mentioned. One great advantage in the adoption of intermittent filtration, in the shape of concentrated irrigation, is that a greater variety of crops may be grown, and the over-stocking of the market with vegetables avoided, inasmuch as by giving each series of filtering areas a rest of a year or two, the growth of cereals and other crops, which are not successfully grown by ordinary irrigation, would take their part in rotation, and thus dispose of those manurial elements which might otherwise be left in the soil.

It would be too sanguine a view to suppose that the ratepayers of a district adopting the filtration process in its narrowest form would receive as much for their sewage as when irrigation is adopted under advantageous circumstances, in its widest form, but it is more than likely that, in a majority of cases, a better return may be gained from a medium course of action than from any other, though it is our duty, in a national point of view, to aim at making the most we can of the valuable matter with which we have to deal.

III.—*Separation of the Excretal Closet-matter from the Liquid Refuse of the Sewer, and dealing with each separately.*

As already stated, the treatment of the excremental contents of the closet separately from the liquid sewage of the sewers, is an object in which agriculturists must take a very great interest, though I have never yet met with any estimate of their value. Reverting, however, to the figures given as the value of the voidings of human beings, it would not be too much to take a fifth of the intrinsic value quoted (8s. 5¾d.), or 1s. 8½d. per head of the population, as the value of that which is retained in the closet, and which is capable of separate treatment, and is easy of removal to lands which cannot partake of the liquid sewage.

As the subject of this paper is limited to the fertilising powers of sewage and the purifying powers of soil, it forms no part of my purpose to discuss the question whether town authorities act wisely in maintaining such a species of scavenging as is involved in the removal of the excretal refuse apart from the liquid sewage. I am, however, prepared to state that, having examined several dry processes now in use, there are some that may be adopted without objection, though it cannot be expected that the occupiers of superior houses who have once enjoyed the comfort of well-supplied and well-constructed water-closets should abandon the advantage and resort to dry closets of any description. At Rochdale, Alderman Taylor has patented a plan which is now in use there. Beneath each seat a receptacle containing a small quantity of a disinfecting fluid is placed, in which the fæces and urine are collected. The receptacles are removed in a covered cart weekly, or more frequently if required, to a manufactory on the outskirts of the town. There they are mixed with fine ash reduced from the cinders and dry refuse collected from the houses. The larger cinders, when separated from the ash, are sold. The average price realised for the manure mixture has been 17s. per ton, affording a profit, after deducting all expenses, of 2s. 5d. per ton. At the price mentioned, the manure is readily sold, and I can well believe is of great value to the farmer, particularly for certain descriptions of grass lands.

In large manufacturing towns, where water is much required in the trade that supports the population, and where it is desirable to economise as much as possible its use, and therefore to avoid water-closets, Alderman Taylor's process has much to recommend it, and from personal observation I am able to declare that it is free from the many objections that attend badly-constructed and badly-managed water-closets. In fact, I examined many closets attached to cottages in Rochdale which were much more creditable than many of the water-closets attached to large establishments in the metropolis.

But whatever may be done with the excretal matter by dry appliances, it will not be possible to avoid the proper disposal of the sewage of the sewers, and that will still have to be done by one of the classes of treatment already explained.

In small towns and villages it is still to be hoped that the dry-earth system, invented by the Rev. Henry Moule, may be more generally adopted. The experience gained, however, shows that the frequency with which the closets get out of order, and the difficulty of supplying and removing the earth is such that, unless a system of management is organised and enforced, they cannot gain much ground.* Where there exists a proper officer, with assistants, if necessary, to supply the earth and remove the soil, and to keep the closets in working order, it is impossible that anything can be more suitable for isolated establishments and country villages; and when it is remembered that the difficulties of providing a public supply of water to villages are such as to be insurmountabe in many cases, and that the leaky condition of the privy and cesspit maintains the soil in close villages in an excrement-sodden condition, resulting in the pollution of tank or well water, it does appear almost incomprehensible that the governing powers of this country should permit the continuance of the present state of things.

Land as a Purifier of Sewage.

Having spoken of the general purification of sewage by land, when treating of irrigation and filtration, it is only necessary to add a brief description of the process of intermittent filtration, as it has been carried out under my directions at Merthyr-Tydfil. There 20 acres of land have been laid out for the purification of the sewage of the district, of which the dry weather flow at the time when the works were commenced amounted to 870,430 gallons per diem, the least flow during the day being 500 gallons; and the greatest 663 gallons a minute. The population contributing this sewage exceeds 50,000, but at present less than half the houses are connected with the sewers, so that the sewage may be taken as equivalent to the discharge of about 30,000 people. The number of water-closets being few, the sewage may be considered to be weak. Upon occasions of rainfall (which is above the average), the flow of the sewers is much increased, the storm waters frequently raising the discharge at least 50 per cent. above the ordinary dry weather flow, and this excess finds its way to the filtering areas. The 20 acres of land were divided into four equal parts, and before forming the surface to receive the sewage the whole was drained from $5\frac{1}{2}$ to $7\frac{1}{2}$ feet deep, and deeply cultivated. By this means 2 cubic yards of soil for every square yard of surface became serviceable as filtering material, there being but very few rods of ground in which the full depth of 6 feet was not secured. The quantity of filtering material was fixed upon so that the maximum quantity of sewage which would at any time have to pass through each cubic yard of soil would not exceed $7\frac{1}{2}$ gallons per diem, while the mean quantity of dry weather sewage would pass through at the rate of 5 gallons per cubic yard. The under drainage was so designed that no sewage could travel over the surface directly above the drain, which is the case in instances of irrigation of free soils in which the results have not been so favourable.

Here the result has been the most complete purification of the sewage up to this time, and the realisation of the fact that the effluent water from the under-drains was as pure when the whole of the sewage was passing through half the filtering areas, viz., 10 acres, as when it passed through 15 and 20 acres, showing clearly that a less number of acres than 20 acres would suffice for the purification of the quantity of sewage dealt with, and that therefore if the sewage had been double the strength or double the quantity, as it may ultimately be when the whole of the sewage of the 50,000 persons is discharged by the sewers, there will be a certainty of complete purification of the whole if the board manage the works efficiently now they are completed.

During the period when the existing sewage, increased at times by the rainfall, was discharged upon the 10 acres (half the areas), they were receiving as much as 144,000 gallons per acre, which is equal to a depth of nearly $6\frac{1}{2}$ inches, and never less than 72,000 per acre, (equal to a depth of $3\frac{1}{4}$ inches).

Instead of following the mode of distribution usually adopted in sewage irrigation when the fluid is either run over a regular surface, or along the ridge to flow over the slopes on either side, the surface of the Merthyr filtering areas was laid out in the ridge and furrow form, as before explained, the object being to allow of the use of the horse and hand hoe, and while growing crops on the ridge to allow the sewage to flow in the furrows, and rise up to the ridge sides with a certainty of being absorbed, and of feeding vegetation at the same time. This treatment has been so successful that, in spite of the deposit of the finer particles of floating matter in the furrow, the whole of the sewage has disappeared within four or five hours after application, and the land has acted as a purifier up to this time in such a way that the effluent water from the under drains is pronounced by Dr. Benjamin Paul to be cleaner than the Thames water above the intakes of the metropolis water companies. In order that its condition may be compared with the standard suggested by the Rivers Pollution Commissioners, I here give the analyses of the discharge from the 10 and 15 acres, when the whole of the sewage was run through those quantities of soil:—

Results of Analyses in Parts per 100,000.

	Effluent Water from 10 acres.	Effluent Water from 15 acres.
Solid contents—		
Total	39·00	55·00
Fixed	34.00	34·00
Volatile	5·00	21·00
Ammonia..........	·082	·086
Organic matter	·018	·011

Though it is a subject of personal satisfaction to me to have been the first to test, by designed operations, the process of intermittent downward filtration, suggested by the Rivers Pollution Commissioners, and to prove by direct evidence that the objections they anticipated can be avoided, the result might have been expected from the circumstance that in every case where sewage has been utilised on land, and allowed to pass through the soil as well as over it, the effluent water has been perfectly satisfactory. This will be seen by the following analyses of effluent water discharged from lands which have absorbed the sewage without any overflow from the surface, and without being laid out for intermittent action, except in the case of Merthyr Tydfil, which I have described.

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* For description of a means of dealing with slop and scullery refuse by Field's self-acting syphon, see "Village Sanitary Economy" in *Journal of the Royal Agricultural Society*, vol iv., s.s. part 1.

Parts per 100,000.

Date.	Place.	Total solid matter in solution.	Organic carbon.	Organic nitrogen.	Ammonia.	Chemical authority.
1868 Sept. 10	Bedford	76·8	·575	·163	·023	Rivers Pollution Commissioners.
„ 23	Carlisle	28·8	·591	·204	·025	„
„ 24	Penrith	21·9	·320	·108	·001	„
1870 July 9	Convalescent Hospital, Walton	10·87	...	·002	·002	Dr. Odling.
July 24	Breton's Farm, Romford	70·60	...	·037	·003	Dr. Russell.
1871 Sept. 4	Merthyr-Tydfil	39·00	...	·018	·082	Dr. Benj. Paul.
„ 4	Lodge Farm, Barking	91·3	·676	·198	·005	Dr. Frankland.
„ 12	Tunbridge Wells ...	34·44	...	·060	·03	Dr. Voelcker.

If the proportions of polluting matter indicated in these analyses are compared with those contained in the effluent liquid discharged from the chemical processes to which reference has been made, or even with those of the effluents from the surface of lands over which sewage has been passed, the superiority of the combined effect of filtration associated with irrigation must be acknowledged. And on a study of all the facts such comparisons will expose, it will be manifest to every unprejudiced mind that, not only is it possible for town authorities to conform to a high standard of purity, but that, with a comparatively small quantity of land at command, it is a simple and inexpensive thing to do.

If this be true, ought there to be any hesitation in adopting a standard so high as to remove all doubt on the subject, with compulsory powers to enforce it?

We have had mournful proof that polluted water will find its way into the palace of the powerful as well as into the cottage of the poor; and our Society has special reasons, in the very serious illness of our Royal President, the Prince of Wales, which has aroused the anxiety of the whole nation, and which is said to be traceable to impure water or sewer gases, for exerting all the power it possesses in preventing the public interests being sacrificed to the influence of water companies, and the false notions of economy which prevail with Local Boards of Health.

DISCUSSION.

The Chairman said the importance of this question was hardly yet sufficiently realised by the general public. It was not in itself an attractive subject, and the public required to be reminded that sewage was one of those unsavoury realities which was inseparable from the present order of nature. The previous generation thought they had settled the matter when they employed water to carry away the refuse from the wear and tear of daily life, forgetting that by this means they were only taking it away from one place and putting it into another, thus converting the rivers and streams of the country into a gigantic nuisance. The rapid increase of populations in towns had made that nuisance perfectly unbearable, and the educated opinion of the country, expressing itself through Parliament, had decided that a great effort should be made to prevent the further pollution of rivers in this way. Several modes had been brought forward, which had been ably discussed by Mr. Bailey Denton, by which this could be effected, and he hoped to hear them fully discussed. There were two parties to the question, on the one side the masses of the population, who required defending in a matter in which they could not defend themselves, and on the other hand the agriculturists, who required the sewage, on account of its valuable properties, whilst between them stood the British ratepayers, at whose expense the process was to be carried on. It was, therefore, of great importance that the course adopted should be most efficient and economical; and, having been the first to discover that the soil had the property of decomposing ammoniacal salts and preserving them in a form in which they could be available for vegetation, he felt great interest in this question, and hoped to hear it well discussed.

Dr. Voelcker said they had had a great many discussions on the purification of sewage of towns, and, although valuable information had been brought forward, one point of view had not been dwelt upon—viz., the importance of the condition of the land by virtue of which it became a purifier of sewage; and therefore he begged to congratulate Mr. Denton on having specially insisted upon the necessity of rendering land a fit filtering medium, for it was only then that the sewage was effectually purified. He had long made up his mind that the land should be the means of effectually dealing with sewage. Whether it should undergo a previous treatment or not would depend on a variety of conditions which it was not necessary to go into; but, finally, the land must be looked to as the means of disposing of an intolerable nuisance, such as the sewage of towns had become. He was very much interested in the account of the experiment at Merthyr, which confirmed him more and more in the opinion which he had repeatedly expressed, that if the maximum and practical value was desired—in other words, to extract as much money from sewage in the shape of crops as possible—they should endeavour to put as much sewage on the land as it would take. The Chairman had alluded to the fact that the soil possessed the marvellous power of absorbing ammonia, and retaining the fertilising ingredients, such as phosphoric acid and potash, which were the most important. It should also be borne in mind that whilst the land possessed the power of retaining a certain amount of ammonia, this power was not only limited, but the ammonia was rapidly destroyed, and became changed into nitric acid, which was eliminated in the drainage that flowed from the land, and so was lost; so that there were no means of storing up in the soil any large amount of ammonia. If they wished to obtain the maximum value from the nitrogenous constituents contained in the clear liquid of sewage, they must endeavour therefore to grow crops whilst the sewage was in the land. His name had been mentioned in connection with the phosphate sewage process. He would mention that he had nowhere expressed any opinion upon the commercial bearing of this matter, but merely that the phosphate sewage process patented by Dr. Forbes so far purified the sewage, if carefully practised, that the water was admissible into a stream of running water. Then Mr. Denton had taken exception to a statement which he had made, viz., that whilst manure of some value could be extracted by this process, the fertilising properties of the clarified liquid, instead of becoming diminished, were just as good as they were in the original liquids, and, in fact, rather better. The matter was very easily cleared up if it were remembered that the sedimentary matter in sewage had very little fertilising value, the fertilising properties being contained in the perfectly dissolved substances. Manure of some value was obtained in the deposit if they previously put in something of value in the actual process of purification. The value of the deposit would therefore depend upon the value of the material put in; but it was perfectly possible to obtain a manure by precipitation of some value, and at the same time render the effluent water not the less valuable, but rather more so as an irrigation agent.

Mr. Robert Rawlinson, C.B., said the tendency of modern civilisation was to mass human beings in towns, and where towns existed there must be sewerage, because the fluids necessarily used in town communities must be removed in some way, and unquestionably they would always be best removed by means of under-ground conduits, sewers and drains. Whatever might be done with the dry-earth system in towns or villages, there must be underground drains to take away fluids; and that being granted, it was a matter for consideration whether the water thus flowing should not be made use of to carry away the small proportion of impurities generated by human beings in places where it could be dealt with by one operation, instead of dealing with it, as in the dry-earth system, by a multitude of operations, continued daily, or at least weekly. Some who had tried the earth system were sorry for it, and no wonder, considering the perpetual intervention from outside which was required. Sanitarians had been found fault with, because, in the first instance, cesspools having been the growth of a former period, when the sewage question was not understood, and water-closets having been introduced at the beginning of the century, when there was a prohibition generally against the existing drains being used as conduits for sewage, these cesspools were dug; but it was unavoidable under the circumstances, and in London they existed very recently by thousands and tens of thousands, and he was not sure there were not thousands in existence now. Windsor Castle, after an expenditure of three quarters of a million to render it a fit habitation for royalty, in 1844, was found to rest upon 53 cesspools full to overflowing; and the first Board of Health, which was established in 1848, met at Gwydyr-house, which was found on examination to contain in its basement nine overflowing cesspools. He could not help alluding, therefore, to the great inconsistency in all legislation affecting matters of health that the metropolis should be exempted. London, of all the places in the empire, remained governed by 45 or more parish vestries, who had charge of the streets and sewers, whilst the Metropolitan Board, which was established for a special purpose, had charge of the intercepting sewers. There were various building acts, perhaps the best ever framed, but there was no law with regard to house drains; and there were houses all over London, especially in the West-end, which were not drained into, that is, connected with, the sewers. They had been separately drained, but not connected, and the evil was not found out until the whole basement was poisoned. He had been three years in his own house in London when he found out that it was in this condition. When speaking about it at the Architectural Society, he was told he must have got into the hands of a bad jobbing builder, when his reply was, that the owner and builder of the house was a member of that society's council. Mr. Bailey Denton had, as usual with him, most ably treated the question in all its parts, but he (Mr. Rawlinson) regretted he had not separated them more. With regard to town communities, sewage was a thing to be got rid of, and it was a fallacy to speak of its being worth one halfpenny a ton. In some cases towns might really be thankful to any person who would take the sewage away and deal with it agriculturally, so as to prevent its being a nuisance, without paying anything for it, and in other places they might fairly and reasonably be called upon to contribute towards the expense. With regard to the removal of the excreta, although he concurred with all the abuse which was lavished on the system of carrying sewage into rivers, still, if human life was the first element to be considered, any town had done a great and good work in purifying the habitations of a hundred thousand people, although they had for the time being polluted a stream, because no evidence had been given to show that the pollution of the stream in the country was one hundredth part so injurious to human life as one cesspool crowded against a cottage in the town. Mr. Bailey Denton, in his admirable paper, which tens of thousands would read, showed how pollution of rivers might be prevented, and by his works demonstrated on a practicable scale that town sewage may be so treated as to prevent its being a nuisance. That was the lesson to be studied, learned, and put in practice.

Mr. W. H. Michael joined with Mr. Rawlinson in regretting that the paper had taken so wide a scope, for he thought one of the topics treated in it would have been quite enough for discussion. There were two things in opposition to one another which ought to be taken into account in considering this question: First, that it was the interest of town councils to have as small a place as possible devoted to irrigation purposes, if that plan were adopted; and, secondly, that it was the interest of farmers to have as large a space as possible that could be effectually irrigated, so as to obtain the largest amount of crop. Therefore, while 40 persons to an acre might be sufficient for one purpose, 3,000 might be better suited to the other. He doubted if they were in a position, from one isolated experiment, to give any answer to the question, whether intermittent filtration was proved to be effectual when joined with vegetation on the surface. If it had been found that cesspools in constant use had so polluted large areas of ground as to poison the whole of the water in the neighbouring wells, how could it be hoped that, after the same lapse of time, intermittent filtration would not so overload the quantity of earth used that it would, after that period, cease to discharge the duty which it had at first amply fulfilled. He did not think the simple experiment performed by Dr. Frankland was sufficient to enable them to speak definitely on this point without further and more extended experience. If it were so, they would have arrived at the solution of the difficulty, because one of the difficulties which was constantly meeting the Local Boards and those who advised them, was the large area of land required to carry out sewage irrigation; and if it were found that one acre of land was sufficient for a population of 3,000, and this fact were proved, the difficulty would be removed. There was no reason to suppose that the government was going to do anything to help in this matter. By laying down any chemical formula, as to the absence of pollution, they would not really assist, nor could government be expected, as preservers of the public health, to say what scheme should be adopted. It had gone quite as far as was proper, when it said to all public bodies, you are not so to deal with your sewage as that it should be a public nuisance. With great deference to Mr. Rawlinson, he could not agree with him, that any town was justified in changing one form of pollution for another, or in polluting rivers instead of wells. He was also surprised to hear what Dr. Voelcker had said with regard to liquid sewage. It could not be too much insisted upon that the solid matter was utterly valueless, but he thought it was going too far to say that it might be entirely eliminated and yet leave the liquid sewage really more valuable for irrigation purposes. Mr. Baldwin Latham had done a great deal by perfecting the process for getting rid of the solid matter, but he could not understand how it could be said that by adding something to sewage you could clarify and purify it, and yet make it more efficient for irrigation purposes; the two things seemed perfectly opposite to each other. He understood the doctor to say that you might add something to the fluid which should take away the ammonia, and yet the ammonia, being the only thing which comparatively rendered the sewage valuable, should be all the more valuable after it had been removed. In conclusion, he thought it very surprising, after the utter worthlesness of chemical methods had been demonstrated, they should still be advocated by some parties. He referred to the A B C, and other frivolous modes, the advocates of which were always promising to do something, but their promises were never fulfilled. They acknowledged they did not take away the ammonia, which, being a matter which became putrescible, gave all the trouble, and that the manure when made was of so subtle a character that it was entirely beyond the province of chemists to distinguish its fertilising powers. He was surprised, therefore, that people should be found ready to throw their money away in a process which absolutely required the expenditure of £10 worth of material in order to produce a manure worth about £5, and hoped they would soon hear the last of A B C or X Y Z processes, which only stood in the way of more efficient modes of dealing with this question.

Mr. Rawlinson said he had in no way advocated the pollution of rivers.

Dr. Frankland, F.R.S., said he had listened to the paper with great satisfaction, though he wished the author had omitted the latter part, which treated of the old system of dealing with refuse matter. He agreed generally with Mr. Bailey Denton, but he had, he thought, failed to distinguish between two separate things, the purification of sewage water, and the extracting from it the manurial ingredients. These two subjects were very frequently confounded. You might purify sewage by transforming its polluting into non-polluting ingredients, so that it might be admissible into any stream without the possibility of creating any nuisance, and not extract from it one particle of its manure value, and in that respect he quite agreed with Dr. Voelcker, although he was not prepared to go so far as he had with regard to the purity of the effluent water produced by the phosphate of alumina process. On the other hand, it was also possible to extract certain manurial constituents from the sewage without completely purifying it, and by the aid of plants and soil you could also extract the valuable constituents from the sewage, and store them up in the tissues of the plants to a considerable amount, still leaving a considerable portion of valuable though non-polluting particles in the effluent water. This was what had been accomplished at Merthyr, as he could testify from an examination of the works and the effluent water. Mr. Denton had there shown that the system of intermittent filtration, which had been experimentally successful in the laboratory of the Rivers Commission, where it was first devised and tried, could be applied on a large scale under certain conditions, and with the additional advantage, which was not at first contemplated, that a certain amount of agricultural produce could be grown at the same time. The soil at Merthyr was very favourable, being sandy and porous, allowing the sewage to pass regularly and slowly through it, whilst, at the same time, it allowed of very perfect aëration, a condition which was essential to success. Moreover, the sewage of Merthyr was only of about half the average strength of town sewage, but at the same time, the effluent water was so pure that if it contained twice the per-centage of impurities which it did, it would still fall considerably within the standards of the Rivers Pollution Commissioners. Many persons drank it, though that was no criterion, for he had seen people drink slightly clarified sewage with avidity, and declare it was excellent. It was asked whether filters constructed on this plan might not become choked and useless, and he might admit the possibility, although it would be contrary to the experience which he had had as yet on a small scale in the laboratory, where he had found no choking of properly aërated filters; he had observed even no tendency that way, although they had been in some cases kept at work for periods varying from one to two years. With regard to the amount of valuable constituents present in sewage, which could be extracted in this way, and converted into marketable produce, they could not expect to compete with more extended irrigation, and, as a matter of fact, the effluent water from the Merthyr filters contained half of the fertilising ingredients present in the original sewage; but this waste went on upon sewage farms almost everywhere to an extent not at all appreciated by those who were applying the irrigation process. It was no uncommon thing to find a quarter, or half, nay, in some cases, seven-tenths of fertilising constituents of the sewage going away in the effluent water, even on the most successful sewage farms. They might, therefore, look forward to getting a much larger amount of produce out of a given quantity of sewage than had yet been obtained. He should be glad to see experiments made in this direction, and the effluent water, which still retained fertilising constituents, applied to subsequent portions of land, in order to ascertain whether it would not produce as good crops as the original sewage.

Mr. Baldwin Latham, C.E., said it was very gratifying to those who had taken the lead in the question of how to dispose of sewage so as to effect its purification, to find that Mr. Bailey Denton had become a convert to their views; for it was but about two years ago the author stated in this room, when his paper on rural water supply was under discussion, that there was no means of purifying sewage, and yet in the short time that has elapsed, he comes forward as one of the boldest champions of the cause he formerly condemned. Still, he must say, that there were some points on which it was not clear that Mr. Denton had arrived at the right solution of this great question. The subject of intermittent filtration had been spoken of as carried out at Merthyr under exceptional circumstances. He feared that the system could not be carried out so successfully everywhere. For example, see what is proposed to be done at Birmingham. Mr. Denton proposes to apply all the sewage to 800 acres of land. At the present time Birmingham stands upon upwards of 5,000 acres of land, and has its thousands of cesspools studded over this area. From these cesspools subsoil intermittent filtration was going on, and yet what are the results? The subsoil water of the district is so poisoned as to be pronounced unfit for domestic purposes. What then will be the result when the sewage of this large district is concentrated on some 800 acres. He did not say that the effluent water would be injurious when flowing in the natural water-courses, as nature has provided in the air the means of oxidising any escaping deleterious matters, but he could conceive that such effluent water would still be poisonous in the sense in which sanitarians look upon impure water. This method of intermittent filtration was certainly not the goal to which sanitarians and agriculturists are looking; who, on the one hand, are anxious to reduce the agents destructive to life to a minimum, and, on the other hand, to get the greatest value for the fertilising materials we have to dispose of. After paying constant attention for some years past to the subject of sewage irrigation, he must say that the conclusions arrived at by Mr. Denton with respect to the necessity of sub-drainage on all irrigation areas are not borne out in practice. Some soils, Mr. Denton admits, are too porous for irrigation, and he does not recommend these, but wherefore it would be difficult to find out, except that they do not require draining. Some soils are dense, cold, flat, and with no natural circulation. These soils require draining. His experience led him to know that when there is good natural drainage the cost of artificial drainage can be dispensed with. Moreover, in the case of land through which there is a thorough circulation of water when applied for irrigation, no drainage is required as an absolute element of success, as laid down by Mr. Denton. From the remarkable results that have transpired where sewage has been applied in large volumes to undrained land, he was led to form an opinion that there were some forces at work which had hitherto escaped our attention, and which give all the advantages of drainage without its cost. From a series of experiments carried on with various kinds of sand and soil, he had arrived at the conclusion that wherever the surface to which the sewage is applied has a given amount of inclination, a perfect circulation takes place in the soil to considerable depth, and to depths below those to which the liquid would pass by ordinary gravitation. These conclusions he arrived at by making a series of experiments, first with silver sand and afterwards with other materials. The experiments are so interesting, and throw such a new light on the irrigation theory, that they were about to be repeated by his friend Dr. Odling, at the Royal Institution. He would take one experiment, which he showed by means of a diagram. In a glass tank four feet long, twelve inches deep, and six inches wide, was put silver sand saturated with a solution of perchloride of iron. The tank was inclined at an inclination of 1 in 100 at the upper end; an infusion of nut-galls was allowed to pass into it drop by drop. By natural gravitation, the water would have penetrated to a depth of six-tenths of an inch at the upper end and nothing at the lower; yet, after eight pints of the effusion had been applied, it showed that penetration had taken place to a depth of nearly five and a half inches, and every increase in the quality applied increased the depth of the penetration. The apparatus formed its own diagram, for all the perchloride was displaced by the galls; but at the point of junction, owing to the formation of tannate of iron, a clearly defined line was visible, and until this line reached the lower end of the tank nothing but perchloride of iron came over. In order to ascertain that these results did not arise from simple diffusion, a quantity of the same material was placed in a glass jar and kept at rest, yet, in six months, the colour had not penetrated the sand more than a quarter of an inch. The tendency of these experiments was to show that a given volume of sewage passed on an irrigation area first displaces a given amount of subsoil water, and that afterwards every increasement of sewage passed on displaces a former increasement, so a constant circulation is taking place in the soil, and every particle of sewage is thus brought intimately in contact with the soil. Drainage promotes circulation, but the experience of all the larger irrigation works in Europe unmistakeably points out that a circulation is promoted by the application of large volumes of water to properly prepared surfaces. Of the thousands of acres irrigated in Piedmont, Lombardy, and Spain, under-drainage is not resorted to, and yet the value of irrigation in these cases is tested by the proportion of the water applied. The larger the quantity, the more valuable the undertaking. The conclusions therefore to be drawn are these, that when there are good natural falls, with a large volume for application, under-drainage is not an absolute requirement, but if there is no fall, circulation must be provided by under-drainage. Now, as sub-drainage adds enormously to the cost of irrigation works, and has not always proved successful (as at Norwood, where the drains have been taken out), it is a point gained to know where and when they may be adopted, and where dispensed with, for the more certain and less costly we can make irrigation works the more hopefully will the system develop, to the common advantage of all.

Mr. Hope asked if the tank was filled with wet or dry sand.

Mr. Latham said the tank first had 5½ gallons of the perchloride solution put into it; the sand was afterwards added, and it was then allowed to rest, to ensure saturation and settlement before commencing the experiments. It was curious that, at whatever point the galls were applied, if there was an inclination of surface, the liquid penetrated to a considerable depth; but if there was no inclination of surface, and movement over the surface, there was no penetration. The same results again occurred when the iron was passed through the tank, after the galls had displaced the former perchloride of iron.

Mr. Hope said he could conceive it was within the bounds of possibility that such a process of circulation might take place in rough, coarse sand, but, as a matter of fact, on catch-water irrigation farms the water could be followed, flowing along the surface of the land, and flowing off. As a matter of fact, there was no circulation, whatever the theory might be; and if it was considered that land irrigated for months or years successively became completely lightened by the action of the water, it was evident that such circulation would be impossible. If there was one axiom in agriculture more thoroughly adopted than another by all men of experience, it was that you must drain land, and if you added to the natural moisture or rainfall on the land a large quantity of artificial moisture, in the shape of sewage, surely the drainage was none the less necessary. He had listened to Mr. Denton's paper with great pleasure, and agreed with him so completely, that he would not occupy time in discussing those few minor points on which he differed. Dr. Frankland had pretty well disposed of the question of cesspools and filtration, pointing out that the completeness of action was owing to the intermittent aëration of the filter, while the pollution of the cesspool was due to the constant saturation and non-aëration of the surrounding sub-soil, two things radically dissimilar. With regard to the phosphate process, he would, if he might be allowed, venture to defend Professor Voelcker's veiw of its action on the effluent water. It was quite possible, although it had not yet been sufficiently proved, that that process might produce the solid precipitate, and at the same time enrich the effluent water, because the process of subsidence, which was purely mechanical, deprived the sewage of the bulk of the phosphate; and, as he understood, there was a process by which a certain amount of free phosphoric acid was liberated, which would replace the phosphate of which the sewage had been deprived. That, of course, had nothing to do with the question as to its commercial value. The great difficulty would be that the solid matter was obtained in the form of a nasty slush, containing some ninety per cent. of water, which would have to be driven off by some mechanical means. With regard to the A B C process, he had not been at all converted by his recent visit to Leeds. It had always been put forward that some future operations were to be looked to to prove the value of this process, and he had been requested to examine the works at Leeds, but on doing so he was obliged to call in question the analyses published by the company at the meeting of the Local Science Association, which showed 4½ per cent. of ammonia and 9 per cent. of phosphate, as compared with one per cent. of ammonia and 2½ of phosphate, as shown by Drs. Franklin and Voelcker. The company had since admitted the accuracy of the last named estimates, but they still claimed that their product was worth 70s. a ton, at which they were selling it, while this analysis showed it to be only worth 35s., and they were now obliged to fall back on the ingenious theory that there was some virtue in solid human excrement other than that disclosed by chemical analysis. It really resolved itself, therefore, into a question of what was the commercial value of mumbo jumbo; for, whilst 35s. a ton represented the value of the ammonia and phosphate, the other 35s. could only represent the value of mumbo jumbo. With regard to the suggestion that the effect of the effluent water containing inorganic nitrogen escaping from sewage farms should be tried upon fresh soil, in order to ascertain its manurial value, he feared that such an experiment would be disappointing, because the experiments conducted over so many years by Doctors Lawes and Gilbert showed that a certain waste of nitrogen was unavoidable. As far as he could ascertain, it was impossible to obtain the commercial result due to a given quantity of ammonia without the loss of the inorganic nitrogen. The question was very abstruse and difficult to experiment upon, but the observations of M. Cloez in France went to show that the majority of plants had no power to assimilate ammonia at all, but only nitrogen in the inorganic form. It was impossible to say whether or no that was the case, but he feared it was not, and that Dr. Gilbert was right when he said that the inorganic nitrogen was only taken out of the soil in a long course of years. The real secret of the waste of nitrogen in the effluent water was that the quantity of manure applied was far in excess of the possible requirements of the plant. He had previously stated that land would not take the sewage of more than from 20 to 25 persons per acre, and after two years' experience his belief was it was impossible to get the value from the sewage of more than 20 persons per acre, for it was very easy to over-burden the market with garden produce, and the bulk of manure, therefore, must be converted into more portable produce, such as cereals. Having given great attention to this subject, he believed it might be so applied, and that the bulk of the sewage would be so used in a few years' time. From perhaps the first of September to the first of May sewage might be applied to cereal crops with advantage. In the earlier part of the time it might be used to produce a crop of mustard, which would afterwards be ploughed in, and there was no better preparation than that for wheat. At a later period it might be applied directly to the wheat, after that again to fallow land in preparation for either wheat, barley, oats, or beans. Then, again, in spring it could be applied to cereals sown in the autumn which did not receive any sewage at that time. In this way they would get the greatest return with the minimum of outlay, and at the same time the minimum of uncertainty as to a market. With regard to Mr. Latham's remarks about Birmingham, he felt rather sore on that point, because he had recommended what was practically the same scheme as he had formed many years for London, a small area of land as a sort of filter at the end of a culvert, with the power of selling the sewage to farmers right and left. He was now about to lay out for the corporation of Birmingham about a thousand acres for the intermittent filtration of sewage, amounting to a daily average of about 16 million gallons. On his farm at Romford in last June, December, and January he had applied 6,000 tons an acre continually to a portion of about seven acres, and the result was perfectly satisfactory, although the land had not been so thoroughly drained as it should be for such a purpose. This was at the rate of about 31,000 tons per annum per acre, and the 16 millions of gallons in Birmingham would be about the same proportion when applied to 1,000 acres. Consequently he did not apprehend any danger from the operations proposed to be carried out there.

Mr. Spencer said he had been for fourteen years successfully engaged in the purification of sewage water, and, although not a thick-and-thin advocate of sewage irrigation, he was chemical adviser for the Liverpool Sewage Irrigation Company from the commencement. His own speciality, however, was the purification of sewage, and he believed he was entitled to claim the credit of introducing the method of intermittent filtration. For the last seven years he had purified the water of a narrow river, almost like a canal, and sewage from about 70,000 inhabitants went into the water that was given to the population of Wakefield to drink. Notwithstanding, there had been so much less disease since this process had been adopted, that he wondered more notice had not been taken of it. He was glad that Dr. Frankland had come over to his way of thinking as regarded intermittent filtration, though, in 1862, when he (Mr. Spencer) was engaged on a bill in Parliament for the purification of the whole of the tributaries of the Mersey and Irwell by this method, Dr. Frankland, being engaged on the opposite side, had laughed the idea to scorn, and the pamphlet in which he had advocated it was described as absolutely ridiculous. Now, however, the same method was described as the great panacea for all the evils of effluent sewage water. The fact was, however, that the whole efficacy of the process depended on the nature of the soil. If the soil contained no iron the sewage might be filtered through it to any depth, and though it might be mechanically purified, it would not be in the least affected chemically, so that all the matters held in solution would still remain. Mr. B. Denton had spoken of the advantage of clay soils, but it must be red clay, containing iron; white clay, like white sand, would be useless for the purpose. So long, however, as the soil contained iron, the filters would be self-purifying. At Wakefield, the filters had not been touched for six years, except to scrape out periodically the deposited matter; and he had no doubt that at Merthyr, where the filters were found to work so satisfactorily, there was a large per-centage of oxide of iron in the sand. It had been asked what became of the sewage matter, and how did the filter purify it; it must go somewhere. The answer was, that it was destroyed by the power which peroxide of iron had of changing organic matter into carbonic acid, by a process precisely analogous to that which went on in the lungs.

A vote of thanks having been unanimously accorded to Mr. Bailey Denton for his able paper,

Mr. Bailey Denton said he did not like making observations upon what he did not fully understand, and therefore he would take an early opportunity of calling on Mr. Baldwin Latham, and having the nature of his experiment more fully explained; but, in the meantime, he would ask his audience to reserve their opinion upon the matter. He had been engaged for 25 years in draining, and all that time he had never yet known water to run up-hill; and it seemed to him as if Mr. Latham's experiments showed that to be the case. In reply to Mr. Michael, he would say that he did not venture to contend that the experiment at Merthyr was conclusive, and one which should be held up as a pattern for all the kingdom to imitate; but, as far as it had gone, it was perfectly satisfactory, and he believed there were in the case such indications as enabled one to look somewhat into the future, and to say that, with the aid of vegetation applied to the area being used as a filter, and letting a portion rest for a period at intervals, during which it should be given up wholly to vegetation, the end aimed at might be accomplished. Mr. Latham had followed Mr. Michael in comparing so many thousand acres of excrement-sodden soil at Birmingham with the filter beds at Merthyr; but two elements were entirely absent. In the first place, there was no intermittent filtration; and, secondly, houses took the place of vegetation, which made all the difference.

Mr. Hyde Clarke writes to call attention again to the large experiment of many centuries as to the treatment of sewage matter in Flanders, with an area of 4,000 or 5,000 square miles, and a population of 2,000,000, or 400 or 500 per square mile, on a sandy and porous soil.

ANNOUNCEMENTS BY THE COUNCIL.

MOSCOW POLYTECHNIC EXHIBITION.

This Committee met on Friday, the 29th of November. Present—Messrs. Seymour Teulon (in the chair), A. Cassels, Edwin Lawrence, and Lieut. Moukhan, of the Russian Navy. The Secretary reported that he had received a number of applications from persons and firms desirous of exhibiting, and that he had, in accordance with the directions given at the last committee meeting, arranged with Mr. W. P. Marshall to visit manufacturers and others in Birmingham, to explain to them the scope and object of the exhibition.

THE LIBRARY.

The following books have been presented to the Library :—

The Origin and Progress of the Cotton Supply Association. By Isaac Watts. Presented by the author.

The Fifth Report of the Destitute Children's Dinners Society. Presented by the secretary.

The Speech delivered by Mr. Stevenson, M.P., on "The Metric System," in the House of Commons, on the 26th July, 1871.

Classification des Huiles et des Graisses Végétales. Par le Conservateur du Musée Commercial Industriel de Melle.

The Journal of the Iron and Steel Institute. Vol. II. November, 1871. Presented by the institute.

Reports published by the Belgian Commission and Jury for the Paris Universal Exhibition of 1867. Four vols. Presented by the Committee of Council on Education.

Address on Health. By Geo. Godwin, F.R.S. Presented by the author.

Indexes of Patents and Patentees in Victoria, for 1869.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

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Attendance of Visitors in 1871.—The average number of visitors admitted to the exhibition by payment on each day of the week was as follows :—

Monday	(admission 1s.)	9,310
Tuesday	„ „	9,868
Thursday	„ „	10,151
Friday	„ „	7,604
Saturday	„ „	9,496
Wednesday	„ 2s. 6d.)	2,958

Royal Albert Hall.—His Royal Higness the Duke of Edinburgh presided at a meeting of the Executive Committee of the Royal Albert Hall, held yesterday at the South Kensington Museum. There were also present Mr. Fowler, Mr. Cole, Mr. Thring, and General Scott, secretary.

General Conditions for the Erection of Supplementary Galleries.

1. Galleries constructed of brick or other incombustible materials, according to a design to be approved by Her Majesty's Commissioners, may be erected on behalf of foreign exhibitors, by their respective governments, upon payment of a nominal rental.

2. Each foreign government may arrange to have an allotment of ground for such a supplementary gallery, proportionate to the space occupied by such government in the select exhibition.

3. These supplementary galleries are to be erected solely with the object of giving additional space to the exhibitors selected for admission into the Annual International Exhibitions, and are only to be used for the display of objects corresponding with those prescribed for each particular year.

4. Such supplementary galleries are only to be used by the respective commissions during the period of each Annual International Exhibition, including the time required for the arrangement and removal of objects. At other periods they are to be at the disposal of Her Majesty's Commissioners, on terms to be arranged with each government.

5. The tenure of such galleries may be until after the exhibition of 1880, but terminable by Her Majesty's Commissioners after each year's exhibition, upon a payment proportionate to the unexpired term of each lease.

6. The supplementary galleries are to be kept in repair, to the satisfaction of Her Majesty's Commissioners, by the respective governments.

7. All other charges connected with the supplementary galleries are also to be defrayed by the several governments.

8. No object is to be removed from these galleries during the hours the exhibition is open; and if objects are removed in the evening or early in the morning they must be replaced by similar objects before the exhibition is again opened.

9. Every foreign government having a supplementary gallery shall comply with the regulations of Her Majesty's Commissioners for the time being in force, in relation to the maintenance of the gallery and conduct of business therein. Any government making default in complying with such regulations shall, if required so to do by notice under the seal of Her Majesty's Commissioners, close such gallery until the default is remedied to the satisfaction of Her Majesty's Commissioners; and if the default be not remedied within a period, to be fixed by Her Majesty's Commissioners, of not less than one month, Her Majesty's Commissioners may either require the government in default to remove their gallery, or may themselves purchase the gallery at a price to be agreed upon, or in default of agreement to be settled by arbitration.

Fine Arts.—The general regulations for exhibiting examples of fine art applied or not applied to works of utility are as follows :—

I. Examples of fine art applied or not applied to works of utility will form part of each exhibition of the series, and will be arranged in the following classes :—

Class 1. Painting of all kinds, in oil, water colours, distemper, wax, enamel, and on glass, porcelain, Mosaics, etc.

Class 2. Sculpture, modelling, carving and chasing in marble, stone, wood, terra-cotta, metal, ivory, glass, precious stones, and any other materials.

Class 3. Engraving; lithography; photography, as a fine art, executed in the preceding twelvemonths.

Class 4. Architectural designs and drawings, photographs of executed buildings, studies or restorations of existing buildings, and models.

Class 5. Tapestries, carpets, embroideries, shawls, lace, &c., shown not as manufactures, but for the fine art of their design in form or colour.

Class 6. Designs for all kinds of decorative manufactures.

Class 7. Reproductions, *i.e.*, exact copies of ancient or mediæval pictures painted before A.D. 1550. Reproductions of mosaics and enamels; copies in plaster and fictile ivory. Electrotypes of ancient works of art, &c.

II. No artist can be allowed to submit more than three works of each kind for exhibition, but he may submit as many different kinds as he pleases; thus the same artist may send for admission three oil paintings, three water-colour paintings, three paintings on enamel, porcelain, &c., also three sculptures in marble, three in wood, &c.

III. Paintings and sculptures may be either separate works, or form part of the decoration of objects of utility, *e.g.*, vases in pottery, fans, panels for furniture, wood carving for furniture, &c., provided that such objects are entitled to be classed as works of fine art.

IV. All works of art, except architectural works and reproductions of ancient and mediæval works, must have been executed by living artists, or by artists deceased since 1862.

V. The building to which the architectural drawings, &c., relate must have been designed, executed, or commenced since 1862, and the model, drawing, or photograph shall not have been exhibited in any metropolitan exhibition within a space of seven years, or at any preceding International Exhibition.

VI. Architectural drawings and designs which have gained the travelling studentship of the Royal Academy, or the Soane Medallion of the Royal Institute of British Architects, within the preceding five years, will be considered admissible without other question than that of sufficiency of space.

VII. A producer will be permitted to exhibit reproductions of any number of ancient or mediæval works of art.

VIII. Foreign works may be sent with the certificate of admission given by the respective governments of the countries in which they are produced. Foreign works sent without such certificate, and all works of British subjects, will be submitted to the approval or rejection of judges, appointed by Her Majesty's Commissioners, for the respective classes. The decisions of the judges will be final, and the result of such decisions may be ascertained on application at the exhibition building.

IX. To prevent unnecessary trouble and expense to artists who may wish to exhibit heavy objects, such as sculpture, decorative furniture, architectural models, and bulky reproductions, photographs or sketches of the works proposed for exhibition, with specification of height, and dimensions of the base, may be sent to the secretary on or before the 1st January, 1872, so that a decision may be come to as to the possibility of their admission.

X. The Commissioners cannot undertake to receive any package which may be presented by carriers with charges unpaid. Foreign artists whose works are not sent through a foreign government should consign their works to an agent in London.

XI. Each picture or drawing must be in a separate frame, but a series of drawings relating to one subject, very small miniatures, or sculptured gems, placed in a frame not exceeding the Imperial size, will be admitted as one work.

XII. Each architectural work should bear the name of the architect who designed, as well as that of the artist who painted it. Architectural models should be submitted when possible. Drawings of plans, which can be admitted only as explanations of the general design, should be on as small a scale as possible.

XIII. All pictures and drawings must be in gilt or suitable frames. Drawings with wide margins are inadmissible. Excessive breadth in frames, as well as largely projecting mouldings, may prevent pictures obtaining the situation they may otherwise merit; and oval frames should be avoided, as they are difficult of arrangement.

XIV. The prices of works, if for sale, must be stated on a label accompanying the work, and if not for sale, the work must be so marked.

XV. A numbered list of the works submitted for approval must be sent in with them, each work bearing a number corresponding with this list. To each work should also be securely attached a label bearing the title and the artist's name and address: particular accuracy is requested in this respect.

XVI. Objects produced in the United Kingdom, as well as those objects produced in foreign countries, for which space has not been guaranteed, must be sent direct to the Exhibition buildings for the inspection and approval of the judges. All objects must be delivered at the proper places in the building, which will be hereafter advertised, and into the care of the appointed officers, free of all charges for carriage, etc., unpacked, labelled, and ready for immediate exhibition.

The Loan Exhibition of Musical Instruments at the South Kensington Museum.—The first meeting of the committee appointed to promote this exhibition, which will be opened in the month of June, 1872, was held on Wednesday morning at the South Kensington Museum. His Royal Highness the Duke of Edinburgh presided, and there were present Lord Gerald Fitzgerald, Sir George Elvey, Mr. Arthur Chappell, Mr. C. H. Cheyne, Mr. Cole, C.B., Mr. John Ella, Mr. Carl Angel, Mr. Owen, Dr. E. Rimbault, Mr. R. Redgrave, R.A., Mr. R. Thompson, and Mr. Alan Cole, secretary to the committee.

TRAMWAYS AND THEIR STRUCTURE, VEHICLES, HAULAGE, AND USES.

The following is the reply of Mr. W. Bridges Adams, on the discussion of his paper on "Tramways," read at the meeting of November 29th:—

The gist of the paper was to point out—

First. The probability that the clashing of the interests of the various tramway companies would involve disputes and arbitrations, ending in the State buying back the concessions.

Secondly. The mechanical defects of the existing tramways and vehicles involve more tractive resistance than either road vehicles or railway trains, and would ultimately require removal and replacement.

Thirdly. That to allow the minimum of resistance, flexible vehicles, with radial axles, independent wheels, and spring tires would be needed, such as would pass round short street-corners, and utilise narrow and curved streets and lines of road, the rails being so bedded in the road as to key into it and keep the exact surface level, elastic asphalte being used to prevent disintegration.

Fourthly. That it was desirable to get rid of horse traction on the tramways, and substitute for it small steam locomotives, or hot-air locomotives, as being manifold cheaper, far cleaner, and freer from risk of accident; and that such locomotives might be made to work without smoke or noise by rightly using efficient fuel and improved exhaust.

Fifthly. That in such case the tramway might cover all the roads, and become, in addition, supplementary railways, on which wagons with goods and materials might be delivered direct to the consignees, without shifting to road wagons.

Mr. Masey complained that the laws and statutes regarding tramways were "a snare and a delusion as regarded companies, which a single member of the House of Commons could wield for his own purposes." However this may be, it is quite certain that, as a rule, the English government does not initiate improvements, but leaves them to individual action, till they become a national interest too important to be left in private hands. The electric telegraph was the work of two skilled individuals, Cooke and Wheatstone. Several speculators bought up their patents to obtain a monopoly, and then set to work to impede, by law and a long purse, all improving patentees likely to interfere with them. Finally, the government stepped in and purchased the whole system. The amount of waste, and law costs, and time between the advent of Cooke and Wheatstone and the succession by the post-office was all a loss to the community. If the post-office at the outset had possessed the perception of the company, the transfer from Cooke and Wheatstone to the government direct would have been a cheap and simple matter. But there is no royal road to knowledge, and the probability is that the tramways will go through a similar ordeal, to be ultimately transferred to the governing authorities, State and municipal. But they will not be worked by them. Individuals and companies will contract to work them over given distances as was the common-sense plan of the old mails, before the advent of railways, subject to the control of the ruling bodies.

Mr. Masey adverted to the great cost of the present tramways per mile, and wished it to be brought down to £3,000 per mile. If he examines the diagram, he will find that timber is wholly dispensed with, and that the weight of iron for an efficient way, fit for light engines, will not exceed 85 tons per mile, single way, and that the probable total cost, including laying down on an asphalte bed, in the ordinary macadam, will not exceed £2,000 per mile, and this for a road adapted for light engines.

With regard to what is called the "off and on" system, it is quite clear that small wheels, fixed on the axle and without radial movement, could not go off to any advantage. But with free wheels, of larger size and radial movement, they could go off and on without difficulty for the short distances required, unless we suppose a mud road without hard surface. The present cars do run off frequently, and are dragged on again by main force. With regard to portable rails to run into farms and fields, there can be no difficulty. As far back as 1850 Mr. Adams had dealt with this question.

Putting aside the political economy of the matter, Mr. Bramwell dealt wholly with the mechanical question. He demonstrated the waste and wear of the existing system, and gave testimony to the importance of the loose wheels, radiating axles, and spring tires, proposed by the writer. Agreeing wholly with the importance and economy of substituting mechanical traction for horse-power, he threw some doubt on the possibility of obtaining the large power on so small an engine—as regards the steam production. His criticism on the various kinds of fuel—coke, coal, liquid, and gas, was quite clear—all resolving themselves into gas production, direct or indirect. He rendered justice to Mr. Hancock, the earliest and most successful steam worker on common roads, and instanced his vehicle in proof that there was no real difficulty in putting steam so to work. In combatting prejudice, the writer had dealt with the question of explosion, referring to the difference of hot air and hot steam, the latter needing a magazine and the former not. Mr. Bramwell showed that it was possible to use steam without a magazine, as instanced by the Howard engine on the river, "in which the steam was produced for every stroke of the piston by the injection of a given portion of water on a heated surface." This was, in fact, a similar process to that used by Perkins for his steam-gun, as shown at the Adelaide Gallery, and by Brown in his gunpowder engine, and in modern time in gas engines. The strength of a boiler to resist rupture was the square of the diameter; the danger when rupture took place was in proportion to the increase of the contents. Mr. Bramwell stated that the actual explosions of existing boilers was considerably less than one in two thousand.

This shows that, in calculating power, the first question is, how much power do we want? Mr. Adams assumed it to be practicable to construct a tramway engine with 3,500 tractive force, but that for ordinary purposes in the suburbs, only 1,000 lbs. would be needed. It is the question of boiler power, and what is the greatest power we can safely calculate on without risk for a tramway.

Mr. Haywood stated that tramway carriages were drawn by steam in the United States, and also in Madrid. He did not like the idea of steam along the common roads; but he had always said that the time would come for them, and he believed now that it would come sooner than he had once expected.

Mr. Hill said that the difficulty at the present time was to get the tramways upon the common roads, not getting engines on the tramways. Acts of Parliament, and the Board of Trade, and the enormous expenses consequent thereon, were the great impediment.

The Chairman considered that "these exclusive tramways ought not to be allowed to go any further into towns," for this reason, that "their nuisance was not confined to gentlemen's carriages; but was extended to all sorts of light vehicles—tradesmen's light carts, gigs, and the like. They are open to all the economical objections which the public now feel to railway companies."

This alludes to the damage to wheels, consequent on the bad condition of the road, by reason of the bad construction of the trams, by the grooves, or by the want of fixture on the surface—the "bad paving" which Mr. Hayward formerly stated to be a concomitant of tramways. It is to the amendment of this condition that Mr. Adams' plan is designed, as shown in the diagram. There is no groove to catch a wheel, but only a shallow channel on or out of which any wheel may run, and it is a fixture on the road, maintaining rather than deteriorating its general surface. The chairman had changed his opinion as to the value of tramways, and believed that asphalte surfaces were better than iron rails. He stated:—"A roadway of that peculiarly powerful sort of material, laid down of the space equal to a pair of tramways may cost double the tramways, but then it will accommodate not only double but three or fourfold the amount of traffic, besides insuring those indirect economies which I have specified in my paper."

Now, an asphalte surface means a solid rock of concrete, a foot or more in thickness, laid on a solid base. The asphalte is an elastic wearing surface analogous to the tire on a wheel. If it be not elastic, it will rapidly disintegrate, and must be constantly repaired as fast as it works into holes, by pouring in hot material to the previously heated surface. If not so treated it will be rapidly destroyed. If laid on a bad or unfirm surface it will not answer. No doubt, for crowded streets, in which it is needful for all kinds of vehicles to be incessantly crossing and re-crossing, rails of any kind would be a disadvantage, but then speed ceases to be possible. Safety with speed needs automatic guidance; and it is a mistake to suppose that, on a given width of road, more traffic can be conducted without rails than with. A given width of carriage will occupy the same space on the road as on the rail. Inasmuch as the traffic on the road will only be at half the speed of the rail, it will be only half the quantity. And if it were practicable to run in two fixed lines on asphalte the load borne by each wheel would be far less than that on the iron rail, or it would soon be worn out. The comparison between a bad class of tramway and a good class of asphalte will hardly yield a logical deduction. There is no reason why tramways should not be laid as firmly and as permanently as the iron gutters on the streets, which neither wear out rapidly, nor damage the wheels of vehicles.

CORRESPONDENCE.

THROUGH RAILWAY TO INDIA.

Sir,—If anything strikes an Englishman who has been away for some time, and returns home, it is the wonderful capacity our fellow-countrymen have for setting aside or ignoring palpable facts. What I stated to the Society consisted of facts, which related to what is already accomplished. If what I said in the room was indistinctly stated or heard, it has since been reproduced in this *Journal*, for cooler perusal and consideration.

The groundwork of my paper was the actual progress of the railways in European Turkey, the capital for which has been found in Austria, and elsewhere on the Continent of Europe, and the interest of which is provided by the Turkish government and people; indeed, even since then several locomotives have been landed for the Enos branch.

I referred likewise to the connection of the new system with an existing line, the Varna and Ruschuk Railway, 140 miles long.

It never occurred to me to make a preliminary exposition that there is no danger of murder or murderous assault to passengers on Turkish railways, because there is no justification for the suggestion of such danger; and I was speaking in presence of those connected with the management of railways in Turkey, and of those who have been habitual travellers on them. There are railways there which have been open above ten years, and carried millions of passengers, under a system of management and conditions equivalent to those in England.

When I spoke of the Varna and Ruschuk Railway, I might have hoped it was known to men of intelligence that this railway, in supercession of the Kustenjeh or Danube and Black Sea Railway, is a part of the main line from London and Paris by railway to Basiash, thence by the Danube steamers to Ruschuk, from that town by railway to Varna, and from the port of Varna by a few hours' steamboat transit to Constantinople. This latter line has been at work some years, and last year, as before, conveyed the mails and passengers, ladies and babies, to and fro. Mr. Galloway proposes to make this a part of a through railway to India. Persons who started from London with a bag got to Constantinople without buying a revolver; and when the Varna and Ruschuk Railway is superseded by the Basiash and Constantinople Railway for through traffic, the course will be the same.

It is best known to the persons who start such theories why it should be suggested there will be danger beyond Constantinople. All we know is, that on the 150 miles of railway now in established working in the Smyrna district, a Turk or Greek, a woman, even a timid Jew, takes in hand a German made bag, such as are sold in London, buys a single or return ticket, and goes from or returns to the thoroughly Turkish cities of the interior. Such must be the conditions of travelling in the greater part of Asia Minor. When the time comes that the nomads are reached, there may be occasion for speculation.

This speculation must, however, have special reference to the fact that a railway is a political engine or apparatus. Here, from the high organisation of society, we see it only in its aspect of a machine for the rapid transport of passengers and goods. The governor of a less advanced population looks on a railway as he does on a breech-loader, or any improved weapon, and with the same deep interest. The chief thing he sees is how he can protect his people against enemies from outside and within; and what is the power he gets against the disaffected and the predatory classes. He knows that a railway and a telegraph are mechanical police and military *materiel.* At this moment the Governor-General of the viceroyalty of Bagdad, who is contending in the field with the Arabs, is starting steamers and planning tramways, so that he may more effectually complete their overthrow. Now, the depredators can choose their scene of plunder, and it takes some time to assemble troops and police from the several stations; but if there were a through railway from Constantinople, no Arab tribe would move even a man, because it could have brought down upon it the whole military force of the empire.

An incident will illustrate this sufficiently. At a time the works on one of the railway lines were not open for traffic, but the engine could reach about fifty miles from Smyrna, I was at the palace about noon, when the Governor-General told me that a particular malefactor was lurking in the neighbourhood of our works, and that he wanted our assistance to send down police, and to co-operate in his capture. I asked him if we might take him into custody, and received his assent. I remained with him to transact business, but I had given instructions to one of our people to telegraph at once the necessary instructions.

At two o'clock I sent word to the Governor-General, to request him to send police at once down to the Smyrna station, to receive his prisoner. When I next saw him, he expressed his full appreciation of the help the railway was to the government. As I had foreseen, not only had an impression been made on the local authorities as to the power they possessed in dealing with criminals, but also on the outlaws in the mountains, who found they were in the hands of the Governor-General of Smyrna. For such a capture before a party of police must have been sent out on horseback, and the prisoner marched back, an affair of some five days at least, whereas the whole matter was accomplished in as few hours.

One result of this was the breaking up and surrender soon after of a very large body of outlaws, who, it may be remarked, were, as in most such cases in Turkey, merely runaway conscripts, and not habitual criminals. Since the opening of the railways, this course of refuge has become impossible within reach of the railway, and crime in its largest dimensions has been reduced to the occasional appearance of small bands of highwaymen, chiefly from abroad, which have been soon grappled with.

Next to this influence, as it may be called, comes that milder influence, described by Mr. Austin, as the result of employment on the works in the course of construction, and there are many of us who can confirm what he says. Beyond this, every farmer, labourer, and shopkeeper near the works, and everyone on the line of extension, has the like interest in preventing the railway from being interfered with. To them it is a mine of perpetual prosperity. I remember an old Turkish yeoman asking me as to the prospects of railway extension to his district of the interior. "Why," said I, "do you take such an interest in railways?" "Because we know that when a railway is surveyed land doubles in value, and when it opens it doubles again." There is not an old woman who has fowls but knows that the chickens and eggs she can now only sell for farthings, if she can sell at all, will, on the opening of a railway, fetch Smyrna prices.

If we are seriously to consider such questions as those under discussion, we must not look upon them with simple English notions, or seek to apply to them existing facts, which are under different conditions, but we must avail ourselves of that experience which is strictly relevant. By this time we have gained experience as to railways in Turkey, if we only use it.—I am, &c.,

Hyde Clarke.

32, St. George's-square, S.W., Dec. 2nd, 1871.

THEORY OF COLOUR.

Sir,—When we consider the length of time that incorrect, inexact language has prevailed in reference to the theory of light, it is not extraordinary that the false first impressions which such language engenders should be difficult to eradicate; for instance, here is Mr. Benson, after nominally admitting colours to be sensations, still writing of colours as if they had external objective existence, when they are now known to be solely conditions of the sentient being.

"Did Mr. Thomas never experiment with the common colour top? What can the resulting colour be but a mixture of the separate rotating colours, received in rapid successions, on the same eye?" . . . "But we can even mix the sensations received in the separate eyes."

A top or disc cannot be painted with sensations; the sun does not, as Mr. Benson's language would imply, give off colour sensations to be "rotated," "mixed," and "received" in the eye. Experimentalists do not, with their turn tops and discs, trundle sensations, but surfaces reflecting wave action of different periodicity, almost simultaneously, which wave action is communicated to the retina. We cannot even tell that the sensations, produced by precisely the same mechanical means, are exactly the same in any two people; we can only very indirectly infer whether they are or are not.

A mechanical combination of two different wave periods will produce a third sensation differing from that produced by either singly; it is, nevertheless, a distant and separate sensation; it is not the mixture of two sensations, but the effect of a mixed or combined wave action. Every sensation is at any one moment of time an indivisible prime. It is a very remarkable fact that the same cause may produce different sensations under different circumstances. Painters well know the change of effect produced in one sensation by the juxtaposition of another on the retina. A similar effect occurs in other affections of sense; for instance, if three basins of water be placed in a row, containing respectively cold, lukewarm, and hot water, and one hand be placed in each of the extreme temperatures, and then after a time both hands be simultaneously transferred to the intermediate degree, this will produce in us, at the same time, the sensation of both heat and cold. Seeing then that the immediate character of sensation is so dependent on relativity, it is almost hopeless to expect any precise nomenclature, and after all, artists know more about colour than anybody else. The greatest colourists that ever lived were neither indebted to books nor diagrams; they intuitively knew the æsthetic science of colour, for in fact, it is a science of the inner self of the sentient being. They worked to perfection, in total ignorance of either the Newtonian or undulatory theory.

The fact that sensations are something beyond the reach of physics is an important subject to reflect upon, for it may be perceived that, when we have pursued physical action to its ultimate contact with sense, there yet remains an effect which defies, and will in all probability for ever defy, human analysis.

The latter part of the letter on which Mr. Benson comments, refers to the vulgar notion of light being "a matter" which travels and passes through bodies, and the inconsistent transposition of language appropriate to the Newtonian hypothesis to the undulatory theory. All who have studied this subject deeply now know that there is "no matter of light," and how wave action, under ordinary circumstances, is communicated through media. But there is generally such misconception on the whole subject, that a little discussion may be beneficial, even though nobody yet knows, or will ever know all about the subject.

German writers pointed out, some twenty years since, that the theory of compensation, which Mr. Benson affects, was totally inadequate to explain the phenomena. —I am, &c., W. Cave Thomas.

November 25th, 1871.

Italian Trade with Odessa.—From the returns of the movement of shipping at Odessa in 1870, we find that, out of the 996 sailing vessels that left the port during the year, 337, or about a third, were Italian; the next in importance in number were Austrian vessels, of which 225 left Odessa during the same period. The British vessels amounted to 164; those belonging to other nations were few in number, and even Russian vessels did not amount to 100. With regard to steam vessels, the returns show a different result, and out of 300 which left this port, 109 were Russian, 85 English, 77 Austrian, 11 Belgian, 10 French, and only 5 Italian. The commerce of Odessa shows a considerable increase in 1870, as compared with that of the previous year, and was as follows:—

Number of Ships that left—

	In 1869.	In 1870.
Sailing vessels	432	996
Steam vessels..........	248	300

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

December 13.—"Observations on the Esparto Plant." By Robert Johnston, Esq.

December 20.—"On the Study of Economic Botany, and its Claims Educationally and Commercially Considered." By James Collins, Esq.

CANTOR LECTURES.

The Second Lecture, "On the Manufacture and Refining of Sugar," by C. Haughton Gill, Esq., was delivered on Monday evening, December 4th. The remaining lectures will be given as follows:—

Lecture 3.—Monday December 11.

The sugar-beet—Extraction of juice by diffusion and by presses — Defecation — Carbonation — Preliminary filtration — Concentration — Refiltration — "Boiling" — Separation of syrup from crystals—Treatment of Syrup — Second and third products — Molasses — Nature of molasses—Difference between molasses from cane and beet—Estimation of the value of raw sugar.

Lecture 4.—Monday, December 18.

The refining of sugar, the complete cleansing of it—Melting or blowing up—Filtering, charcoaling, boiling, filling out, draining, liquoring, stoving—Utilisation of syrups—Treacle.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

INDIA COMMITTEE.

A Conference will be held on Friday evening, December 15th, on "The Route to Western and South Western China by the Irrawadi, and the Commercial Advantages attached to it," also on "Chinese Canals and Indian Rivers." The conference will be opened by Captain F. E. Manners, and will commence at 8 o'clock.

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lecture. Mr. C. Haughton Gill, "On the Manufacture and Refining of Sugar."
Social Science Association, 8. Adjourned discussion on Mr. Thos. Hughes's paper "On the Present State of the Co-operative Movement."
Royal Geographical, 8½. 1. Mr. Keith Johnston, "Remarks on Wakefield's Map of the East African Lake Region." 2. Capt. R. F. Burton, "On the Ukara or Ukerewa Lake." 3. Capt. S. B. Miles, "On the Somali Country."
Medical, 8.
London Institution, 4.

Tues.....Royal Medical and Chirurgical, 8½.
Civil Engineers, 8. 1. Discussion, "Stresses of Rigid Arches." 2. Mr. Charles Andrews, "The Somerset Dock, Malta."
Photographic, 8.
National Union for the Education of Women, 4. At 18, Cadogan-place.

Wed.....**SOCIETY OF ARTS, 8.** Mr. Robert Johnston, "Observations on the Esparto Plant."
Graphic, 8.
Royal Literary Fund, 3.
Archæological Association, 8.
Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.

Fri.......**SOCIETY OF ARTS, 8.** India Conference. Captain Manners, on "Route by the Irrawadi to Western and South Western China."
Philological, 8¼.

Sat... ...Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."

Journal of the Society of Arts.

No. 995. Vol. XX.

FRIDAY, DECEMBER 15, 1871.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

SPECIAL NOTICE.

The Ordinary Meeting, fixed for Wednesday evening, the 13th inst., when Mr. Robert Johnson was to have read a paper, entitled, "Observations on the Esparto Plant," was postponed, on account of the dangerous illness of His Royal Highness the Prince of Wales, President of the Society. The India Conference, announced for this evening, will not take place, for the same reason.

PROCEEDINGS OF THE SOCIETY.

INDIA COMMITTEE.

A conference on the subject of Indian Forests and Indian Railways, was held on Friday evening, Dec. 1st.

The Chairman said, in opening the proceedings, that he thought it would be gratifying to those of the members of the Society of Arts who had taken an interest in the proceedings of the India Committee of the Society, if he offered a few observations by way of review as to what had been done in the past session in regard to India. He thought the India Committee of the Society of Arts might congratulate themselves on the progress of the measure in which the Society took active part, the establishment of an Indian Agricultural Department. But while the India-office acceded to the request which the Society made, it ought not to be forgotten that many of the friends of India have expressed great regret that the Department of Agriculture has not been placed in a sufficiently independent position, but is subordinated to the Board of Works or the Board of Revenue. What is wanted with regard to agriculture is, that there should be a department having in the various presidencies and provinces, directors who shall be, as it were, the official representatives of the interests of agriculture, and who shall be able to attend particularly to the Revenue Department, which exercises so large an influence upon agriculture; while on the other hand the Agricultural Department, if it is made simply dependent, will not be able to carry out these views. In the next place, the India Committee are entitled to congratulate themselves with regard to the continued prosperity and maintenance of the Manchester Cotton Supply Association. At a period of the past year when there was a prospect of that association discontinuing its labours, the proposition was made that in such a case the Society of Arts should be asked to supply, as far as it could, the place of the Cotton Supply Association, by establishing a permanent Cotton Committee. That proposition had no doubt a considerable effect in stimulating their friends in Manchester to maintain that institution, which they have carried on for so many years, with such great benefit to India, by its labours in advancing the culture of cotton in that country. Another topic to which reference might be made, was with regard to the East India Association. In the early part of the past year, the Council of the Association were in a state of great despondency, arising from various circumstances, and some conferences took place between the Society of Arts and leading members of the East India Association, to ascertain whether further support could be given to the East India Association for its perpetuation and maintenance. In that case also the Society of Arts were justified in considering whether, with a further measure of support, they could strengthen the exertions of their friend, Mr. Dadabhai Naoroji. The encouragement which was given induced Mr. Dadabhai Naoroji to start with some degree of firmness and confidence, upon a tour in India, which has resulted in endowing the East India Association with new funds, and has begun for it a new era of prosperity. Looking back to the labours of past sessions, the India Committee have every reason to hope that, during the approaching session, they may, in their humble way, be able to render new services to the cause of the advancement of India. They could not expect that any subject of this nature could be popular; they could not expect that there could be any degree of general interest in regard to Indian questions; but if they could succeed in bringing together, and keeping together, a small band of labourers, who could profit by the facilities given by the Society of Arts to communicate their ideas to the leading men of the commercial, the political, and the scientific world in England and abroad, and if they could profit by the means the *Journal of the Society of Arts* affords of disseminating their ideas still further, aided by the co-operation of the Indian newspaper press, it would be a great encouragement to those friends who came there to contribute their ideas, or to engage in discussions upon Indian questions. On the present occasion they had been invited to hear the views of Lieutenant-Col. Wragge upon the important question of the relation of Indian forests to Indian railways, and he would now call upon his gallant friend to open the discussion.

The paper read was:—

INDIAN FORESTS AND INDIAN RAILWAYS.

By Lieut.-Colonel A. Romaine Wragge.

No doubt many of those who have honoured me with their attendance this evening, have asked themselves the question, why have I coupled Indian forests with Indian railways? Those who have read my previous paper, published in the *Journal* of this Society on the 3rd of February this year, on the utilisation of those natural deposits of fuel which are at present available and untapped in various parts of India, to provide remedial measures for reducing the working expenses of some of the Indian railways, will readily understand why I have coupled them; but to those to whom the subject is now presenting itself for a first consideration, I would briefly submit that, owing to the absence of a supply of cheap coal (the great element of cost in locomotive expenses) the economic supply of wood fuel from Indian forests is a matter of vital import to railway success on those lines which are using wood in the endeavour to lower their working expenses, and therefore, unless every exertion is made to work the forests at as low a remunerative price as is compatible with the due provision of a cheap supply of firewood, those railways interested must be the sufferers from a needlessly enhanced rate of production, which will and does tend to an increased per-centage of the consumption of their gross receipts by their working expenses; and you have now my reasons for coupling the forests and railways together.

The recent discoveries of coal in Central India, of vast import to some of the lines, cannot be used economically over their entire lengths, as, from their great extent and consequent distance from such collieries, the cost of haulage along the line to remote spots becomes a heavy burden indeed; for instance, when the Great Indian Peninsula Railway begins to use the Mopani coal, it will be able to reduce its working expenses materially within certain limits, by its substitution for a high-priced English coal; but it could not effect such a desirable object at its terminus towards Bombay, for the simple reason that the railway company would have to convey it over more than 480 miles before it reached the terminus, and, of course, the cost of its carriage would be a serious item in their working expenses.

The recent discoveries of good coal in the Chandah district, again, owing to its great distance from Madras and the want of cheap water carriage to the Madras Railway, precludes the hope of its being able to compete with English coal on that line, or the Great Southern of India Railway; and, therefore, it is to its forests that Madras must turn its attention, as it has hitherto ignored the existence of its cheap and valuable deposits of peat, which nature has so bountifully placed at its disposal, to help it out of its present fuel difficulties. Why government has not not made much of the goose that has laid them golden eggs I know not; but I have no hesitation in asserting that such neglect is subversive of economy.

When the government, which cannot provide a sufficiency of firewood, rejected certain proposals of mine, made three years ago, to utilise their peat deposits, I offered, if they would place a bog or two at my disposal, to go out there, and prove to them, not only that a most economical fuel might be made to assist the railways in their dilemma, but that such would also prove a new source of revenue to the government. To this second request I have up to the present received no reply, so that it is being considered at leisure, while the working expenses of the Madras and Great Southern of India railways have been rising half-yearly gradually higher and higher, and cotton remains locked up, unable to move, from the high cost of transport, entailing thereby a great loss on the capital and labour employed in its production, and discouraging its cultivation this year; a great loss to the railways, from the withdrawal of its anticipated transport, and is highly detrimental to Manchester, from the non-arrival of cotton for manufacture, whose market is now somewhat depressed; and I trust therefore that Manchester will use its influence to further views having for one of their objects the setting free of that commodity without which its factories would be idle, trade impeded, and a large body of its hard working productive population suffer great want and privations.

To illustrate the great want of firewood, I quote the following remarks of the Government Director of Indian railways, in his published reports on them, addressed to her Majesty's Secretary of State for India, which will show for how protracted a period the fuel question has been impeding the efforts of the railway authorities to arrive at commercial success.

Par. 49, Report of 1862-63:—

"It is satisfactory to learn that this state of things may soon be altered, as measures have lately been taken by the Government of India for organising a new system of administration for the management and conservation of forests, with the view of making their produce available for the railways and other public works of the country."

From this paragraph we see that the Government Director of railways began to hope something from the forests as far back at least as 1862, nearly ten years ago.

Par. 34, Report of 1863-64:—

"Compared with English railways, the Indian lines (some more than others) labour under the disadvantage of expensive fuel, and of a more rapid deterioration of works under atmospheric influences, and an expensive European agency. The first will be seen in the increased cost of locomotive power; and to show the importance that is to be attached to the question, the following statement of the locomotive superintendent of the Madras railway on the saving he expects to effect by the use of wood, may be taken as a single illustration:—

"'As regards wood-burning, the number of engines fitted with spark catchers has been greatly increased, and if I can continue to get ample supplies of firewood at anything like present rates, the saving in cost of fuel will be very great. The total cost of fuel consumed by engines, on capital and revenue account in the month of November, was £921 10s. less than in July last, although with an increased mileage, and heavier average loads; this is entirely due to the decrease in the consumption of coke and coal by the substitution of firewood."

Par. 42, Report of 1865-6:—

"With regard to the working expenses, there are two items which, at present, are particularly high on Indian lines, and these are the European establishments and the fuel, both of which, compared with railways in Europe, entail a heavy charge. As regards the high cost of fuel, however, this does not apply to the Bengal lines, the coal for which is obtained from collieries at Burdwan, Raneegunge, and Kurhurballee. The great advantage of these sources of supply will be understood, when it is stated that the price of coal at the pit's mouth to the East Indian Railway is about 10s. per ton, while English coal has lately cost the railways in the Bombay and Madras Presidencies from 40s. to 70s. a ton at their maritime termini. This high price is, at the present time, caused by the rise in freights from this country to India, but the cost at the most favourable times will not be less than 40s. On some lines wood is used instead of coal, and with proper precautions against the escape of sparks, answers admirably. On the Madras railway it is calculated that the cost of wood fuel is less than half that of coal and coke. When some 150,000 or 200,000 tons of fuel are consumed annually, and when from 40s. to 60s. per ton has to be paid for it, *it is time to look round for relief.* Australian coal has been tried, with what success has not yet been reported; but from India herself the supply of fuel should ultimately come. By the judicious planting and preservation of forests, and by the development of the mineral resources of Central India, means will, it is hoped, be afforded for rendering her independent of foreign supplies."

From the above paragraph we see that, in 1865-66, he was of opinion that it was time to look round for relief, which he might have had now three years ago, for from that time I took the question up, and relief might have been attained the next year, if my suggestions had been listened to; and I would also observe that the coal-fields of Central India have not furnished him with their mineral resources up to the present, as he had every right to expect. I adduce this to show the general procrastination this fuel question has received; but I believe a railway is now being made, or is about to be constructed, to supply the railway with this coal.

Pars. 59, 60, 61, and 62, Report of 1866-67:—

"59. Various questions connected with the traffic and working of the railways have engaged the attention of the government and the railway companies during the past year. The most prominent were those relating to the supply of fuel; the use of iron or wood for sleepers, and the employment of steel for rails; the formation of roads as feeders; and the rates and fares.

"60. The importance of the fuel question can hardly be exaggerated. *Cheap and dear fuel may in some cases be almost equivalent to success or failure.*[*] It will be seen by the following statement that the high rate of freights from this country at the present time makes the value of coal and coke, before it is landed in India, something like 50s. per ton. When to this is added the landing charges, and the cost of conveyance down the lines, the average cost of coal for the railways on the western and southern sides of India may be taken at about 60s. per ton. Thus, while the cost of coal per train mile on the East Indian railway was 3¼d., on the Great Indian Peninsula it was 1s. 6¼d. last year.

Coal Exported from England.

Railway.	Coal and coke sent out during 1865.		Cost in England.	Freight, &c.	Average cost per ton on arrival in India.			Estimated average cost over the line.		
		tons.	£	£	£	s.	d.	£	s.	d.
Great Indian Peninsula ...	Coal	37,569	20,952	58,623	2	2	4	3	0	0
	Coke	13,575	15,324	19,454	2	11	3	3	12	0
	Patent fuel	8,404	5,427	14,370	2	7	1	3	8	0
Madras	Coal	7,140	3,861	13,919	2	9	9½	3		0
Bombay and Baroda	,, ...	37,219	19,462	60,585	2	3	0	2	18	0
Scinde	,, ...	7,952	4,235	16,704	2	12	8	3	0	0
Great Southern	,, ...	3,663	1,996	7,541	2	12	0½	2	18	0

"61. A recent report from Mr. Oldham, the Superintendent of the Geological Survey of India, on the coal resources of the country, does not encourage the hope that coal will be found in many parts of India where it could be of very great value to the railways. 'Viewed as a coal-producing country,' Professor Oldham says, 'the British territories in India cannot be considered as either largely or widely supplied with this essential source of motive power. Extensive coal-fields do occur, but these are not distributed generally over the districts of the Indian Empire, but are almost entirely concentrated in one (a double) band of coal-yielding deposits, which, with large interruptions, extends more than half across India, from near Calcutta towards Bombay.' He adds, further on in his report—'There still remains, however, much to be surveyed, and, until careful mapping has been carried out of all the fields, any estimate of the coal resources and productions of British India must be defective. . . . . Up to the present time, it may be said that little more than surface workings have been carried on in India. . . . In parts of the Raneegunge field, these open workings are of marvellous extent and size, covering hundreds of acres.'

"62. We may conclude from these remarks, that a supply of coal will be available for the lines passing through Bengal and Central India. The Bengal railways have, indeed, already obtained their fuel from the collieries near Raneegunge. The Central India coal has not been used by the Great Indian Peninsula Railway, as the line is not yet sufficiently near the collieries, and the cost of conveying it by the road would make it too expensive. In the upper, western, and lower parts of India, it may be presumed that the railways will not possess the advantages of native coal. *The importance, therefore, of obtaining other sources of supply increases every year.* Coal from Australia and from Labuan is being tried. But wood is what we must look to chiefly, if economy is to be secured. The subject has engaged the serious attention of government, both at home and in India. Several despatches,[†] pointing out the importance of the subject, and suggesting the necessity of adopting *immediate measures for increasing the plantation of suitable timber*, have been addressed to the Government of India by the Secretary of State during the year. It has been calculated that a plantation of 20 acres will be the average proportion required to meet the requirements of every mile of railway; and Lord Cranborne observed that it was 'evidently necessary that planting on an extensive scale should take place annually for several years to come.'"

Pars. 50 and 51, Report of 1867-68:—

"50. A marked difference will be observed between the expenses in the locomotive departments of the Bengal and Bombay lines, showing the great importance of the fuel question. On the Madras lines, the difference is not so great, although they are as dependent upon England for coal as the lines in Western India. This is partly due to the more general use of wood, but partly also to an economical system of management, which reflects credit on the railway authorities in the Madras presidency. *With regard to wood fuel, measures have been taken by the Government for planting and preserving forests for the purpose.* With respect to coal, an abundant supply is obtained in Bengal; but the beds in Central India have not yet been made available for railway purposes, access to them having been *delayed by the tardy operations* on the Great Indian Peninsula railway. A short branch to the mines will be required when the trunk line to Jubbulpore is completed; and it is to be regretted that arrangements have not already been made for carrying out this work, so that the coal may be ready by the time it is wanted. Other places in the neighbourhood of the Great Indian Peninsula Railway, where coal is known to exist, have been explored, but the result of the exploration has not yet transpired.

"51. The following table shows the amount of fuel which has been sent from this country during the year. A patent fuel, it will be observed, has been tried, and hitherto the reports have been favourable as to its suitableness for locomotive purposes. The cost of coal at Bombay was very much enhanced by the great demand for it, as well as for shipping, at the commencement of the Abyssinian expedition. Australian coal has been supplied at Bombay at 25 rupees or 50s. a ton. No report has yet been received of its quality.

Fuel Exported from England.

Railway.	Coal, coke, and patent fuel sent out during 1867.		Cost in England.	Freight, &c.	Average cost per ton on delivery in India.
		tons.	£		s.
East Indian	Coke	1,666	3,886		46
	,, ...	980	3,579		73
			£	£	
Great Indian Peninsula	Coal	49,354	27,418	98,708	51
	Coke	18,329	21,855	34,882	62
	Patent fuel	11,361	8,031	22,763	54
Madras	Coal	3,778	2,075	8,131	54
	Coke	8,142	6,319	17,825	59
	Patent fuel	5,351	3,903	11,825	59
Scinde	Coal	5,348	2,850	11,335	54
Great Southern	Coal	2,847	...	...	54
	Coke	440	...	...	76
Bombay and Baroda[*] ...	...		...	...	...
Total		107,595			

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[*] The failure is at hand from *dear* fuel, now, in 1871; and further apathy and listlessness will entail heavy misfortunes on the Madras railways.

[†] Nevertheless, these dispatches appear not to have been efficacious in producing, even up to the present, a sufficiency of wood-fuel, though we are still relying upon the forests; and, moreover, it will require at least 50 acres of plantation to each mile of railway to supply its annual demand for fire-wood, for the consumption per mile is over 100 tons per annum; and you must not calculate on obtaining more than two tons per acre when the forests are sufficiently advanced to be productive, as no doubt much firewood will be stolen, as of old, therefrom. It is no slight undertaking now that there are 832 miles of rail opened on the Madras line and 168 on the Great Southern, with many more sanctioned to be constructed. These 1,000 miles of rail ought to be provided with 50,000 acres, or more than 78 square miles of forest; and, if they go to distant forests remote from the rails, the cost of firewood will be so enhanced, that we shall probably hear of English coal being burnt for economy!

[*] No coal was sent out by this Company during the year, a plentiful supply having been provided the year before. The Company has a contract for 10,000 tons of Australian coal, but no ship had arrived at the close of 1867.

Par. 48, Report of 1868-69 :—

48. "The next item of expenditure which presents the greatest contrast on different lines is that of the locomotive department. While the train milage cost of this department on the East Indian is 16·4d., on the Great Indian Peninsula it is 29d., and on the Scinde 39·5d. The reason of this is plain. The East Indian pays on an average about 20s. a ton for native coal. The lines on the western coast are at present dependent for coal upon England or Australia, the cost of which comes to from 60s. to 80s. a ton. The railways on the Madras coast are, however, equally deficient in a supply of native coal, and have, during the past year, paid even a higher rate for English coal, and yet the cost of their locomotive department is less than those in Bengal, amounting only to 13·4d. on the Madras, and 13·5d on the Great Southern. This may, in some measure, be accounted for by the lowness of wages and the lightness of their trains compared with those on the East Indian; but it is also due to the use of a considerable proportion of wood fuel, and also to good management.[*] *Fuel must always be a source of great expense on those lines which are at a distance from coal producing districts or from forests.* It is, therefore, most important, in the interest of Indian railways, to develop the coal resources of the country and to *regulate and preserve the forests.*[†] The government is very anxious to promote both these objects. I have referred to Australian coal; it has been tried on some of the lines of Western India, and has been well reported on; the experience of the locomotive superintendent of the Scinde company is, that "it is equal to Welsh coal in all respects; its evaporative power is nearly equal to Welsh coal, but the consumption per mile is less than with Welsh coal. The price hitherto has been under that of English or Welsh coal. Fuel made of compressed coal-dust and certain cohesive ingredients has also been used and found to answer well. Experiments have lately been made in this country by Mr. F. C. Danvers, of this office, with the view of devising means for the manufacture in India, with materials on the spot, of blocks of *this kind of fuel.*[‡]"

Par. 38, Report of 1869-70 :—

"38. It will be observed that the proportion of working expenses to gross receipts in some cases was above 80 per cent., while in others, viz., the East Indian and the North-west line of the Madras, it was about half that proportion. The average expenses of the 13 lines which realised profits were, in 1868, 61·77, and in 1869, 64·05 per cent. of the gross receipts. It may be expected that, when the lines have more fully developed the traffic which they ought to command, and *when*[§] *by the use of cheaper fuel from native sources*, the present heavy charges in the locomotive department are reduced, the average rate of expenditure will be under 50 per cent. If this had been the case during the past year of depression, *nearly* £350,000,[||] *would have been added to the net receipts.* Strenuous efforts are being made, both by the government and the companies, to reduce expenditure[*] *in every way*, and to bring the working and establishment charges as low as is compatible with efficiency."

Par. 55 and 56, Report of 1870-71 :—

"55. The fuel question is always an important one in connection with the working expenses of Indian railways, and it is satisfactory to find that native coal *will soon be more extensively used.* The coal from the Nerbudda fields is at length likely to be available for the railways in Central India. A tramway, from the pits to the Great Indian Peninsula Railway, is now being laid down, and the railway company has engaged to take a certain quantity monthly at a fixed price. Sanguine hopes are also entertained with respect to the Chandah coalfields, specimens from which have been favourably reported on after experiments with them. The mines are situated to the south of the Nagpore branch of the Great Indian Peninsular Railway, and a line is being laid down by the government, with the main object of obtaining a good supply of fuel from this source. With these aids, a considerable reduction should take place in the working expenses of the locomotive department of the Great Indian Peninsula line, and more favourable results produced by the traffic.

"56. *A regular system has been organised in the Madras Presidency for obtaining an adequate supply of wood fuel for railway purposes.* It has been estimated that nearly 100 square miles will be required to meet the demand; and already measures have been taken by the Forest Department for demarcating 26 miles in the districts of Cuddapah, North Arcot, Salem, and Coimbatoor, to be used for the cultivation of trees suitable for the working of the railways. Similar measures have also been adopted in the Punjaub and Scinde."

Here we are again upon the forest tack, and the Government Director of Railways, I trust, feels happy after his prolonged and indefatigable exertions, which seem to have been so thoroughly thwarted for so protracted a period, in the hope that at last his reiterated requests will be attended to, and that he will be able soon to give a better account of the working expenses of his railways. It is always a disagreeable thing to throw a damper upon brightening prospects, but my duty must be done to my *protégé*, peat, and I am therefore bound to tell him that measures for demarcating forests *are only preliminaries to the production of wood fuel*, and that after demarcation comes preparing the ground, raising the young trees in the nurseries, and planting them out, and carefully tending them for some time, and guarding them while in the plantations from various dangers their young life is exposed to, such as the excess of moisture, sudden floods, want of moisture, the depredations of cattle, the attacks of insects and wild animals, such as rats, who create great havoc in many parts of India, porcupines, deer, camels, goats, accidental fires, hurricanes, clandestine felling, wholesale robbery, incendiarism, &c.; and when the survivors have successfully run the gauntlet of such minor juvenile complaints, *he will have to wait eight years* before these new plantations, if they have been planted in judiciously selected sites, with suitable soil, &c., can be made available to provide his railways with a sufficient supply of wood fuel, supposing that all these requisite plantations are started at once, which they will not be. How then, I ask, *is he going to tide over* this deferred consummation of his hopes? The new plantations cannot be available sooner, which is greatly to be regretted, as he has ever done his utmost to reduce the working expenses of these lines. But have his constant appeals been met with equal *earnestness?* or has he received that assistance *which a judicious economy would have provided* for his oft-repeated demands? He most assuredly has not; and, therefore, I would again venture to whisper in his ear the panacea for his railway maladies, the good and great medicine, "peat," which is kept in store on purpose for use; and I am ready to show how the dose is to be taken for the recuperation of his railways.

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[*] Not necessarily so, unless you despise the bounties of nature in the shape of peat fuel, which coal had such a struggle to displace three centuries ago, that Acts of Parliament were passed to prevent its being burnt, and peat remained triumphant for a long time; still some wicked sinners would burn it on the sly And this is the fuel that is now being treated with contempt, when its services would be of such vast use to government, while the proposed plantations are being formed.

[†] Our old friends, the forests, crop up again.

[‡] Patent fuel made of coal dust, is more expensive than coal What is wanted to reduce the working expenses is a *much cheaper fuel than either coal or Indian wood* at its present price, for it is very nearly - now, in 1871—as dear as coal, owing to the mistaken policy pursued by government, in regulating its price up to the standard one of coal in India. My friend, peat, certainly begins to look up, and may afford the Government Director of Railways that relief he has been so long looking for, if he will only take it by the hand.

[§] When. Ah! when, indeed!

[||] I showed, in my proposals, how much might be saved annually to the railways three years ago; but such saving did not seem to be deemed important.

[*] This I cannot accept, as the expenditure has not been reduced in the most important matter of providing a cheaper fuel for the Madras Railway, because the Forest Department cannot supply a sufficiency of wood fuel at a reasonable rate, and have not hitherto availed themselves of an economic fuel from native sources, ready at hand.

I feel assured that you, like myself, will feel exceedingly delighted that we have at last got over the railway reports, which I think you will agree with me fully establish that the Forest Department is *a broken reed to rely upon* for the production of an economical supply of firewood for the railways; they have long been weighed in the balance and *found wanting*, and, therefore, it is to *some other source* that we must look for a present remedy. I know at the same time that the Forest Department have many elements to contend against, but they do not appear to me to have profited by experience, and with their present system all their attempts must result in failure.

It is not a wise measure towards reducing the working expenses of the railways to argue that, because coal is at a high price, they can afford to pay a comparatively high price for wood, which has been proved by the experience of the Madras line to be of less than one-third of the value of coal, weight for weight, for locomotive purposes, and therefore when that railway has to pay 18s. a ton for it at Bangalore and elsewhere, it is more than equivalent to having to pay three times 18s., or 54s. a ton for coal. Surely, then, wood at such a price cannot be deemed an *economical supply*, and it is really *taking advantage* of the fuelling *necessities* of the railways. The object of the government should be to supply firewood at as low a rate as possible consistent with a *slight remuneration* to cover interest on outlay, and not to endeavour to realise a large revenue out of the unhappy position of Indian railways with regard to their fuelling requirements.

In my judgment, an error has been made in clearing away all the trees upon certain favourable localities, and then handing the cleared land over to the ryots for cultivation; and instead of re-stocking such eligible lands as had been already pointed out by nature as well adapted for forest trees, seeking fresh sites for the formation of plantations upon soil which afterwards turned out unsuitable for the growth of the trees planted thereon, and resulted in the treble loss of time, capital, and produce. Since Dr. Cleghorne's departure (who was officiating Inspector - General of Forests) forestry seems to have greatly fallen off in Madras.

Again, it has been stated that the chief object of government was not to derive revenue from the forests, but rather to provide a supply of timber and firewood for public purposes; but that this object has been *systematically lost sight of* cannot be doubted, when, as I shall show presently, they derive over 40 and 80 per cent. upon the outlay expended annually, and cannot supply anything near the amount of fuel required.

To prove this in a satisfactory manner, we will proceed to the examination of the last forest accounts circulated for general information, but before we do so I should like to offer a few remarks on the relative values of coal and peat in India, which are to the following effect: —

That the comparative advantages of using peat and coal in England are vastly different to what such would be in India; for, while in England coal is plentiful, and to be obtained at what is now unfortunately considered a moderate price, there is not much margin left for the employment of condensed peat economically, as its price would not fall very much below that of coal; but these circumstances are totally reversed in Madras, for there coal is very costly, while peat could be provided at a comparative low price, as is done on the Bavarian lines. It is time that some more powerful voice than mine should lend a helping hand to this important question, and I trust that either her Majesty's Secretary of State for India, or his Excellency the Viceroy, will not allow this fuel question to be longer *dragging its weary length along*. And I would here call attention to the following remarks in last year's "Railway Report:—

"44. While much may be done towards the improvement of the revenue from railways, by wise economy, prudent management, and an equitable adjustment of rates and fares, their prosperity must in a great measure depend upon the general advance in the trade and condition of the people of the country. When commerce is active and labour is in demand, railways will thrive if they are properly managed. During the past year, trade has been depressed and railways have suffered. Much of the cotton which had been grown has not found its way to the coast, and in some places it has been stored or *buried to wait for better times*. At the same time the high amount of working and maintenance expenses on certain lines seem to imply either an *absence of strict economy* or imperfect construction in the first instance, and to demand constant and earnest attention from the managers of railways."

The colonial railways at the Cape, Mauritius, Ceylon, and Demerara, are paying 6 and 7 per cent., and why should not India do even better, with its vast population?

And now for the forest budget of 1869-70:—

A reference to the supplement of the *Gazette of India*, published on the 25th of March last, by authority, affords us the information contained in the following table, relating to the working expenses and profits of the various British Indian forests for the year 1869-70.

GOVERNMENTS.	Actual receipts.	Actual total charges.	Per-centage of charges on total receipts.
	£	£	£
India	—	3,434·8	—
Madras	49,578·9	28,669·1	58
Bombay	100,576·5	40,855·8	41
Sindh	22,949·2	13,623·8	59
Bengal	11,375·3	9,587·4	84
N.W. Provinces ..	72,625·5	42,341·0	58
Punjab	39,413·2	71,365·4	181
Oudh	10,682·2	10,527·0	98
British Barmah ..	98,477·3	42,146·2	43
Central Provinces	41,602·0	47,424·6	114
Coorg	10,815·2	3,308·2	30
Total......	458,095·3	313,283·3	68·38
Total British net revenue..	144,812	—	—
,, Mysore	29,521·8	10,425·0	35
,, Hyderabad ..	14,548·1	8,071·0	55
Total....	44,069·9	18,496·0	42
Net revenue......	25,573·9	—	—

From which it will be seen that the total receipts of all the British Indian forests, for 1869-70, amounted to £458,095·3, and that these were collected at a cost of £313,283·3, yielding thus a net revenue of £144,812 for that year, which is equal to a per-centage of £46·22 on the outlay expended.

This is certainly a very high rate of interest on State capital, and explains fully how it is that the railways, factories, iron works, general public, &c., are complaining of the very high price of fuel. Surely, with profits of 46 per cent. government could easily afford to reduce the present exorbitant price of their fire-wood, which is sold at so much above cost price, and which is a policy totally at variance with that pursued by continental nations, who do not conserve their forests with a view of deriving a great revenue out of them, but rather for the provision of a supply of cheap fuel for general purposes.

The course pursued by government can only tend to *enhance the cost of all produce conveyed by rail*, and of all manufactured products which are dependent upon a supply of fire-wood for their existence, such as sugar, indigo, iron, bricks, &c.

Nor can it be affirmed that such a high per-centage of profit is necessary in order to cover losses on working the forests in past years, as the following table, inserted in the same *Gazette of India*, shows that the profits on outlay, for the years 1864 to 1870 inclusive, were respectively as under:—

For 1864-65 = 88·03 per cent.
,, 1865-66 = 66·31 ,,
,, 1866-67 = 48·41 ,,
,, 1867-68 = 47·72 ,,
,, 1868-69 = 61·39 ,,
,, 1869-70 = 46·22 ,,

The question, then, that naturally arises from such evidence is, How is it, in the face of such heavy returns for outlay, that it has been found necessary to raise the price of fire-wood supplied from government forests 66 per cent. in June, 1868, and then again an additional 60 per cent in September 1869; and why has such latter increased per-centage only resulted in a reduced per-centage of profits? I think it would be beneficial to the general interests, if government instituted a searching inquiry into this very extraordinary result of forest conservation.

Again, how is it that, while the total charges of all the British Indian forests, consumed as much as 68·38 per cent. of receipts, the native forests of Mysore and Hyderabad were worked at a loss on receipts of only 42 per cent? I fancy that such result can only be attributed to forest destruction, and that with the heavy demands upon the former forests, felling has been resorted to *ad libitum*, while the conservation that should have, by its judicious treatment, kept a-head of destruction, has been in a state of quiet repose, while its *protégés* fell incessantly victims to the axe, and while there were many deaths, there were but very few births, in the shape of young trees, to replace their defunct seniors; but as the railways do not consume wood to the same extent in Hyderbad, and there are none at all in Coorg, their forests have not been called upon to sacrifice themselves to the same extent. I understand that all the forests in the immediate neighbourhood of the railways have quite disappeared, and yet such alone is the position in which wood fuel should be grown, if a supply is to be provided at a low cost of transport. Forests should be created also on all river banks of navigable streams, for convenience of removal.

The following is the second table referred to, which embraces the total receipts, charges, and profits of all the above Indian forests, with the exception of those of Mysore and the Berars:—

Years.	Receipts.	Charges.	Profits.	Per-centage of charges on receipts.
1864-65	£350,202·2	£186,246·1	£163·951·6	53·18
1865-66	356,338·2	213,638·7	142,699·5	59·92
1866-67	304,418·3	205,114·5	99,303·8	67·27
1867-68	331,588·4	224,456·4	107,132·0	67·69
1868-69	420,073·7	260,284·5	159,789·2	61·96
1869-70	458,095·3	313,283·3	144,812·0	68·38
	2,220,716·1	1,403,023·5	817,692·6	—

The above table shows that from the years 1864-70 inclusive, the receipts on all the British Indian forests amounted to £2,220,716·1, with an outlay thereon of £1,403,023·5, yielding profits of £817,692·6, or an average of £136,282·1 per annum, which is a per-centage on outlay of 58·28. What necessity then for an advance in the price of firewood?

There is no way of ascertaining, from the information published in the *Gazette of India*, the extent of the forests alluded to in the above tables, and therefore we cannot arrive, by its instrumentality, at the profits made per acre of forest, but we can discover, by referring to the "Statistical Abstract relating to British India, from 1861 to 1867," at page 1, what is the area and population of each presidency or province, and thus obtain the forest revenue per acre of the whole areas and per head of the various populations; and from this source, and the forest budget, the following details have been abstracted:—

No. 1.—*Area and population of each Presidency or Province of British Administration in India, exclusive of Native States.*

Presidencies and Provinces.	Area in square miles.	Area in acres.	Population.	Forest receipts, 1869 and 1870.
				£
Hyderbad	16,960	10,854,400	2,220,074	14,548·1
Mysore ..	28,301	18,112,640	4,056.766	29,521·8
Coorg	2,400	1,536,000	112,952	10,815·2
Bengal....	239,591	153,338,240	35,975,274	11,375·3
N. W. Provinces	83,785	53,622,400	30,086,898	72,625·5
Punjaub ..	102,001	65,280,640	17,596,752	39,413·2
Oudh	24,060	15,398,400	11,220,747	10,682·2
Central Provinces	84,162	53,863,680	7,985,411	41,602·0
British Burmah	98,881	63,213,840	2,463,484	98,477·3
Madras ..	141,746	90,717,440	26,539,052	49,578·9
Bombay ..	87,639	56,088,960	11,093,512	100,576·5
Sindh	54,403	34,817,920	1,795,594	22,949·2
	963,929	616,914,560	151,146,516	502,165·2

The above table shows that the whole forest revenues of the above presidencies and provinces for the year 1869-70 yielded a profit at the rate of £1 to every 1·919 square miles, or every 1,228·16 acres, or one penny to every 5·117 acres in their respective provinces, or one pennyworth per annum for every 1¼ persons. Can such be said to be a supply of firewood? But taking into consideration how much of this wood is consumed by the railways, factories, indigo works, &c., how much per head will each unfortunate resident be provided with? It is true that the ryots are allowed to cut a certain quantity for domestic purposes, free of seignorage, or the royalty paid to government on firewood grown in government forests.

Next, let us examine in what relation the various productive forestal powers of the different provinces stand; and taking Coorg, the smallest in extent, as the unit of calculation, we find that the following table may be compiled:—

PROVINCES, &c.	Produces £1 to the under-mentioned number of acres.	Produces £1 to the under-mentioned number of persons.	Value of wood supplied per head of population.
			s. *d.*
Coorg	142·02	10·44	1 10¾
Mysore	613·53	137·41	0 1·746
B. Burmah	744·72	152·60	0 1·441
Bombay	557·67	110·29	0 2·176
N.W. Provinces ..	793·41	414·27	0 ·579
Oudh............	1,441·50	1,050·41	0 ·228
Madras	1,829·75	535·28	0 ·448
Sindh	1,517·17	78·24	0 3·067
Central Provinces	1,294·73	191·94	0 1·250
Punjab	1,656·31	446·46	0 ·537
Bengal	13,479·06	3,162·57	0 ·075

Which shows us that the following is the productive order of the forests, as compared with the area of their respective provinces, and that :—

1.	Coorg	has 4·320	times the productive forestal powers of	Mysore.
2.	,,	has 3·926	,, ,,	Bombay.
3.	,,	,, 5·243	,, ,,	B. Burmah.
4.	,,	,, 5·586	,, ,,	N.W. Provinces.
5.	,,	,, 9·116	,, ,,	Central Provinces.
6.	,,	,, 10·149	,, ,,	Oudh.
7.	,,	,, 10·682	,, ,,	Sindh.
8.	,,	,, 11·662	,, ,,	Punjab.
9.	,,	,, 12·883	,, ,,	Madras.
10.	,,	,, 94·909	,, ,,	Bengal.

Therefore, the results of forest produce for all India, for the year 1860-70, may be summed up as follows :—

	Per acre.		Per head of popu ation.
1. Coorg produced	1·689d.	and supplied wood to value of	1s. 10d$\frac{3}{4}$.
2. Bombay	·4363d.	,,	2·176d.
3. Mysore	·3901d.	,,	1·746d.
4. B. Burmah	·3209d.	,,	1·441d.
5. N.W. Provinces	·3024d.	,,	·579d.
6. Central Provin.	·1853d.	,,	1$\frac{1}{4}$d.
7. Oudh	·1664d.	,,	·228d.
8. Sindh	·1581d.	,,	3·067d.
9. Punjab	·1449d.	,,	·537d.
10. Madras	·1311d.	,,	·448d.
11. Bengal	·0177d.	,,	.075d.

This shows a lamentable deficiency of available forest, resulting in great distress to the inhabitants ; and therefore points out where forest is required, to a certain extent; and such results are certainly not brilliant ones after fifteen years of forest cultivation, and it does not admit of participation in the hopes of the Government Director of Railways, that the Madras Forest Department will be able to supply the railways of the presidency with wood fuel, so as to reduce their working expenses, which are yearly rising higher and higher, as instanced below, and which is greatly owing to the rise in the price of firewood :—

PERIODS.	The per-centage of revenue consumed by the working expenses of		
	The Madras Railway.		The Great Southern of India Railway.
	S.W. Line.	N.W. Line.	
The 1st half of 1868	42·95	31·27	46·86
,, 2nd ,, ,,	44·93	37·72	44·85
,, 1st ,, 1869	45·45	40·35	62·24
,, 2nd ,, ,,	48·62	40·85	64·50
,, 1st ,, 1870	49·03	56·60	61.15*

To show the immediate attention this subject requires, I will instance the following remarks :—

The *Asiatic*, of the 7th of August last, extracts as under from the *Calcutta Englishman*, a startling statement, headed, "Save our Trees." It says :—"If any one would form a true notion of the extent to which the country generally has been denuded of wood, he need only consider the fact that the demand of indigo planters for wood for boxes and for fuel is, in many parts of the country, leading to the gradual destruction of mango-topes." In the Berar district, "tope after tope of fruit-bearing trees has fallen before the ruthless axe of the planter, or those who contract to supply them with wood," and the same is occurring in the North-West Provinces.

Talking of noble groves of mango-trees destroyed in Bengal and Behar, the *Englishman* also observes "that throughout more than three-fourths of these provinces, wood for fuel is beyond the means of at least three-fourths of the people. The mango affords wholesome food for tens of thousands of the poorer classes, and frequently aids, in years of famine or scarcity, in the preservation of human life."

This is a sad picture, and, bearing in mind the recent famines in India, should such disasters re-occur, they will have much to answer for who refrain from listening in time to the voice of humanity. To such groves the order should immediately go forth, of "Woodman spare the tree ; touch not a single bough."

In the Berar forests adjoining the Central Provinces, the wood, within the last two years, has been rapidly cleared off the face of the country, and fire-wood has in consequence risen there so exorbitantly as to become a cause of hardship to the poorer classes in the vicinity of large places, and near the line of rail. Yet there, Babool-wood, a good fuel, is of rapid growth, and if planted in quantity, would in a very few years remedy the existing scarcity.

It is evident that the Forest Department are quite incapable of providing a sufficiency of wood fuel for a long time to come. Then why not immediately utilise the peat deposits, with their fuel ready for instant use? And if the Forest Department cannot see their way to effect this useful and absolutely necessary measure, and cannot themselves provide a cheap fuel, it is subversive to true economy, and the general interests of the Madras Presidency, to offer opposition to the only remedial and prompt measures which others at least could easily carry out, and it certainly is most hard that the residents of India generally should have to subscribe so largely to meet the annual deficit* towards the contribution of the guaranteed interest of 5 per cent. on Indian lines, when so much is left undone towards the wholesome reduction of their working expenses with regard to the provision of a cheap fuel; and, from what I know of forest matters in India, and of the mode of procedure there, I have no hesitation in saying that, as at present organised, the Forest Department will be totally unable to provide a sufficiency of wood-fuel at a price that will admit of its being used as an economical fuel on any Indian lines of rail at present constructed. They do not seem to have gained experience by practice, but are still carrying on a system of experiments both costly and useless, and from the failure of the late attempts† at growing railway fuel in Madras, I see no present prospect of the wishes and expectations of the Government Director of Railways being realised, in reference to a supply of wood fuel for the Madras railways; and coal cannot be brought from Chanda at a price that will admit of its competing with English coal on the Madras lines.

I will now wind up this paper with a final consideration of the relative merits of the two proposals to meet this pressing fuel dilemma, namely, the one under contemplation by the Government, as proposed by the Forest Department, and the other, the means suggested by myself.

The former proposal consists in the planting of about 100 square miles of land with trees, which will require a heavy outlay, and even supposing that all the sites selected turn out well-chosen, they will only turn out at the end of seven or eight years an annual yield of about from two to three tons of wood fuel in perpetuity; and that to meet the present emergent demand distant forests should be utilised, having tramways laid down to them, for the transport of firewood, and that considerable sums of money should be expended in rendering a certain river navigable by removing the many natural obstructions therein, so as to float the timber to a distance, requiring the aid of gunpowder to blast rocks, &c., and the creation of a small canal round an obstructive dam, &c., all of which expensive proceedings must greatly enhance even the present high price of wood, which is now causing so great an amount of discontent.

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* Reduced, owing to accidental arrivals of ships with Australian coal, seeking a sale.

* The *Friend of India*, of 29th March last, says that the profits of the Madras line only amount to a dividend of 2·2 per cent., while those of the Great Southern of India only attain 1·4 per cent.

† The only chance of obtaining cheap wood fuel is by private enterprise. Government will certainly never grow it economically if present notions are adhered to.

While my proposal is to utilise for immediate use the services of the peat deposits of Madras, which are now actually bursting with matured fuel, and their valuable contents scattered abroad, in the face of their so-called "conservation," nature having already selected their suitable sites, and by condensing the peat contained in them, a good, portable, economical, and efficient fuel, equal in calorific effect to double its weight of wood, and yielding ten times the weight of fuel per acre, per annum, can be produced if treated in a way I would point out, which, therefore, makes it equal to 20 times the weight and yield per acre of wood, or say 40 tons to the acre annually; and which is at the same time readily accessible to those who understand how to approach it and transport it economically, without having recourse to any of those expensive and dangerous modes suggested for the conveyance of the wood-fuel.

By all dispassionate reasoners, surely, there can be but one answer returned as to the relative merits of these two widely-differing proposals, and for the sake of economy they should both progress together, if the first is to be carried out, so that the second may help to find the means for the former's requirements, so as not to trench too greatly upon the lately much-discussed impoverished condition of Indian revenues, and against the collection of which, as pressing most severely upon the residents of India, several meetings have been called, and petitions presented by such suffering communities appealing for relief from such a heavy, and apparently to them unnecessary, burden; and I feel assured that the Government will now lend its earnest attention to any well-devised scheme to promote economy; and it is with this belief that I now venture to offer my present suggestions, and in public, so that they may have the advantage of being openly discussed and favoured or discountenanced according to their strong or weak points; and such a course will probably assist Government in coming to a conclusion upon a project which only those few who have well studied this neglected fuel are perhaps capable of taking part in; but my own opinion, candidly expressed, is, that it would be highly advantageous, in the interests of economy and commerce, if the Madras Government, or the Secretary of State for India, would listen to any advice that would provide the Madras Presidency with an efficient and cheap fuel, which is so urgently demanded at the present moment, and on that point numbers here assembled are doubtless both competent and willing to express their opinions, and I do court the fullest discussion equally from those in favour of my plans, as well as from others adverse to them, so that if it be possible the present distressing state of the railways traffic and working expenses, and of the cotton interests, may be afforded that relief, without which a commercial panic must soon prevail.

Already no less than seven very disastrous circumstances may be traced to the want of economic fuel in Madras, which I will briefly sum up, and to which, I have no doubt, I could add more:—

1st. From the large quantity of cotton locked up, in the production of which a considerable amount of capital has been unremuneratively employed, much injury has accrued to its cultivators.

2nd. That, in consequence of such a stoppage of supply, its cultivation has been so seriously retarded that there are this year no less than 300,000 acres of land uncropped with cotton than were so planted last year, and that, therefore, thousands of poor natives are debarred from following their customary agricultural pursuits, and must be suffering great privations in consequence.

3rd. That a heavy loss results to the Land Revenues of Madras, from the fact of such a falling off in the culture of the land, and its assessment for the year will, consequently, yield about £40,000 or £50,000 short of what it should do.

4th. That the anticipated revenue from traffic on the Madras Railway alone, from the detention of this cotton, has suffered a loss of over £60,000 in the second and third quarters of 1870, being less by that amount than it was in the corresponding periods of 1869.

5th. That the working expenses of the Madras railways have consequently consumed so heavy a per-centage of their gross receipts, that special inquiries had to be instituted with regard to that circumstance, and if a speedy remedy be not provided their interests will be seriously affected.

6th. That the present high price of firewood has created a vast amount of discontent generally in Madras, and resulted in numerous appeals for relief therefrom from the railways, sugar-factories, ryots, &c.

7th. That the value of cotton fell as much as 40 per cent. in one month in Madras, while the exports of it, both in the United Kingdom and to foreign countries, have fallen off about 80 per cent.; which must inflict great injuries on many interests, especially in the face of an expected diminished supply from the shortness of the cotton crop in America this year, although if an economical transport be devised, this latter unfortunate occurrence to the Far West may tend to give enhanced returns to the holders of Indian cotton, by which their losses this year may be perhaps even fully covered.

In the remarks I have been called upon to make in justice to my suggestions I hope I may not be misunderstood, and that I have not the slightest desire to cast any reflections whatever upon any authorities either at home or in India, for they have been placed in a most perplexing situation, and have doubtless done their best, in the usual beaten track, to avail themselves of the best means that they knew they had at their disposal; but circumstances alter cases, and under the present disastrous one a new line of road must be travelled, and as the old means of supply have failed, and a new source has now been prominently brought to their notice, by the aid of which the present fuelling difficulties may be surmounted, it is to be sincerely hoped that such will receive the attentive consideration which it deserves, at least such is the humble trust of the propounder of the present scheme, who hopes he may now be favoured with a candid expression of the opinions of any of those now present who feel sufficiently interested to enter into the discussion of it, whether such be favourable or in direct opposition to the same. I can see no earthly reason why the services of peat should not be utilised while the forests are progressing towards affording a supply of wood fuel.

DISCUSSION.

Mr. Charles Horne observed that he should like to say a few words in reference to his own limited experience of forests in the North-West Provinces, in the neighbourhood of the Himalayas, and generally in the province of Rohilcund. He thought the people of India, and indeed the English people also, were accustomed to look too much to the government to do everything, and this would account for so much remaining undone. The growth of trees might be stimulated immensely by a very simple and easy expedient. Were but the reward of a few pence offered to every Indian villager who planted a few trees, an untold multitude of trees would be planted. The zemindars are naturally diametrically opposed to the planting of trees, from which they get only a very small per-centage, in the shape of fruit, and afterwards a certain proportion of the timber; but they get infinitely more when the land is under tillage. Hence arises the villager's difficulty when he seeks permission to plant a few trees. It requires good land for trees to flourish, and the cultivation of trees is not profitable to the landowner. One of the most beneficial things which would result from the adoption of the course he suggested would be the provision of firewood. The natural fire-wood of the North-West Provinces is that which grows upon the hedges of the fields, and the villagers are allowed to grow this, because it is useful also in the construction of agricultural implements; but, as a rule, all other tree cultivation is interdicted. It may sound very easy to lay down three or four acres of plantation; but, speaking from his own experience in India, only a comparatively small proportion of the saplings arrive at maturity. Trees are subjected to many dangers, some of which are due to the customs and habits of the people. One tree, when it has grown to a small height is broken off by the natives to make tooth-brushes; and the expense of keeping up a nursery of trees is enormous. He used to give away young trees to such of the zemindars as applied for them; and thought the way to get good timber for fire-wood would be to encourage this process of planting as much as possible. There could be a no more pitiable sight than to stand upon an eminence, and, looking along the Great Indian Railway, to see that, for a breadth of seven or eight miles, and for a length of 100 miles, there is scarcely a tree standing. This desolation has come about because the railway companies have bought the trees for a good price; and as long as they are willing to give a good price the people will naturally sell. The zemindars plant no new trees, because the cultivation of rice, or sugar, or some other commodity is much more remunerative. As to the suggestion which has been made that the banks of rivers should be utilised for the cultivation of trees, it should be remembered that the land near the rivers was the most valuable part of all the land, and the most luxurious in its cultivation. In fact, the same difficulty arises in respect to tree cultivation as is found in colonising in India. It is exceedingly difficult to find a single acre of land unclaimed for settling or for plantation purposes. The zemindars know their rights, and claim them, if necessary, in the English courts of law, where the decisions are often in their favour, being, as they are, perfect models of fairness; and therefore the government have found the subject of forest conservation and extension an exceedingly difficult one. In respect to Lieut.-Colonel Wragge's remarks on the Forest Department's sale of wood, it was fair to note that when the Forest Department sold rights for cutting brushwood they were exceedingly careful that timber should not be cut, and that every means should be exerted to secure the observance of this restriction; and every care was exhibited to insist upon the strict observance of all regulations for the preservation of timber. He should mention, however, that in the district or province where he was situated, the Forest Department is never heard of, for there are no forests to conserve; and even where there is any jungle it is private property, and the zemindar or rajah to whom it belongs does what he pleases with it. He could bear personal testimony, however, to the energy of the officials when any spot offered where a plantation could be made—a plantation being put in wherever it could be done. The Forest Department is now working zealously to restore the forests of timber, and is opening out what were formerly inaccessible forests. As to the comparative merits of peat, or coal, or wood, he could not enter into the discussion, for he could not pretend to speak with any degree of authority upon the subject. But he was acquainted with many civil engineers, and having been trained for that profession before he entered the Civil Service, he knew something of it, and by these the use of wood has been generally condemned. It was said to be very costly in practice, so costly that coal, though higher in its first price, was cheaper in the long run, for, apart from other considerations, wood is found to be very destructive, and the liability to fire is very great. The policy he had indicated at the commencement of his remarks, *i.e.*, the offering of a small reward for the planting of trees, would, he was convinced, be very beneficial. Every villager would gladly plant a few trees round his house, and these would grow to fine timber—"Mony a mickle mak's a muckle"—and an immense change would be effected in a very few years by the operation of this principle.

The **Chairman** asked Mr. Horne whether the population of his district were addicted to burning the forest wood for their own purposes?

Mr. Horne replied affirmatively, and added that he very often had to punish culprits found guilty of incendiarism.

Mr. Lewis Olrick observed that the gallant colonel had hardly done justice to the government of India, in respect to their endeavours to devise an economical transport, and the utilisation of Indian sources of fuel; because he had apparently ignored the efforts which the Indian government have been making in this respect. The Indian government have commissioned one of their officers (Lieut. R. C. Crompton, of the Rifle Brigade) to get road steamers built, for the double purposes of carrying heavy loads at a slow speed, and for passenger-traffic at a rate of speed varying from ten up to twenty miles an hour; and prior to that officer coming to this country, he had been for two years experimenting, with the object of obtaining the most suitable kind of road steamer. Messrs. Ransome, Sims, and Head, of Ipswich, had accordingly been directed to build two road steamers; and, one necessary point being the economising of fuel, two kinds of boilers were used, designed by different inventors, the only condition being that the inventor whose boiler was the most efficient should have the orders for those required by the Indian government. He was gratified to be able to state that his own boiler was the conqueror in the competition, and the road steamer, fitted with the "Field" boiler, had just completed the journey of 1,000 miles, from Ipswich to Edinburgh and back, passing through some difficult country in its path—a feat which had never before been accomplished. This road steamer was especially designed for burning wood, and she has acted so well that the Indian government have given orders for others of a similar construction to follow. She has, amongst other feats, taken a load of forty tons up an incline of one in seventeen for three and a half miles, at a rate of four miles an hour, and, having reached a level, then proceeded at a rate of twenty miles an hour—a fact which proved that she could be used both for heavy loads and for passenger traffic also. The suggestion of Lieut.-Col. Wragge that the peat which is to be found in various parts of India should be used for railway purposes, is an excellent and perfectly feasible proposition; and he (Mr. Olrick) happened to be in a position to show the advantages of the use of peat. In comparing coal, wood, and peat, it was necessary to refer to the total heat evolved by one pound of each kind of fuel; and, viewed in this manner, the units of heat contained in coal may be represented by 13,000, wood by 5,260, peat of the ordinary description by 7,150, and artificially prepared peat by 8,730. This shows clearly that peat of the ordinary description is 35 per cent more valuable, as a producer of heat, than wood, weight for weight; and that the superior kind of peat is 60 per cent. more valuable than wood in this respect. From this it would be perceived that Lieut.-Col. Wragge's suggestion to utilise peat was a very valuable one, and that his theories have been substantiated by practice. He might be allowed to add that, although peat has been used successfully in the road steamer adopted by the Indian government, yet it could not be used for ordinary boilers; indeed, it was almost entirely useless in them. But in the "Field" boilers, to which he had referred as now being adopted by the Indian government, peat has now been used for several years with the greatest economy. He had offered these few remarks because he did not think it should be supposed that the Indian government were neglectful or indifferent to the matter; and, by what he had said, he thought he had shown that the Indian government were on the right track in their endeavour to devise a cheaper means of locomotion; and also that the means proposed by the gallant colonel in respect to peat were such as might be advantageously put in operation for the purpose, and more particularly in the kind of boilers which have been adopted by the Indian government.

At the request of the Chairman, the following description of the "Field" boiler, alluded to as being fitted to the road steamer "Ravee," was handed to the Secretary for publication in the *Journal*:—

Description of the Road-steamer "Ravee."

The road-steamer "Ravee," was in all other respects a sister engine to the "Chenab," except in regard to the boiler, the "Chenab" being fitted with one of Thomson's pot-boilers, whereas the "Ravee" was fitted with one Field's patent boilers, which, according to Lieutenant Crampton's report, gave excellent results when put through a series of trials with wood fuel on Ipswich racecourse. This boiler was specially designed for burning wood, by Mr. Lewis Olrick, of 27, Leadenhall-street. The boiler is 3ft. 3in. diameter at the top, and 4ft. 3in. diameter at the bottom, 7ft. $8\frac{1}{2}$in. high. It has 50 square feet of heating surface in the fire-box and 127 square feet of heating surface in the Field tubes, making a total of 177 square feet; the greatest surface is, 11·25 square feet. The weight of the boiler is two tons, and it contains 13 cwt. of water.

The "Ravee," when loaded with one ton of coals and 375 gallons of water in the tank, weighs about 14 tons; the driving wheels are 6 feet diameter; the cylinders 8 inches diameter and 10 inches stroke; geared, fast speed $3\frac{3}{4}$ to 1; slow speed, 12 to 1. When the "Ravee" ascended Lootray-hill, an incline of $3\frac{1}{2}$ miles in length, varying from 1 in 25 to 1 in 17, at the rate of 4 miles an hour, the steam rising from 75 lbs. pressure at the bottom of the hill to 140 lbs. at the top, and the water rising from 2 inches in the glass to $3\frac{1}{2}$ inches, she exerted 64 dynamometrical or actual horse-power, or at least 80 indicated horse-power, and the boiler evaporated upwards of 40 cubic feet of water per hour, which means that one cubic foot of water per hour was evaporated for each $4\frac{1}{2}$ square feet of total heating surface, a most excellent performance, which has never been equalled by any other boiler up to the present moment. As a sample of the performance of the "Ravee" on her trip from Edinburgh to Ipswich, is appended a table of what she did from Wansford to Ipswich, the last 95 miles of her journey:—

Total fuel consumed, in pounds	3,696
Total water evaporated, in pounds	24,150
Total distance travelled, in miles	$95\frac{1}{2}$
Time actually travelling	9h. 51m.
Engine standing under steam	7h. 24m.
Average speed in miles, per hour	9·69
Gross load, in tons	20·5
Mile tons	1,957·75
Pounds of coal per ton per mile	1·88
Water per ton per mile	12·33
Pounds of water evaporated by 1lb. of coal	6·53

Mr. Briggs said that as, unlike most persons present, he had never been in India, he felt somewhat diffident in venturing to offer an opinion; yet, as human nature was pretty much the same all over the world, especially in matters relating to cooking, he would say that he thought something ought to be said in regard to the details, not only of the forest question and the development of the use of peat as against coal, but also as respects the way in which the power and resources are to be obtained for developing these things. If the government of India continue so unwise as to place a prohibitive duty upon the people's salt in India, how can it be expected that the resources of the nation can be developed in such a way as to get the land cultivated, and the means of transit facilitated? Take for instance the operation of this regulation in the question of fuel. The people in most parts of India—the agriculturists—have to use their best manure, the ordure of cows, for fuel; and consequently their need for a cheap fuel is great, while the need for a manure is increased. Should they desire to use salt as a manure, they find it is heavily taxed, and the means of transit for the salt are so defective as to combine to make it too expensive. Were salt cheap and untaxed, and means of transit easy, the result would be that the want of fuel would not be so great, for there would be a large amount of produce by the salt manure, which would better enable the ryots to pay for fuel brought from a distance. In this way the resources of the country would thereby stand a better chance of development. As regards the development of peat as a fuel, he would say something practical upon its usefulness, for when he was a boy it used to be a common thing for him to go across the creek of Morecambe Bay, wading over the channel, and thence to the bog to gather the peat fuel out of the ditches. At that time the industry of peat gathering was an absolute necessity, and the people in the district to which he referred were as "hard up" for fuel as the Indians are now; for coal, owing to the difficulty of transit, was costing 30s. or more a ton. Peat in such a case was the only resource, and it was a regular industry to gather it. If therefore the people of India were put in the way of utilising their own resources, and if the government took off the shoulders of the ryots the pressure of the salt duty, and other similar taxes upon raw produce, he had not the slightest doubt they would achieve a happy condition, and the country would rapidly grow more valuable and wealthy, and more able to withstand the hardships of a droughty summer. With respect to the observations of the Chairman, in reference to the Cotton Supply Association at Manchester, Mr. Briggs added that he had had long arguments with those people for not supplying the five millions of bales of cotton they had promised. Instead of five millions of bales being produced in India, there was a decided falling off, as was proved by the statistics given by Lieut-Colonel Wragge. It appeared to him that this decrease in the produce of cotton and East Indian produce was a fact requiring explanation.

Lieut.-Colonel Wragge stated that he had given very high authority for the statement, that as the means of transit are ineffective, and the fuel extravagantly expensive, the cotton could not be moved, and that it was "buried in the ground for better times,"

Capt. Taylor said the opener of the discussion had very properly drawn attention to the importance of the peat in the Deccan and Neilgherries, which undoubtedly ought to be used more than it is. The natives of the Deccan do use the peat, and so do the English residents, and there is not the slightest doubt that it ought to be used on the railways. But there is one peculiarity with India and everything connected with it, and it has affected the wood and peat question; and that is, that the introduction of peat will not lower the cost of coal and wood, but peat will rise nearly to their price. This is to be accounted for by the mode of procedure in obtaining the supplies of fuel. The railway calls for a tender; the contractor goes into the market and buys all the peat that is to be had, and then charges the railway at a price nearly equal to that of coal or wood. This is an Indian difficulty which must be met on the threshhold of the question, and it is an obstacle not so easily overcome as might be imagined. As regards what had been observed with reference to the fact that cotton is not coming to England in as large quantities as it has done in past years, there is, in fact, nothing mysterious about it. The districts which were supplying England with large quantities of cotton while the cotton famine had greatly enhanced its value, have now reverted to the cultivation of indigo, as they did prior to the American civil war; and this has been done because it is found that indigo pays a great deal better than cotton does at its present rates. Thus is afforded a natural explanation of the falling off in the cotton exports from India. Capt. Taylor concluded by observing that he doubted whether much cotton was buried under the earth "until better times," for in most cases it would not be many days under ground before it would be destroyed by white ants.

Mr. Horne asked leave to correct an evident misapprehension on the part of Mr. Briggs. There is no tax upon salt used for agricultural purposes in India; and, speaking generally, salt is used mainly for feeding cattle, &c., and it has not been found beneficial as a manure. There used to be a tax upon salt used for agricultural purposes, but it has long ago been repealed.

Mr. Briggs explained that, in company with some friends, he once attempted to open up an Indian business in salt, but in consequence of there being a heavy duty on salt in India, he had to pay dearly for the experiment. Was not that sufficient to show to every man that there exists an obstruction to the unlimited supply of salt to India? Were salt duty free, it could be carried as ballast, and the ships return with Indian produce. As to the use of salt as manure, a certain kind of salt was always useful.

Mr. Lloyd Wise said—With regard to suggestions thrown out in the valuable paper they had just heard read, it was important to be assured that the peat, as proposed to be used, will answer well for its intended purpose; and therefore it might interest those present to know the results of some experiments he carried out, some three or four years back, in conjunction with his friend Mr. Edward Field, the well-known engineer. "Some peat, prepared in the way advocated by Colonel Wragge, was submitted to us for trial, with a view to demonstrating the practicability of employing for steam purposes even very inferior peat, when prepared by the process in question, by which it can be produced in a marketable form at a moderate cost. Our experiments were conducted with a Lancashire boiler, 20ft. long by 6ft. 6in. in diameter, the diameter of each flue being 2ft. 6in., and the total fire-grate surface being 40 square feet. The blocks of peat were packed in sacks, each containing one and three-quarter cwt. of the fuel. The experiments were commenced at half-past eleven o'clock a.m., and lasted till eight o'clock p.m., thus covering a period of eight and a half hours, during which time 18 sacks, or 31½ cwt. of peat were consumed, and 1,584 gallons of water evaporated. As the boiler was kept in constant work day and night, a coal fire was burning at the time of commencing the experiments with the peat; but due allowance was made in this respect, by considering the experiments as having terminated at a time when the peat fires were similar in condition to that of the coal fires at the time of commencing the experiments, thus giving no unfair advantage in favour of the peat. The level of the water in the boiler was carefully noted at the commencement of the experiments, and was at the same height on their conclusion. The quantity of water evaporated was accurately measured in a tank from which the boiler was supplied, the water fed to the boiler being cold. The blocks of peat were exceedingly sound, and, by reason of the peculiar process adopted in their preparation, were very portable, not having the slightest tendency to crumble in transit, which we deemed an important feature. They produced a most excellent fire, such as we considered in some respects superior to a coal fire, notwithstanding that the blocks used on the occasion were prepared from peat of very inferior quality, taken from the upper stratum, and not from the lower stratum, which latter would be selected as steam fuel, and would undoubtedly give very much better results. The boiler was performing its regular work while the experiments were being conducted, during the whole of which time an abundant supply of steam was steadily maintained. The evaporation, as will be seen, is below that of coal, being about 4½lbs. of water per pound of fuel (a very good result for peat); but, taking into consideration the enormous available quantity of peat in many districts, combined with the very low price at which it can apparently be prepared, and also bearing in mind that the peat tested was, as before stated, of very inferior quality, we considered that the prepared peat possessed important properties, bidding fair to bring it largely into use."

Dr. Cleghorne remarked that the opener of the discussion had treated upon many topics, but the gist of his argument was, apparently, to show the importance of peat as a fuel, and that the stores of peat in India are not being utilised as they should be. The first Oriental peat brought to England was brought from Thibet; and ten years ago he himself brought some from the Neilgherry hills, where it is in constant use, and is sold at a moderate price, there being a considerable supply. There is no doubt that its use might be, and should be, very considerably extended, and that the result would be a considerable saving in the expenditure on fuel. But there are great difficulties in extending its use over large areas; for although the ramifications of the railway system have done much to develop facilities for traffic, yet the means of transport are very inadequate. The peat fuel is produced only at very high elevation in India, its producing plants being the same in genera, though not in species, as the peat-producing plants of the British Islands. Situated as they are in circumscribed positions on the tops of the hills, they are especially valuable in their sponge-like properties by retaining the water to feed the streams; and therefore he would go even further than Colonel Wragge, in arguing the conservation of the peat-bogs of India in the strictest manner from all ill-judged excavations. How the peat is to be applied to the service of the railways is a difficult question, which had not really been met in the course of the discussion. The real problem is, how is the peat to be conveyed from the hills down to the railways in the plains, while the means of transport are so inefficient? Dr. Cleghorne concluded by expressing his conviction that the forest officers, the railway authorities, and everybody else in India, would alike be very pleased if it were found that peat could be utilised in the way proposed.

The Chairman said the discussion which had taken place having gone far to elucidate the subject, he thought it desirable to bring it to a close. They had had very valuable testimony given by several speakers who had addressed them—speakers who had the advantage of practical knowledge of the subject; and, on the other hand, they had the benefit of the observations of eminent public servants, like Mr. Horne and Dr. Cleghorne, who had laid before them facts which must be regarded in considering the subject under debate. Even such an apparently trifling matter as the natives' practice of cutting off the tops of certain young trees, in order to make tooth-brushes, becomes of importance when viewed in its relation to the conservation of the forests of India. People in England would naturally ask, "Why don't the people use bristles for their tooth-brushes?" Such querists are unaware of the fact that there are in the British service whole battalions of troops who cannot be induced to use brushes for fear they should contain hogs' bristles, and cause them to break a ceremonial observance of the Mussulman creed. And even with regard to tooth-brushes, there are populations other than those of Hindustan, using tooth-brushes to a much larger extent than the English, who yet strictly require that their's shall be a vegetable tooth-brush of a particular form. Hence Mr. Horne's reference to the natives' practice is explained as a matter of religious observance—they are compelled to use a prescribed kind of brush for the purposes of ablution. The engineering experience of

Mr. Olrick and Mr. Lloyd Wise was valuable, and their testimony agreed in pointing to the value of peat as a fuel for steaming purposes. In this connection, the important experiments conducted by Mr. Olrick, in regard to road-steamers, are worthy of great attention. In England, the importance of those experiments had not been appreciated at their proper value, but in India their bearing upon the means of transport would command for them the attention and consideration they certainly deserved. For what did the one thousand miles' journey of Mr. Olrick's road-steamer prove? It proved that engines of a similar construction could be effectively employed on the great trunk-roads of India.

Mr. Ward said that the success of the trip between Ipswich and Edinburgh proved nothing in regard to India, because the main difficulty would be to get over the bridges. They could not support the weight of the steamer.

The Chairman said there was no doubt Mr. Ward's objection would apply to some parts of India, but all Indian roads were fortunately not so badly situated in this respect as the road of which Mr. Ward had considerable experience—the road between Calcutta and Darjeeling. Mr. Horne had remarked that the zemindars have given up the cultivation of trees, and substituted other crops as more remunerative; but it is very probable in India, as in other countries, it would be found that wood cultivation is not a bad return for investment, although, of course, it is not an immediate return, as in the case of cotton or indigo. As to the causes of the falling off in the production of cotton in India, they had been well explained by Captain Taylor. The displacement of cotton by indigo is caused by the fact that at present the latter is more remunerative than the former. But this may bring about a restoration of the cultivation of cotton, because the demand for indigo has led to its being largely grown in Central America, and the result may be a gradual decrease in price. No remedy could be expected for such a falling off; it is due to the free and fair play of trade, and if that is allowed to continue, such fluctuations must always be expected. The question of the forests in India is, in many respects, an exceedingly difficult one for the government. On the one hand, it is necessary to encourage the growth of trees, and on the other hand the action of the government may be positively mischievous by stimulating the production of one crop to the depression of another. The whole subject brought under debate by Col. Wragge is one of the highest importance, because it is certain that the forests of India are decreasing, and the absence of forests is known to have proved an immense evil in other countries, whose forests, by neglect, have been destroyed. The railways are being affected by this decrease of fuel, and agriculture also suffers by it. The other day, the *Times* correspondent in Greece, in commenting on the effect of the denudation of the forests in that country, pointed to one district, once the dwelling of a large population, but which is now unable to support its scantier people, entirely through the removal of the forests. Forests are valuable in many direct respects, and, in a secondary sense, they afford a means of storing up water, in just the same way as the peat mosses which Dr. Cleghorne is desirous of preserving for that very reason; and trees, where circumstances are favourable, are of great value, when planted along the banks of water courses. The Turkish government is engaged, through its Forest Department, in obtaining the plantation of trees along its water-courses, wherever it is found at all practicable, and is thus rendering an important service to the culture of trees in the empire. It should be remembered also that the conservation of trees is a great service, in making fresh and fertile vegetable soil; and one of the most effective expedients to make waste, barren land profitable, is to plant trees upon it, as is done in England and in Flanders. The benefit of this course is especially shown in Flanders, where land which was little better than sea sand fifteen years ago, has been brought under profitable culture, by the deposit of vegetable soil upon it from the trees which were placed there. The fuel question is obviously closely connected with the transport question in India, a fact which greatly heightens its importance. And while upon this point, he might remark that in regard to the lighting of Indian railways, experiments are in course of operation for using petroleum for this purpose. Suggestions like those made on the present occasion were not made as strictures or censures on the action of the government; they are due to the natural feeling of interest in India which is felt by Englishmen in regard to a country in which they have spent the prime and vigour of their lives, and the welfare and prosperity of whose people they feel anxious to promote. The means of conference afforded by the Society of Arts were, therefore, in every way valuable; and the extension of railways in India makes possible that which, owing to the difficulty of communication, has hitherto been impossible. In India, formerly those resident in one presidency almost ignored the existence of the other presidencies and provinces; but now there are better means of communication, more frequent reunions, and consultations of officials are possible, and there are better means of meeting than the bazaars and fairs, and ordinary meetings of chiefs. Exhibitions of all kinds are extending in India, and it is to be hoped that the period will soon arrive when other institutions of England can be initiated, and conferences and consultations will be held in India, as on the present occasion in the theatre of the Society of Arts. For instance, he believed that much good would result if there could be a congress in India of those who are interested in the propagation of trees and the extension of forests, where the practical and technical points of the subject could be fully discussed. Conferences of railway managers, of medical men, and of scientific men in India, might also be held to great advantage. To these remarks he would add, that those present would agree thoroughly with him in thinking the proceedings would not be complete without awarding Colonel Wragge grateful thanks for the careful and instructive paper he had read, and therefore he had great pleasure in proposing a vote of thanks to him.

Lieut.-Colonel Wragge, having acknowledged the compliment, briefly replied to the observations of some of the speakers. He disclaimed the slightest intention to find fault with what the government were doing in the matter; he only desired to point out that nothing was being done in the direction he indicated, viz., the attempt to provide a cheap fuel, in order that the cotton ("lying buried," as a high official had stated, "for better times") might be removed. What he wanted was to show a means of bringing on those "better times," for it could only be done by a cheap fuel. What he argued was, that there is nobody to assist the railways to find such a fuel, and that something should be done to prevent disastrous results which the railways are now experiencing. What should be done he had pointed out, as far as his humble ability allowed him. Capt. Taylor had argued that the utilisation of peat would not cheapen fuel, but that the peat fuel would rise to the price of coal and wood; but that could only happen supposing the government were so neglectful as to allow the contractors to act in the manner Captain Taylor described. As regarded the general fuel question, he might add his opinion, that if the government does not keep the new collieries in its own hands, the railways will get no advantage, for the coal from the new collieries will be raised to a price little less, if any, than the prices at present quoted for English coal. The government should retain those collieries in its own hands, and, working them at a fair interest upon the capital invested, should secure them from falling into the hands of companies of monopolists, whose only object would be to get a high price, regardless of the consequences. Dr. Cleghorne had said the Forest Department had nothing to do with the fuel, but his (Lieut.-Colonel Wragge's) contention was that they should have. Dr. Cleghorne had also pointed out the usefulness of peat-bogs as natural reservoirs for the supply of water to the streams; but the proposition advanced in the paper he has read would not necessarily incapacitate the peat from performing its natural and highly useful functions; for, by the exercise of a little care, the cuttings from the peat can be made in such a manner as not to injure the properties of the bogs in the least. The gallant colonel concluded by repeating his entire absence of intention to find fault with the Forest Department in India, but urged that when, year after year, the official reports state that "steps will be taken," or that "steps are about to be taken," and yet nothing is really done, it was time that attention should be directed to the subject.

ANNOUNCEMENTS BY THE COUNCIL.

THE LIBRARY.

The following books have been presented to the Library:—

Pamphlets on "Land and Water Carriage for India," and "The Navigation of the Godavery."

The Proceedings of the Scientific Association of Trinidad.

Reports of the Inspectors of Factories for the half-year ending 30th April, 1871. Presented by Alexander Redgrave.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

Exhibition of 1872.—A meeting of the General Purposes Committee appointed by Her Majesty's Commissioners for the Exhibition of 1851 to carry out the current series of Annual International Exhibitions, was held on Wednesday at the Privy Council Office. There were present the Marquis of Ripon, (chairman), Sir Francis Sandford, C.B., Mr. Cole, C.B., Mr. Gibson, Dr. Playfair, C.B., M.P., Mr. Thring, and Major-General Scott, C.B. (Secretary).

Royal Albert Hall.—His Royal Highness the Duke of Edinburgh presided at a meeting of the Executive Committee of the Royal Albert Hall, held on Friday, the 8th instant. Also present Mr. Cole, Mr. Thring, and General Scott, secretary.

Jewellery.—Intending exhibitors of jewellery will have to obtain cases in which to array their specimens previous to submitting to the Committee of Selection. The cases are of two sizes:—

1. 23½ in. × 16 in. × 4 in.
2. 15½ in. × 11½ in. × 4 in.

They open with a plate-glass lid.

Rules for Supplementary Galleries for Foreign Exhibitors.—In conformity with paragraph 9 of the general conditions for the erection of supplementary galleries, published in the last *Journal*, the rules relating to foreign annexes are as follows:—

Exhibitors whose works have been admitted to the Exhibition proper by the Committee of Selection will be awarded further space where they may display objects belonging to the undermentioned classes chosen for the year 1872, provided that such objects are duplicates of those displayed as manufactures in the Exhibition proper, or correspond as nearly as possible with them.

Class 8. Cotton and cotton fabrics.

Class 9. Jewellery, *i.e.*, manufactured articles worn as personal ornament made of precious and other metals, precious stones, or their imitations, jet, mother-of-pearl, steel, iron, etc., but not goldsmiths' and silversmiths' manufactured work of other sorts which it is intended shall be exhibited in 1876. It is intended that ornamental watches shall be exhibited in 1875, with other horological manufactures. Fine art in precious metals will be admitted with fine arts.

Class 10. Musical instruments of all kinds.

Class 11. Acoustic apparatus.

Class 12. Paper, stationery, and printing.

Division III. Products of Inventions and Discoveries, admitted to the Exhibition proper, capable of being exhibited in a very small compass.

Exhibitors having supplementary space, in the annexe, granted to them will be permitted to fit up their own cases, subject to the approval of Her Majesty's Commissioners, who will prescribe the system of lettering, and the form of large notices.

The objects sold on each day cannot be removed from the building until after the close of the day's Exhibition at 6 P.M., and after duplicates have been substituted.

The catalogue and prices of each supplementary collection must be printed, and given or sold to the public. During the Exhibition, no change can be made in the nature of the objects displayed or in the prices stated.

Acoustic Apparatus and Appliances.—The following are the general regulations for exhibiting acoustic apparatus and appliances:—

1. The exhibition of acoustic apparatus will include all kinds of instruments and appliances for facilitating hearing, and for illustrating the laws that govern the production and transmission of sound.

2. The aim of the Exhibition being to bring prominently into notice specimens remarkable for excellence, novelty, invention, &c., it is desirable to limit the number of specimens from each producer to those which are absolutely necessary; consequently no duplicates of any object can be admitted.

3. The name of the object, as well as that of the manufacturer, should be securely attached to each article.

4. Objects produced in the United Kingdom, as well as those objects produced in foreign countries, for which space has not been guaranteed, must be sent direct to the exhibition buildings, for the inspection and approval of judges appointed for the purpose. All objects must be delivered at the proper places in the building, which will be hereafter advertised, and into the care of the appointed officers, free of all charges for carriage, &c., unpacked, labelled, and ready for immediate exhibition.

5. All objects belonging to this Class must be delivered on Tuesday, the 5th of March, 1872.

South Kensington Museum.—With a view towards the completion of the collection of water-colour paintings illustrating the history of that art, Mr. William Smith, vice-president of the National Portrait Gallery Trustees, has allowed Mr. Redgrave, R.A., the Inspector-General for Art, to select from his choice and valuable collection as many rare specimens as, in Mr. Redgrave's judgment, would illustrate the early period of this truly national art. The works selected by Mr. Redgrave have been presented by Mr. Smith to the nation.

EXHIBITIONS.

EXHIBITION OF THE ARTS, INDUSTRIES, AND MANUFACTURES OF IRELAND.

A preliminary meeting of the vice-presidents and council of the Exhibition of Arts, Industries, and Manufactures of Ireland was held on December 7th, in the boardroom of the Exhibition Palace.

His Grace the Duke of Leinster, President of the Exhibition, took the chair.

The Chairman said the meeting had been called to consider a proposal made by Sir Arthur Guinness and Mr. Edward Cecil Guinness, to place the Exhibition Palace at the disposal of the public, for an Industrial Exhibition, during the next year.

The following letter was then read :—

"Exhibition Palace, 7th Dec., 1871.

"My Lord Duke, my Lords and Gentlemen,—Believing that an exhibition of the arts, industry, and manufactures of Ireland would confer many advantages on this country, we have much pleasure in submitting the following proposal. We propose to devote to this purpose for a certain time the Leinster Hall in the Exhibition Palace. We are aware that there is not any public fund or Parliamentary grant, such as South Kensington enjoys, available for the purpose of this exhibition. Its success, therefore, must altogether depend on the patriotism and liberality of our countrymen, in supplying from their private collections, manufactories, or workshops, the objects suitable for the purpose. But we are satisfied that no public or private exertions will be spared in bringing this project to a successful issue. We propose that another portion of the building should be placed at the disposal of English and foreign exhibitors, believing that Irish manufacturers and artisans have much to gain from a fair and free competition with those of other countries. We should wish to place the whole exhibition under the management of Mr. Lee, aided, of course, by suggestions and advice from you. As we have determined to make all the pecuniary advances that may be necessary, and to bear any losses this project may entail, we desire that we shall have uncontrolled charge of all financial matters. The rest of the building, which will not be required for this purpose, will also continue under the management of Mr. Lee. Trusting this proposal will receive the approval and support of your Grace and this meeting, we have the honour to be, your Grace's obedient servants,

"Arthur Ed. Guinness.
"Ed. Cecil Guinness.

"To his Grace the Duke of Leinster."

The Earl of Howth proposed the first resolution, which was to the effect that the munificent and most liberal offer made by Sir Arthur and Mr. Edward Cecil Guinness be accepted with grateful thanks.

Sir George Hodson, Bart., seconded the motion, which was adopted.

Lord Sandhurst moved :—"That the nobility and gentry, who are collectors of art and art manufactures, be requested to contribute to the loan museum."

The motion was adopted.

The High Sheriff of the city proposed that the gentlemen named on the council should form themselves into a committee to carry out the programme laid down, and with permission to add to their number.

Sir John Barrington seconded the motion, which was passed.

The Marquis of Conyngham proposed the next resolution, which was as follows :—"That her Majesty the Queen be respectfully solicited to contribute to the loan museum of the proposed exhibition, from the collection of paintings and pottery at Windsor Castle."

The motion was adopted.

The Chairman announced that he had received a letter from Mr. James Owen, President of the Institute of Architects, submitting for the consideration of the meeting the great desirability of making provision in the Exhibition for the study of architecture, in conjunction with the other arts, as there was at present admittedly no means in Ireland for architectural study.

TRIAL OF COTTON-GINS.

The following arrangements have been adopted for the cotton-gin trials, now taking place at Manchester :—

The organisation and direction of the trials have been entrusted by Her Majesty's Secretary of State for India in Council, to Dr. Forbes Watson, Reporter on the Products of India, with whom has been associated Major-General Frederick Cotton, C.S.I. Every facility will also be given to all persons practically interested in the matter to witness the proceedings. In addition, the experiments will be carried out in co-operation with the different cotton-gin manufacturers—or with the agents —who have entered machines for trial.

The following is a list of cotton-gins (with the makers name attached) which will be tested at the trials :—

1. Cotton's improved Macarthy gin. (Platt Brothers and Co.)
2. Platt and Richardson's patent double-action Macarthy gin. (Platt Brothers and Co.)
3. Platt and Richardson's double-forked knife gin. (Platt Brothers and Co.)
4. Single-acting Macarthy gin, fitted with Henderson's patent diagonal knife. (Platt Brothers and Co.)
5. Macarthy gin. (Dobson and Barlow.)
6. Knife-roller gin (Brakell's patent.) (Dobson and Barlow.)
7. Double cylinder saw gin. (Dobson and Barlow.)
8. Jones's patent cotton-gin with revolving beater. (Dobson and Barlow.)
9. Jones's patent cotton-gin. (Dobson and Barlow.)
10. Cowper's lock-jaw cotton-gin. (Curtis, Parr, and Madeley.)
11. Chaufourier's "Churka." (E. W. Thomas.)
12. Toothed roller gin. (P. and C. Garnett.)
13. Dharwar factory 18 saw gin. (Government factory, Dharwar.)
14. Dharwar factory 10 saw gin. (Government factory, Dharwar.)
15. Macarthy gin. (Henry Bayley, Son, and Co.)
16. Macarthy gin. (Henry Bayley, Son, and Co.)
17. Evan Leigh, Son, and Co. patent improved Macarthy double-roller gin. (Evan Leigh, Son, and Co.)
18. Evan Leigh, Son, and Co. patent improved Macarthy single-roller gin. (Evan Leigh, Son, and Co.)
19. Sugden's patent gin. (Howard and Bullough.)

The seed cotton of different kinds available for the trials amounts to upwards of 70,000 lbs., and consists of the following varieties, namely :—Broach, Dhollerah, Candeish, Madras of sorts, American Dharwar, American Uplands, and Egyptian, together with smaller quantities of Sea Island and Brazilian.

The following are the rules for the conduct of the trials :—

1. The trials will take place from 10 a.m. to 3 p.m., and will probably last until the 20th of December.
2. All the gins will not necessarily work at the same time. As a rule only a limited number will be at work simultaneously.
3. On the part of the direction care will be taken to maintain the room, during the entire duration of the trials, at an equal temperature ; to provide every gin with cotton of the same description, and in as nearly as possible the same condition ; as also to keep the motive power constant during the whole time. A series of definite tests will be applied to show how far those conditions have been fulfilled.

4. The management and feeding of each gin will rest entirely with the makers or their agents themselves, and no one will be allowed to touch or examine any machine without their consent.

5. The kind of cotton to be used to test the several gins will be a matter of special agreement with the representatives of the gins. It is, however, considered to be desirable that each gin should be tested with all the varieties of cotton in stock.

6. The results of every day's trial will be contained in a "daily record" kept separately for each gin, and the accuracy of the statements contained in it will be attested by the signature of the agent responsible for the gin. If the agent should take exception to any entry, or if he should like to record any remarks respecting the day's trial, he must do so in writing in the "daily record," and on the day to which it refers. No subsequent rectification will be admitted. A book will likewise be provided for the entry therein of remarks by any of the gin makers or visitors. All complaints, duly signed, must be entered in this book.

7. The particulars to be entered in the "daily record" will be the kind and weight of seed cotton used, the weight of clean cotton and of seed turned out, the time of starting and stopping of the gin, the duration and cause of stoppages occurring during the work, &c.

8. The weight of the clean cotton and seed turned out will be taken at the end of each day, and the bags then sealed and stored in such a manner as to prevent all possibility of tampering with their contents.

9. The force consumed by each gin during its working will be tested by means of a dynamometer, under the supervision of Mr. Amos, who, for upwards of twenty years, has conducted similar experiments for the Royal Agricultural Society of England.

10. The quality of the cleaned cotton, as usually tested, depends not on the action of registering instruments, but on the opinion of experts. Precautions will therefore be necessary to prevent even the imputation that partiality or accident can have influenced the result. For this purpose a mode of dealing with the samples has been devised which will prevent any one identifying the gins from which the different samples have been taken. The samples, under these conditions, will be submitted to the broker and spinner, and only after all the valuations and reports have been obtained will the seals be broken which afford the key to the identification of the samples.

11. Independent of those valuations, the cotton may be subjected to other tests, in order to arrive at a more exact determination of the effect produced upon the quality of its fibre by the different gins.

CORRESPONDENCE.

INDIAN FORESTS AND INDIAN RAILWAYS.

Sir,—I was very sorry to see so few persons met to discuss Col. Wragge's valuable paper on "Indian Forests and Indian Railways." The subjects connected with this comprehensive title are so vast and momentous that a month of conference would not exhaust the discussion; yet only one hour was given to it.

Lest inaccurate notions should be conveyed by my few hasty remarks, I would wish to add to them a few lines in the *Journal*. The property in the forest trees in villages in the north-west is vested in the landholder or zemindar, and not at all in the cultivator, who may not plant without permission, as it would be assuming the rights of the superior landlord. Government has no power to prevent these trees being cut, however it may wish to avert the injury caused by too great a denudation of the country of its groves of trees.

There is, however, another side to the story. These lands, planted with groves, are assessed at a very much less rate of revenue, as long as they remain so cropped. Hence trees are most commonly replaced when blown or cut down. At times such land is converted to tillage, the name of grove remaining fraudulently entered on the office books, in order to avoid the higher assessment.

Deep ditches and high banks are made around such plantations to protect them; and unless such precaution was taken not one out of ten trees would survive the danger of the first few years of growth.

Again, I spoke of the sad state of the country, denuded of trees on either side of the East India Railway. There should be set against this the course of the canals, with their planted banks and well-watered adjoining gardens. This may be seen from the Himalayas like a dark line across the distant plains, and from the nurseries large numbers of trees are annually sent forth.

But the chief object of my letter is to ask any of your correspondents to kindly tell us how many peat bogs there are in India? Where they are? What is their extent? How can they be utilised? and, How much carriage expense the compressed peat will bear? At the same time, I would inquire whether the whole of the boilers and furnaces in India would not need to be reconstructed if peat were used, presuming it could be obtained in anything like sufficient quantities?

Colonel Wragge evidently had the use of peat, to supplement if not supplant wood fuel, in his mind whilst writing the essay, and should, I think, have enlightened us on some of the above points.—I am, &c.,

C. Horne (late B.C.S.).

Norwood, December 2, 1871.

THE NAVAL UNIVERSITY.

Sir,—With reference to the able letter upon this subject, which appeared in your last number, permit me to state that I fully concur with the writer in the opinion that it is very desirable to make the naval university as fully available for the mercantile as for the Royal marine. In fact, I should consider it a great mistake to establish a national naval university on a narrow basis, and I am convinced that innumerable benefits would arise from opening to the mercantile navy the doors of a well-constituted and wisely-managed college, for both the general and the technical education of naval officers of all classes.—I am, &c.,

E. J. Reed.

Hull, 6th December, 1871.

PROCEEDINGS OF INSTITUTIONS.

Hertford Local Board.—The annual distribution of the prizes and certificates of this board was held on Tuesday, December 5th, at Hertford; Richard Hoare, Esq., presided. The report showed that the number of candidates that had come up for examination was very largely in excess of previous years, a large proportion of them being females. The meeting was addressed by the Chairman, the Rev. Canon Blakesley, W. G. Larkins, Esq., who represented the Society of Arts, and Robert Dimsdale, Esq. M.P., the chairman of the Local Board.

MEETINGS.

Charity Organisation Society.—A meeting of this Society was held in the great room, by permission of the Council, on Tuesday afternoon. It was found impossible to put off this meeting, the promoters of which were promised the use of the room some weeks ago.

The meetings of the Society of Arts have, however, been postponed for the present, on account of the dangerous illness of His Royal Highness the President.

GENERAL NOTES.

Statistics of Queensland.—A statement of the revenue and expenditure of the colony of Queensland for the quarters ended 31st March, 1870 and 1871, recently published, shows that the gross receipts for the present year amounted to £203,458 17s. 10d., whilst for the corresponding quarter of 1870 the receipts were £191,270 8s. 3d., the apparent increase being £12,188 9s. 7d. The Customs receipts during the quarter above referred to amounted to £84,218, against £61,766; the land revenues amounted to £57,760, against £60,856; the amount received from postage, licences, &c., was £21,100, against £18,385 in 1870; the expenditure for the quarter amounted to £245,322, against £236,622 in 1870.

Raw Cotton. — The following shows the quantity of raw cotton imported into the United Kingdom during 1870, and the countries from which it was received:—United States, 6,495,045 cwt.; British India, 3,040,550 cwt.; Egypt, 1,283,037 cwt.; Brazil, 573,331 cwt.; France, 330,653 cwt.; Natolia (Asia Minor), 51,581 cwt.; European Turkey, 33,278 cwt.; sundry European countries, 35,271 cwt.; Chili, 36,119 cwt.; Peru, 21,216 cwt.; New Granada, 34,295 cwt.; Foreign West India Islands, 14,660 cwt.; British ditto, 18,851 cwt.; Venezuela, 8,268 cwt.; New South Wales, 7,928 cwt.; Queensland, 8,201 cwt.; New Zealand, 3,348 cwt.; West Coast of Africa, 12,503 cwt.; Argentine Confederation, 1,478 cwt.; Ecuador, 28 cwt.; Mexico, 18 cwt.; British Guiana, 1,812 cwt.; Nova Scotia, 4,317 cwt.; China, 94 cwt.; Siam, 135 cwt.; French India, 2,348 cwt.; Ceylon, 8,269 cwt.; Persia, 527 cwt.; Algeria, 20 cwt.; Gambia, 120; Sierra Leone, 493 cwt.; Gold Coast, 2,721 cwt.; Cape of Good Hope, 561 cwt.; Natal, 4,368 cwt.; Mauritius, 6 cwt.; Euphrates and Persian Gulf, 1,060 cwt.; Syria and Palestine, 7,326 Greece, 571 cwt.; Malta, 832 cwt.; Illyria and Dalmatia, 2,114 cwt.; Italy, 611 cwt. Total, 12,047,964 cwt.

Act for the Prevention of Crime in Dealing in Old Metals.—This Act, which came into operation on the 2nd November, contains, among other stringent clauses, one levying a penalty on dealers in old metals purchasing quatities of less than a specified weight. The clause, which is No. 13, runs as follows:—Any dealer in old metals who, either personally or by any servant or agent purchases, receives, or bargains for any metal mentioned in the first column of the schedule annexed hereto, whether new or old, in any quantity at one time of less weight than the quantity set opposite each such metal in the second column of the schedule annexed hereto, shall be guilty of an offence against this Act, and be liable to a penalty of five pounds . . . . For the purposes of this section, the term 'dealer in old metals' shall mean any person dealing in, buying, and selling old metal, scrap metal, broken metal, or partly manufactured metal goods, or defaced or old metal goods, and whether such person deals in such articles only or together with second-hand goods or marine stores." The following is the schedule referred to in the clause.—

			Quantities of not less than
Lead, or any composite, the principle ingredient of which is lead.........			112 lb.
Copper,	do.	do.	56 lb.
Brass,	do.	do.	56 lb.
Tin,	do.	do.	56 lb.
Pewter,	do.	do.	56 lb.
German silver or spelter,		do.	56 lb.

Darjeeling Tea Crop.—The out-turn of tea in the Darjeeling district this year has reached three million pounds. New gardens have recently been opened out in the Terai; more are expected to follow, and it is expected that in a few years the export of tea from Darjeeling will reach ten millions of pounds. The annual increase is estimated at 400,000 lbs. The great drawback now is a line of railway, to connect the Darjeeling with the East Indian railway at Sahibgunge or Rajmahal.

Consumption of French Wines in England.—Mr. T. G. Shaw, in a letter to the *Times* of Dec. 13th, says that "during the ten years previous to the reduction of the duties in 1860, the annual average consumption of French wines in this country was about one glass for each person, and it is now one bottle, the increase from 1859 to the end of 1870 being from 695,913 to 4,157,372 gallons, and will this year be nearly a million more. The increase is great, but our population has increased above three millions, and our wealth probably 50 per cent."

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

December 20.—"Observations on the Esparto Plant." By Robert Johnston, Esq.

CANTOR LECTURES.

The Third Lecture, "On the Manufacture and Refining of Sugar," by C. Haughton Gill, Esq., was delivered on Monday evening, December 11th. The remaining lecture will be given as follows:—

Lecture 4.—Monday, December 18.

The refining of sugar, the complete cleansing of it—Melting or blowing up—Filtering, charcoaling, boiling, filling out, draining, liquoring, stoving—Utilisation of syrups—Treacle.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

MEETINGS FOR THE ENSUING WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lecture. Mr. C. Haughton Gill, "On the Manufacture and Refining of Sugar."
Social Science Association, 8. Mr. Jacob Waley, "On the Devolution Transfer and Disposition of Land."
British Architects, 8.
Actuaries, 7. Mr. W. M. Makeham, "On the Laws of Sickness and Invalidism and their relation to the Law of Mortality."
Medical, 8.
Asiatic, 3.
Anthropological, 8.
London Institution, 4. Prof. Huxley, "Elementary Physiology."
Tues.....Civil Engineers, 8. Annual General Meeting.
National Union for the Education of Women, 4. At 18, Cadogan-place, S.W.
Statistical, 7¾. Dr. Balfour, "On the Comparative Health of Seamen and Soldiers."
Pathological, 8.
Wed.....**SOCIETY OF ARTS, 8.** Mr. Robert Johnston, "Observations on the Esparto Plant."
Geological, 8.
Royal Society of Literature, 8½.
Science and Art Department (South Kensington Museum), 2½. Prof. Duncan, "Elementary Physiography."
Thurs...Royal, 8½.
Linnæan, 8. Prof. Owen, "On the Anatomy of the American King-crab (*Limulus polyphemus*).
Chemical, 8. Mr. H. Bassett, "On Eulyte and Dyslyte."
Numismatic, 7.
Philosophical Club, 6.
London Institution, 4. Mr. J. C. Broug , "The Philosophy of Magic."
Fri.......Quekett Club 8.

Journal of the Society of Arts.

No. 996. Vol. XX.

FRIDAY, DECEMBER 22, 1871.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

FIFTH ORDINARY MEETING.

Wednesday, December 20th, 1871; Edwin Chadwick, Esq., C.B., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Baker, Benj. Bloomfield, Roupell-park, Streatham, S.W.
Coddington, Thos. Butler, 9, Kensington-park-gardens.
Collcutt, Thomas Edward, 12, Finsbury-place south, E.C., and Elsfield-lodge, Ravenscourt-park, W.
Fildes, James, 44, Spring-gardens, Manchester.
Haworth, Abraham, Pall-mall, & Strutt-st., Manchester.
Maher, Michael, 41, Upper Temple-street, Birmingham.
Miller, Lieut.-Col. James, 20, Hyde-park-gate South, W.
Torrens, Lieut.-Col. R. R., M.P., Holne, Ashburton.
Walker, Enoch, 4, Banbury-terrace, South Hackney, E.

The following candidates were balloted for, and duly elected members of the Society:—

Baker, Robert, 107, Albion-road, Stoke Newington, N.
Bigg, Smith Henry, Nuthurst, near Horsham.
Brake, Rev. Charles, 19, Marquess-road, Canonbury, N.
Cole, Alan Summerly, South Kensington Museum, W.
Cole, Lieut. Henry Hardy, R.E., 10, St. George's-terrace, Gloucester-road, Kensington, W.
Drew, Jos., LL.D., F.R.A.S., Belgrave-ter. Weymouth.
Ellison, C. O., Adelphi Bank-chambers, South John-street, Liverpool.
Goodman, John C., 3, Gilston-road, West Brompton, S.W.
Hardy, Ralph Price, London and Provincial Assurance Society, 21, Fleet-street, E.C.
Horne, Chas., Innistail, Beulah-hill, Upper Norwood, S.E.
Nunn, T. W., F.R.C.S. Eng., 8, Stratford-place, W.
Straight, Douglas, M.P., 1, Cloisters, Temple, E.C.
Thomson, T. D., 21, St. Augustine-road, Camden-town.
Zimmermann, F.A., 7, Fen-court, Fenchurch-street, E.C.

The Chairman said—I must allude to the postponement of the paper to be read to-night from last Wednesday, on account of the dangerous illness of His Royal Highness the President of this Society, and express our congratulations at his recovery so far, and the hope that he will speedily be restored to full health and strength. I regret very much the absence, from illness, of my esteemed friend, Mr. David Chadwick, the member for Macclesfield, who should have taken the chair to-night. I regret it for the subject. He has given efficient aid to the movement for cotton supply, and, as we know here, for the silk supply. Those supplies, when attained, are good for the commerce of the country, and for the clothing and ornamentation of the body. But his active aid is wanted for the promotion of an improved paper supply, which, however important as a merchandise, is of the highest importance for the supply of cheap literature, and the intelligence, and order, and progress of the community. I beg your pardon, and ask your indulgence for what may appear to be a digression, but which I would submit as an exordium, and my personal ground of sympathy for the subject of the paper to-night, as well as the public policy it involves. In 1831, I wrote a paper in the *Westminster Review*, urging the importance of the removal of all of what I first named as taxes on knowledge—as obstacles to the mental and moral progress of the people. The late Archbishop Whateley and Dr. Arnold, of Rugby, proposed a subscription for printing and circulating that paper separately. For a time that question was called in Parliament my question. By the exertions of Lord Lytton and of Mr. Milner Gibson, one part of it was carried, and by Mr. Gladstone the remaining part was cleared away by the entire removal of the paper duties. It is now the condition before us that, having made information accessible to some portions of the people, by a repeal of fiscal charges, we should make further advances and keep the ground already made, by getting cheap and good reading paper. The advance already made reaches only a proportion of the reading population. The extension of education will advance the demand for paper beyond the present, or even the present prospective, means of supply. There are people now, as there were then, who view all advances of cheap newspapers or cheap literature with apprehension. One ground, or one of the grounds, which I then advanced for it, was that it was a means of safety, and indeed, that if it were beset with some danger, it certainly was a means of guarding against yet greater dangers to society. For I showed that there was nothing circulated necessarily openly, and to some extent responsibly, in print, that was, or that could be, so bad as the statements, feelings, and opinions that were circulated secretly, without responsibility, *viva voce*, amongst non-reading, uneducated, and ignorant populations. I will give an illustrative instance. During the cholera visitation, which we had to deal with at the General Board of Health, we were assured of profound beliefs prevalent amongst the uneducated of one district, that the cholera was a poison purposely distributed by the government to thin the population; that wells were poisoned; and that the government medical inspectors sent to check or stay the pestilence were the maleficent agents for its propagation. If such things had been promulgated in print, we could have got hold of the author or the promulgator, and made him answer for it, and have, by print and otherwise, stayed the moral pestilence. I received from India, a short time ago, a paper, advocating the education of the Hindoos, the teaching them to read, especially that they might read newspapers, which was advocated on the ground that the circulation of matter in print would in time set aside the more dangerous circulation of matter *vivâ voce.* No doubt the Hindoo writers would be uncomplimentary to the English rulers, but it would enable the latter to see more of what was going on, and adapt themselves better to native feeling, and to guard against such under-currents as that in relation to the greased cartridges, and the violent outbreak to which it led. As examples of the terrible states of ignorance, which require correction, an instance was given when a hill district was cleared of population by a report that the advancing British were coming to seize and slay them, and melt them down for their fat. In one instance a fellow preceded a progress of the Governor-General, and levied black-mail upon the villagers, by telling them that he would, on payment, exercise his influence to prevent their children being seized and killed, for that great functionary was fond of eating babies. It is only those who conduct police inquiries who are aware of how little the literate world knows of the dangerous fanaticism and undercurrents of false opinion and malevolent feeling that circulate unchecked in the illiterate world beneath and around them. The pessimist apprehensions of the effect of cheap political papers—whatsoever may be their shortcomings in the opinion of the men of the cloister—have certainly been falsified by the results, whilst, it must be conceded, it is in this country they are steadily improving in quality, and advancing in legitimate influence. This may be said not only of the large cheap political newspapers, but of the non-political papers, created and multiplying, for the advancement of special journals, branches of arts or commerce, such as agricultural farmers' journals, gardeners' journals, trade journals, science journals. One apprehension formerly expressed was, that any one might set up a cheap and mischievous journal. The fact is, no one can set up a cheap journal without machinery and large capital. Sectional papers do not succeed. Those only succeed that have immense sales—hitherto unthought of, and for great sales they must address themselves to the widest open general feelings that can be collected. The cheap newspaper must be a large manufacture, and this manufacture, like the manufacture of cotton, is largely dependent on the price of the chief material—the material of which paper is made. A halfpenny in the pound, or a fraction of a halfpenny, will, with the cheap papers, make a difference of many thousands a-year to a proprietor—a difference of success or failure. The commodity to be treated of to-night, the esparto, is advancing, it appears, almost to the condition of cotton amongst textile manufactures. It has advanced beyond wood or any other fibre, and, indeed, beyond rags. Its culture, you will hear, is exposed to a very serious check, which threatens to be a check to the progress of cheap literature, and to that of salutary mental influence, and the extension of education in this country. I may observe that the popular education in Germany loses much of its effect on intelligence and habitual alertness of mind of the people, that much mental stagnancy exists there, from their having little of cheap papers of any sort to read, on account of the taxes on knowledge, and fiscal obstructions that are still maintained there. Here, cheap and good paper is our present desideratum for advancement.

The Paper read was—

ESPARTO: A SERIES OF PRACTICAL REMARKS ON THE NATURE, CULTIVATION, PAST HISTORY, AND FUTURE PROSPECTS OF THE PLANT; INCLUDING A DEMONSTRATION OF THE IMPORTANCE TO THE PAPER-MAKING TRADE OF PROMPT AND VIGOROUS MEASURES FOR ITS PRESERVATION.

By Robert Johnston, Esq.

Important use of the Esparto plant.—Esparto, or Spanish grass, is a fibre which has for some years past been more or less familiar to the paper manufacturers of England. The *Times* is printed on paper made more or less from this material, and so are most of our leading journals, periodicals, and current publications generally.

Rapid Increase in its Consumption.—In the year 1856, some 50 tons were imported. In 1870, the consumption had risen to over 100,000 tons; and in the past eleven months of the present year the imports have exceeded 130,000 tons, being to various degrees in excess of the importation of jute, wool, flax, and hemp, and standing second to cotton only.

Its value, from £4 per ton in 1858, has risen to £10, which has been the current price during the present year, though to-day, owing to the arrival of the new crop, it is temporarily quoted at from £1 to £1 10s. less.

Object of the present Paper.—Owing to various circumstances, however, the peculiarities attending the growth and harvesting of the esparto plant have never, as yet, received the attention which they deserve; and it will be the object of the present paper to give prominence alike to the serious risks by which the plant is menaced, and further to the possibilities of its wide and successful development, if those risks are avoided, and proper methods and precautions are adopted.

Four-fold Division.—It is designed first, then, to supply a few definite facts on the plant itself, and on the climate and soils that are specially favourable to its growth. Secondly, some account will be given of the time and mode of harvesting. Thirdly, a brief estimate will be taken of the quantity of esparto that may be inferred to have been in growth in Spain at the time of its first introduction into English trade; and, besides a mention of its local uses, it is more particularly proposed under this head to explain the rapid deterioration and destruction of the plant, through a want of sound system when the demand suddenly rose; and fourthly, a series of suggestions will be offered on the true modes of preserving, cultivating, and propagating esparto, the whole being based on a close observation and practical experience running over several years. The paper will be concluded by a summary of general deductions with reference to this increasingly valuable article of commerce.

I.—General Account of the Plant.

Esparto known to the Ancients.—Esparto is no novice in the field of practical uses. Horace (*Epodes* iv.) mentions it as the material of thongs or whip-lashes for the backs of refractory slaves; Livy (xxii.) tells us that Hannibal stored a large quantity for various uses early in the Second Punic War; and Pliny has made more than one allusion to the plant.*

Botanical Classification.—Its Latin name in those days was *spartum*; in more recent Latin it is the *Stipa tenacissima* of Linnæus, and the *Macrochloa tenacissima* of Kunth (see Appendix A); and its name in colloquial Spanish of to-day is *atocha* (feather-grass or bass-weed), or *raigon* (a large, strong root).

Its Appearance and Growth.—It grows in root-clusters from two to ten feet in circumference; and channels between these clusters carry off to the nearest outlet any excessive wet from rain or melted snow. The leaf—the part utilised in trade—grows to a length varying from six inches to three feet. A southern aspect insures the finest fibres; less genial quarters, and a higher altitude away from the coast, produce the larger and coarser qualities. The leaves are from one and-a-half to four millimetres† in diameter, and, though flattish during growth, when they ripen they become dry and closed, with the even, filiform, rushlike appearance by which esparto grass is ordinarily known in trade. They are smooth, and very tenacious, and there is a joint or articulation, called the *una* or "nail," where the blade meets the stem.

The Atochon.—The name *atochon* is given to the junction of the annual growths on leafy stems of the plant with the perennial stock that forms its base. This stem is also cylindrical, and, though without knots, it is covered with short hairs, making it rough to the downward touch. The *atochon* first appears in December or January, and continues growing till spring, when the ear shows itself. This grows to upwards of four and a half feet in height, makes an excellent and favourite food for cattle, and in years of scarcity is used for that purpose. The flowering follows in April or May, the ripening in May or June, the falling of the seed in June or July, and its germination in the autumn following. Seed is produced for the most part annually, and its quantity depends much upon the rainfall.

Early delicacy—Period of growth.—The young seedling is very delicate, and easily killed by late frosts. For the first two years the early growth is scarcely perceptible; even at the end of that time it is hard to distinguish variety of species; and the process of growth continues for no less than 12 or 15 years, at the end of which period, and not till then, the plant will begin to produce serviceable esparto. It may then improve and develop, under proper conditions, up to a great age.

Climate.—The best climate for its growth is that of the sea-coast, and at moderate altitudes. Whether the merit is due to iodine or to chloride of sodium, or to a combination of such chemical influences, the fact remains that no situations can compare with those on the coast. Here is found the fine, short, even esparto, so much prized by the paper manufacturer, a fibre of such sound quality as even to suggest the inquiry whether it might not be turned to use for textile purposes as well. Sunshine is as useful as sea-air; and shade proportionately hurtful.

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* Pliny (*Hist. Nat.* xi. 8) mentions whole districts of *spartum* (*spartaria*) in Spain. Columella (ix. 4) notices the plant, together with the arbute, as bad to gather honey from. Pliny again (xix. 7) lays it down as his opinion that *spartum* was first brought into Spain from Africa by the Carthaginians, under Hannibal, B.C. 216. This was most probably a guess of his; and there is no reason to suppose that the plant was not indigenous on both sides of the Mediterranean from a very remote date. [See further, Appendix B.]

† ·16 inch.

Inland Districts compared with Coast Lands.—It must not be supposed, however, that the sea-side position, though invariably beneficial, is indispensable. Equally fine growths, though with a longer leaf, occur in good inland situations, the difference being one of relative proportion. On the sea-coast the whole of the esparto grown is the short, finely-fibred grass; in the interior, this prime sort will form one-half, and sometimes no more than one-fifth of the whole. The very coarse and rank growth that now and then finds its way into the market is, in reality, nothing more than the cleaning of old esparto lands, newly brought into cultivation. These very lands, after a few years' proper care and harvesting, will yield as fine a quality, though with a longer leaf, as the districts on the coast.

Soil.—Esparto is sometimes found in a thinly-coated, stony soil—sometimes in sandy. It prefers lime and chalk, and never reaches perfection in clay. Depth is not necessary, nor richness; though it must be remembered that esparto has hardly yet been tried in rich soil, having been regularly stubbed up to make room for cereals or other more profitable crops in lands rich enough to bear them.

Garbillo.—The short, and sometimes discoloured, esparto of the coast is, from its fineness and tenacity, the first favourite in delicate manufacture; but the long, handsome, gold-coloured esparto of the interior is a good competitor even for delicate uses, and commands a higher price for other purposes. The name given to this quality is *garbillo* (sieve), the sieves for cleaning grain being made from it. Through Antwerp and Hamburgh it is largely introduced into Germany, where it is used for basket-making and other purposes.

The Esparto Zone.—The esparto zone may be said to run from 32° to 41° north latitude. This includes the southern part of Spain and the northern rim of Africa. In one shape or other the plant is indigenous throughout this zone, at altitudes ranging from the sea-level to about 3,000 feet above it.

Principal Districts.—The esparto proper, so to speak, is indigenous to Spain, and is found in the provinces of Guadalajara, Toledo, Ciudad Real, Albacete, Cordova, Jaen, Grenada, Almeria, Murcia, Alicante, Valentia, and Baleares. The largest quantities are found in Almeria and Murcia. Though the northern belt of Africa, and other parts of the Mediterranean coast produce the plant, as has been remarked, in various forms, it is remarkable that Italy, resembling Spain in so many of its features, is almost entirely destitute of it.

II.—Time and Mode of Harvesting Esparto.

July the Earliest Time.—Full-grown in July, especially in the most sunny localities, esparto should never be collected earlier than that month. Even then it is not always practicable to gather it, as labour will be often pre-occupied by wheat or other crops. The general collection of esparto is thus rarely organised before August, from which date until the end of October harvesting may proceed with perfect safety. If, from scarcity of hands, or want of means, the process should be run on—as is sometimes the case—until a considerably later date, very serious injury and deterioration of the plant will follow, on which subject more will be said presently.

Operation of Pulling the Leaves.—The operation of harvesting is not performed by mowing, but by pulling the leaves from the *atocha*. When fully ripe, between July or August and October, the leaf, with a steady pull, quits the *atocha*, which it leaves uninjured in the ground, ready to send forth its shoots in November or December, for the growth of the following year.

Various Methods.—The pulling of the leaf is accomplished by various methods. One is by means of a short, drumstick-shaped piece of wood, named *arancadera* or *cogedera*. This hangs suspended by the handle from the harvester's shoulder, waist, or wrist. With his right hand he lays hold of the tops of the esparto and twists them round the pointed end of the drumstick, upon which, with a sudden upward and sideward pull, the esparto leaves are torn from the *atocha*, and left collected in the left hand. After practice, this operation is performed with great quickness and dexterity. A second method is the use of a flat piece of leather, hung by a short cord from the wrist, and manipulated much like the drumstick. A third is by the hand only, protected from injury by a leather covering. As soon as the left hand has collected as much as it can grasp between the index-finger and the thumb, the bundle is secured by a turning of its own leaves, and laid on the ground to dry. Every two of these bundles make up a *manada;* ten or twelve manadas make a larger bundle, or *hace;* and every three of these make a *carga*, or donkey-load. The carga, when dry, weighs about 8 arrobas (2 cwt. 24 lbs.), and is the acknowledged measure by which esparto is bought in the interior.

Dry Weather Essential.—The harvesting should never go on except in dry weather. Rain makes the articulations connecting the leaves with the *raigon* grow softened and swollen, so that they resist the pull with tenacity. At the same time, the ground has grown so far soft that it allows the root to be torn up by the pull, which naturally results in extermination to the plant and annoyance to the paper-maker, who finds a material weighed with his esparto, and yet constituting not only a loss in itself, but an expense in separation.

III.—Estimated Quantity of Esparto at the Time of its First Use in Paper-making. Local Uses. Rapid Deterioration of the Plant through a want of Sound System when the Demand Suddenly Rose.

After an infinity of pains, it is but an approximate idea at best that can be formed of the total quantity of esparto existing in Spain at the date of the first demand for paper-making. It will, however, be probably near the actual fact to conclude that, in the provinces mentioned above, an aggregate equal to about 220,000 tons of esparto must have been growing at that date. Of this quantity, the home requirements at that date probably did not exceed 25,000 to 30,000 tons, leaving a surplus of 190,000 for export. Of these 30,000 tons, fully 15,000 were supplied to the towns and villages along the coast for manufacture into ropes, yarns, mats, sandals, or baskets. Most of these articles would find a subsequent market in Madrid, or elsewhere in the larger centres of industry. Crevillente is a sort of seat and focus of esparto mat-making. A certain portion of the produce would also be sent unworked up into Madrid, especially from the provinces of Toledo and Guadalajara, to be used for mat or basket-making on the spot.

Low Cost at that Date.—It is worth remarking that the cost of esparto at this time consisted mainly in the labour of collecting and in transport; and, as the esparto grounds were then in close proximity to the coast, the average price seldom exceeded 25s. to 35s. per ton, of which sum from 2s. 6d. to 5s. only were paid to the proprietor as value for the crop.

Vast Extent of Waste.—Of the 190,000 tons remaining uncultivated and valueless, vast quantities were allowed to rot in the ground. The remainder was grubbed up, partly to make room for cereals, partly to serve as thatch for dwellings, wheat-stacks, and farm buildings, as fuel for the oven, or in place of sods for embankments. Such embankments would be used, especially in the neighbourhood of the mountains, to protect fruit trees from any sudden flow of water, or to retain water on a district, and prevent its outflow until irrigation is complete. Even now, when the value of esparto has so greatly increased, the right of grubbing is looked upon in some localities as a tenant right, and exercised to the rapid extinction of the plant. At the time now mentioned, however, the grubbing which was then in vogue did not prove so hurtful as might have been expected. To save labour the inhabitants chose the easiest plants to extract, that is, the oldest, and left the young and healthy specimens in a much-improved condition, through the loss of their dead or decaying companions.

Rise of Double Cropping.—At the date in question, the esparto wanted for home use was regularly harvested, one crop only being pulled in the year, and that at its proper season. But from the day when the first sudden demand was made for English paper manufacture, the whole system became disorganised. Instead of going back at once to dormant lands in the interior, the collectors called on the coast lands to give double crops.

Vicious Effects of Reckless Harvesting.—The second crop was premature; it yielded an ill-grown, fibreless esparto. The roots were often torn up with the plant during this second and unseasonable gathering, and a zone which at that time gave the finest esparto in the country is now as bare as if the plant had never existed upon it. Driven from the lands which their own avarice had destroyed, the collectors were now compelled to go further into the interior, at an increase of cost for transport; and here they worked over again the damage done to lands near the sea. In particular, the districts in the Sierra de la Almenara and Campo de Lorca present to-day a deplorable contrast to the flourishing state in which they were only a few years since, when the harvesting was regularly done, and before the vicious practices had set in, owing to the want of foresight in meeting the suddenly increased demand.

Double-cropping not in itself Injurious.—The mere fact of a double-cropping is not injurious, however, provided the operation be carefully and judiciously done. It is the abuses committed by careless and hasty harvesters that do the mischief, and a few simple considerations will make this clear. The same cluster of *atochas*, as they to-day exist, do not send forth their leaves at precisely the same time. The shoots from some atochas in the cluster, more favourably circumstanced than the rest, will make greater progress in their growth, while others, from adverse causes—whether in cultivation or harvesting—will be retarded. Hence, in July and August, when the whole crop ought to be—if well managed—of the same length, ripe and fit for harvesting, rarely more than one-third has attained its full-length and maturity; a second third will have accomplished two out of three parts of its growth; the rest will be scarcely or even less than half-grown. By harvesting all the crop indiscriminately, injury is done both to the plant and to the crop—to the plant, from loss of juices consequent on the forcible tearing of the leaves from the *atocha*, or the actual uprooting of the *atocha* itself, from the harvester's endeavour to tear the young and immature esparto from it; and to the crop, from a sappy and fibreless esparto, with the roots attached, forming the centre of every *manada* that is gathered, to the discredit of the shipper and the loss of the manufacturer.

Judiciously and carefully to make two collections from lands thus circumstanced would, so far from injuring, foment and improve them. On the other hand, to defer harvesting till all the leaves were ripe, would involve obvious damage.

If collection were thus postponed, all that portion of esparto which had first attained maturity would die, and, by entwining itself amont the *atochas*, would choke the young growths, and retard the development of the plant. The true method, then, in order to bring neglected or ill-used lands into an efficient state of cultivation, is to have two collections, with proper supervision and trustworthy labour, for the first two or three years; and, after a little time, the esparto getting into a more healthy and vigorous state, will shoot simultaneously, develop and ripen in the same way, and produce a full, even, heavy crop in the proper season. Trustworthy supervision is everything in these collections.

Care and proper supervision essential.—Shortsighted and avaricious producers make rough-handed and reckless harvesters, who gather the growing, the ripe, and the dead indiscriminately, and tear the leaf from the root, and the root from the ground. The wise and sound superintendent will see that the harvester takes hold only of the tops of the long esparto standing up among its fellows, leaving the medium for the second gathering in February and March (if dry), and the short to come in with the July crop in the autumn following.

Tendency of the plant to decrease without careful cultivation.—It deserves especial remark that the produce of more than one hundred esparto lands, harvested by the writer in the year 1868, showed an alarming decrease in the quantity from that which they produced the year previous; and, in one instance, an area that in 1865 gave a crop of 500 tons, only yielded 300 in the year referred to. It may also be remarked that a small *coto* of about 500 acres, the property of the writer, and on which most of the experiments presently to be mentioned were made, shows an annual decrease in the crop of from 2 to 7 (and in some cases even 10) per cent. This is a crop harvested with due care, but without propagation or other cultivation being brought into play. Unless private enterprise steps in, or legal enactment is made to operate, there can be no question that the lands will steadily degenerate, and the plant will vanish away. Yet it is incontestible that, with ordinary propagation and cultivation, the plant can be not only well preserved, but so fostered that it reaches double, treble, and even quadruple its ordinary produce.

So far, the main causes have been examined which occasion the destruction or serious injury of the esparto plant. A few general remarks will now be offered, based on a practical experience of several years, on personal tests and experiments, and on information gleaned from the most observant of the farmers, and bearing on the best methods of preserving the existing esparto, as well as of fomenting and increasing its growth.

IV.—Practical Suggestions on the Best Mode of Preserving and Propagating Esparto, embodying the Result of Personal Experience and Inquiry throughout the Zone.

The comparative neglect of esparto, or positive prejudice against it, for a long period of time preceding its adoption as a paper-making material, and the extraordinary apathy of owners even since that date, render it peculiarly difficult to get at what may be called the traditionary treatment and management of the plant. When we recollect that esparto is a plant which has now for fifteen years or more attracted a large share of attention, that prices were rising, and the plant well understood to be decreasing, or tending to decrease, in all the districts of its growth, such apathy is, to say the least, surprising. It is, however, a fact; and it forms the writer's chief apology in putting forward the results of his own personal experiments, though he is bound to add that these results have been confirmed by later observation in each case, and by information received from the most enlightened cultivators throughout the esparto zone. To preserve to the paper-making trade a most valuable material which is threatened with extinction, to develop its growth, and promote sound culture through the large belts of land which it now occupies, have seemed to him fit objects of arduous enterprise and minute inquiry.

Three Possible Methods of Re-production.—Esparto is reproduced by three methods—by seed, by transplanting, and by the peculiar method of burning the old *atochas.*

In raising the plant from seed, a decided preference must be given to hand-sowing.

A.—Raising the Plant from Seed.—The precise periods for seed-collection differ according to altitude, and to the degree of exposure in lands. The coast lands will be ready by the month of June; those further back, not till July; those lying high, and furthest inland, not till August, or even later. Great nicety is required in hitting the time for seed-collection accurately. If gathered prematurely, the seed will be useless; if the right time is allowed to pass, there will be no seed to collect. A roughness to the touch, when the fingers are passed lightly over the ear, is the surest indication of the proper season. The ears can then be cut, and when they have been dried in the sun, the seed can be separated either by hand, or—when large quantities have to be dealt with—by fluted wooden rollers. Care must always be taken to have it stored dry, and, when properly secured from damp, it is believed that the seed will retain its generating powers for an indefinite number of years. In September, the ground destined to receive the seed should be prepared either by light ploughing, or, in some localities, the simple moving of the surface by an English harrow will be found enough. No great increment of earth is required beyond what suffices to cover the seed.

Time of Sowing.—The best months for sowing are October and November. In these months the rainfall, which is essential, may be most surely reckoned on, and the mid-winter season is too cold for the seed when sprouting. In certain localities, also, it will be found desirable to protect the seed, when sprouting has commenced, by a covering of some kind, as its delicacy requires precaution against any extremes of cold. Immediately after sowing, which should be done with even regularity, cattle may be turned with advantage over the ground, and will suffice to tread it into the soil; or bush-harrows and rollers may be used, the latter being recommended where the cold is likely to be severe. The *atocha* will begin to appear only in the second year; after that time, however, with proper attention, it will slowly develop until the tenth or fifteenth year, when it ought to begin to be productive. The quality of esparto, however, produced at this early period is of such a nature that, were it not for injury done to the *atocha*, it would be advisable to leave it ungathered, as the actual value would not be sufficiently in excess, speaking generally, of the cost of production. To leave it, on the other hand, would cause the *atocha* to rot; whereas regular pulling from the first period of production strengthens the plant, increases the growth, and ensures a clean, healthy, thickly-grown crop of esparto for the future. After four or five years' growth, the clusters of *atochas* will require thinning, and they should again be separated or weeded out in the eighth or ninth year of progress. By this means the early and seasonable development of the *atocha* is fomented and stimulated very beneficially; more room is left for its expansion, the disturbed earth forms a serviceable re-dressing, and sun and air are freely admitted. It is true that this operation, simple as it is, involves an expenditure of some moment, when carried on over lands so wide as the esparto districts. The great benefit, however, secured to the *atochas*, and the fact that the cheapest labour, such as that of women and boys, is amply sufficient for the purpose, justify the outlay. The advantages of thinning may be tested by observing that the best and healthiest esparto will be uniformly found on the outer circle of patches, or, in short, wherever the roots have had full room to grow, and where the sun has most effectually reached them.

B.—Mode of Transplanting.—The mode of transplanting is as follows:—An entire *atocha* is taken up, any separation of the roots being carefully avoided in the process. It is then divided into four, six, or more portions called *golpes* or *pellas*, which are placed one by one in the holes dug to receive them. These holes should be about 20 × 20 × 20 centimetres* in size, and separated from each other by an interval of at least 60 centimetres.† The *golpes*, when placed in the holes, should be covered well over with earth, which should be thoroughly pressed down by a hoe or by the feet, as it is an important point to secure the roots against the influence of the outer air. The best season for transplanting, like that for sowing, is early autumn; if the frosts have once set in the labour of weeks may be lost in a night, and the *golpes* may all be found dead in the holes. Transplanting may also be carried on in spring, but only if the rainfall has been sufficient. The necessity for rain makes it desirable in the ordinary season to open the beds early in September, so as to be ready for the first fall of the autumnal showers, which are beneficial both to the plants and to the earth with which they are afterwards covered, and which is most servicable when thus thoroughly moistened beforehand.

C.—Method of Burning.—By the third method of reproducing esparto, the growth is not only stimulated but the lands are thoroughly cleaned and kept in a healthy condition. This is the method of burning the old *atochas*, the double advantage of which process, to both plant and soil, is very marked. The old *atochas* are fired after the esparto has been collected, and they will then be found to send out new shoots, whose vigour and vitality are so great that they will continue to supply a yield of the finest quality during many years. But though leaves will be thrown out immediately after the burning of the old growths, yet the esparto will not have attained the proper length until the fifth or sixth year succeeding the process. As in the case of the seedling plants, the leaves should be, after the first two or three years, collected annually, in order to prevent decay in the calices on the *atochas*, to the prejudice and rapid injury of the plant. This strong stimulant of burning, though its first mention is sometimes heard with surprise, is in accordance with what is observed in wild, natural growths after such a conflagration as a prairie fire; and it must be remembered that the ashes form a highly useful manure. The process, in various applications was familiar to the ancients, and is mentioned with strong approval by Virgil (Georg. i. 84). The method can obviously not be applied upon new lands, but there is none so effectual for cleansing the soil and stimulating the plant upon old ones, and the *atochas* so produced will, there is reason to believe, be quite as healthy and long-lived as the seedlings.

Comparative Estimate of the Three Methods.—In comparing these three methods of reproduction, it will be observed that sowing has one rather serious drawback. Twelve years, on the average, are required before the seedling plant will produce serviceable esparto. The risks of frosts during the early years of growth are also formidable; but, on the other hand, sowing is a less costly and more simple operation than transplanting. The transplanted esparto begins to be abundantly productive in the sixth or eighth year after removal; and, when once the removed plants have taken well to the soil, there is nothing further to be dreaded from the operation of cold. The process is, notwithstanding, a costly and difficult one, and labour is not always to be reckoned on at the proper time, while a want of due care and intelligence may neutralise the advantages which otherwise ought to be secured. Excepting, therefore, in some localities subject to stormy winds and steady frosts, sowing is to be preferred to transplantation. On new lands, it is obvious that one or other of these methods must be adopted, but on old lands burning is comparatively better than either for stimulating, improving, and increasing the growths. Perfectly simple and economical, and guaranteeing, as it does, a closely-cropped field of good esparto in the fifth or sixth year, this process combines the advantages of the other two without any of their disadvantages. All that is necessary is to isolate the portion to be burned from the rest of the field, and to place a few men round the extremities to cut the fire off from extending. The esparto having been already pulled, the *atochas* will burn but slowly, and the most ordinary care will effectually prevent all danger. These advantages, coupled with the value of the ashes and the speed of execution, justify the selection of this as the best and most feasible method of reproduction.

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* 8 inches. † 2 feet.

The total want of skilled observation before the use of the plant in paper-making, and even of much concentrated attention to it since then, makes it difficult to pronounce with positive accuracy on the period to which an *atocha* will live in a healthy and productive state. But the general verdict of the most experienced among the farmers is, that an *atocha* produced by accidental fire may be regarded as likely to yield good esparto for fifty or sixty years afterwards. Assuming this estimate to be correct (and there is the best reason for relying upon it as a basis of calculation), it would be the worst economy to postpone burning till the end of that period, when the plant would have exhausted itself, and when, for five or six years afterwards, the lands would necessarily remain unproductive. Equally mistaken would be the practice of burning irregularly such portions as seemed most to require it at the time; for an unusual drought, or other vicissitudes, might cause appearances to be misleading, and the burning would frequently be applied at the wrong time. The soundest method would appear to be the following:—

True Method.—The land under treatment should be divided into as many portions as there are years in the life of an *atocha*, namely sixty. Commencing with the worst, one such portion should be burned each year; and, remembering that *atochas* so burned become reproductive in the fifth or sixth year afterwards, it follows that no more than six of these portions, or one-tenth of the whole, will ever remain unproductive at the same time; while the plants throughout the entire district would be kept regularly renewed, and the land effectively cleaned.

These portions should be isolated by removing stray *atochas*, so as to secure lanes between the divisions, which would be doubly useful, as the lanes would serve as checks to the fire, and as mule-paths for the removal of the crops. Quadrangular plots, with the length equal to three times the width, and varying from ten to a hundred acres each, are, from experience, recommended as the most convenient form for the portions to be treated in rotation.

Triple Gain of Burning.—The process of burning ensures a triple gain to the plant. It destroys the old worn-out *atochas*, which cramp growth and prevent free circulation of heat and air by twining round the healthy plant, and it removes these effete growths without injury to what is left. Next, it cleans the roots of the young plant, and frees it from foreign vegetation, which at once gives way before the fire. And, lastly, it supplies a stimulus to this young plant, by means of which more shoots and healthier ones are thrown out than would otherwise be the case. Add to which, that all this is done coincidently with the use of the destroyed matter, by way of an efficient manure for sustaining the plant in the exertions to which it has been stimulated.

Best uses of Sowing and Transplanting.—As the burning, however, can produce no *atochas* on ground where none exist beforehand, it follows that sowing and transplantation should be brought into play, so as to fill up the large unoccupied portions of land between the *atocha*-clusters. This might advantageously be done in the same autumn on the approach of the first rains after the burning. And thus the lands might be brought into a state of advanced and thorough cultivation, so as to present the well-cropped and even appearance of our English cornlands, instead of being, as they now are, barren, arid tracts, studded here and there with clusters of *atochas*, which resemble so many clumps of rushes when seen from a distance.

It is hardly necessary to add that the rate of produce would rapidly increase. There is not the least exaggeration in saying that land, now producing from a quarter of a ton to one ton per acre, would readily and easily be made to yield three tons and upwards per acre under the modes of treatment which have been described.

It was stated, early in this paper, that the total amount of esparto growing at the time of the first demand for paper-making, might be estimated at about 220,000 tons or upwards. It must, however, be recollected that the frequent extermination of the plant, and the disastrous abuse of lands by forced cropping, have reduced this total so far that it is doubtful whether more than 150,000 tons could be to-day mustered from all sources. Could it have been foreseen twelve or fifteen years ago that a demand of 1,000 tons, in 1860, would rise to 140,000 for 1871, lands could have been secured in perpetuity, or on long leases, by properly working which, the produce of 10,000 tons might have been raised to 20,000 off the same lands, at a cost of no more than £2 5s. at the port of shipment; and this, too, without the smallest detriment either to soil or plant. And larger tracts, capable of yielding the total of 140,000 tons, might also have been secured, off which the cost (including increased price of carriage over an extended area) would not have exceeded £3 5s. per ton.

Compare these prices with those which have been ruling during the last few years—£5 to £7 and upwards at a port of shipment in Spain, and £10 in England—and it will be clear that, in the strictest commercial point of view, the gains would now be averaging an enormous annual sum.

Concluding Remarks.

Enough has now been said to justify the drawing together in a brief practical summary the conclusions which naturally arise.

The idea must, first of all, be entirely and absolutely got rid of that, because esparto is indigenous, it is therefore inexhaustible. Once destroyed, it can be reproduced only with great care, and it becomes remunerative not until after the expiration of many years.

Further, owing to vicious modes of harvesting, a regular decrease has taken place annually and is still going on, which, if not checked, must end in the extermination of the plant. As yet, this decrease has not attracted notice, because the demand has not yet risen to the point of exceeding the supply. The greatly augmented prices are, however, when properly considered, a grave indication of the havoc which has been worked in the lands near the coast, and of the consequent retirement to lands in the interior, which, in their turn, will become ruined, instead of being made permanently productive, unless sound methods supersede the vicious ones now in vogue. Nor, again, will the fresh fields of Tunis, Algiers, Morocco, and other countries to which it is indigenous, suffice to supply a demand so necessary as that which exists for esparto, unless means be taken to preserve and foment the growth of that now in existence.

Interest of Paper Trade in combining to check Destruction and promote Cultivation of the Plant.—The paper trade of this country has a direct interest in providing that some such simple and practical processes of cultivation and conservation of produce, as have been described in this paper, should be adopted, and their working secured. And it becomes a question of pressing importance whether steps should not be promptly taken, and the lands now so recklessly treated by proprietors and harvesters be secured in perpetuity, or on long leases, at prices which even to-day might be obtained, as by these measures, a result, ample and satisfactory, would, beyond question, be realized. It is only necessary to assume that lands capable of producing 70,000 to 100,000 tons could be obtained at the cost of £6 per ton, when the article is delivered in England; and a margin of £1 per ton, or a total of £70,000 to £100,000, is the least return that could be looked for when, as has been stated more than once, the current price in this country has been at £10 per ton.

But it must once more be repeated, and in the present paper it has been shown, that by the methods proposed the returns would tend to a steady increase, instead of involving, as they now do, a fatal deterioration and wasting in the very source of supply.

Importance of the General Subject.—The case is, then, submitted for intelligent and practical consideration. No detail has been conveyed which has not been the direct result of the author's personal experience, or of long and careful inquiry and observation during many years' residence in Spain. He believes, in conclusion, that, looking to every ordinary principle of sound economy, and to the almost incalculable consumption of paper in this country, with no symptom or probability of decrease, that the subject to which he invites attention merits the best consideration from the commercial world, and from intelligent observers generally.

Appendix.

A.—Kunth (*Enumeratio Plantarum*, vol. i., part i., p. 179) gives esparto the name quoted in the text, and adds the description of Linnæus, *aristis basi pilosis*, *panicula spicata*, *foliis filiformibus*. In Murray's translation of Linnæus' *Systema Vegetabilium*, 1783 (vol. i., p. 193), this description is rendered thus :—" Awns hairy at the base, panicle spiked, leaves thread-formed." Kunth mentions Spain, Greece, and Barbary as the three localities of the plant.

B.—Pliny (xxiv. 40), denies that the *spartum*, which was mentioned in Greek writers, had anything to do with the esparto of Spain or Africa (*Africanum vel Hispanum spartum*). The Greek material he holds to have been identical with flax (*linum*), and understands in this way the passage in Homer (Iliad ii., 135), where the very word occurs for the cables of the ships :—

Καὶ δὴ δοῦρα σέσηπε νεῶν, καὶ σπάρτα λέλυνται.

" The timbers of the ships have rotted, and the *cables* have grown slack."

DISCUSSION.

In reply to questions from the Chairman,

Mr. Johnston stated that the esparto might, he believed, be cultivated very readily in any country within the zone named in the paper, provided it was not at too great an altitude, nor too distant from the sea, and that the plant had plenty of sun, and the free circulation of air about its roots. As regarded India and our colonies, there was nothing whatever to prevent its cultivation there ; but the question would arise as to the cost of carriage, which would, he was afraid, prevent any esparto produced in those countries, or the corresponding zone in America, being available for the paper trade of England.

Mr. Hyde Clarke said Mr. Johnston had so well developed the subject, that probably his paper would form a model and exemplar for the use of persons in other countries, in the more extensive cultivation of this plant. Upon hearing of a paper of this kind, it was natural to apply one's own knowledge and observation in districts to which cultivation might be extended, and as it was stated that this plant was perfectly associated with the Mediterranean region, having been known there from all antiquity, and flourishing on both shores at the same time. It had been pointed out that, as regards a commercial supply, it only came at present from Spain. It was not cultivated either in Italy or in Greece, and although it might be desirable to call attention to the latter country as a field for its growth, it might be doubtful whether, from the formation of the Morea, it offered the same advantages as the coast of Spain. However, it was the duty of the Society of Arts to carry forward, if possible to a practical result, the suggestions of such a paper. This had been done with other matters, and had been the means of affording great benefit to the colonies and foreign countries, as well as to the trade of this country; and, with that view, he would suggest that some of the regions of Asia Minor appeared likely to afford a field for the cultivation of this esparto. If inquiry were made, it would be found very probably that it was an indigenous plant. Even if it were not indigenous, however, it would be highly desirable that experiments should be made, and if it were thought right by the Council, as he hoped it would be, to take action on the subject, the Ottoman government might be appealed to, and he thought they would cause research to be made for the purpose of ascertaining whether anything could be done. By the action of the Cotton Supply Association, the Ottoman government were induced to extend the cultivation of that plant, the effect being a large increase of revenue, not only to its subjects but also to itself. The nature of the country on the coast of Asia Minor particularly resembled those districts in Spain which Mr. Johnston had said were most suitable to the cultivation of this plant, and the seasons and the period at which a supply of labour might be obtained were also particularly suitable. The population were interested in all agricultural pursuits, and, whenever they devoted themselves to it, capital would easily be found on the spot, while there was more intelligence amongst the population, both Mussulman and Christian, than was generally supposed, and the state of cultivation was in some places almost as forward as in our own orchard districts. It might not appear so to the casual traveller, simply because the corn crop always lay without enclosure, and was not much attended to, but that was because it did not form the most remunerative crop. It was to the crops of cotton, opium, and those articles which went to the foreign markets that attention was most directed. He hoped the Society would give some attention to this subject, and that some practical measures would result. For instance, the government should be addressed, and if the Minister of Agriculture had suitable representations made to him, he would cause experiments to be made, and the local authorities in all suitable districts should at the same time be stimulated, and their attention called to the matter; in fact, the same measures should be taken which were adopted with regard to the cotton cultivation, and which had been so useful. The Society might also, he thought, very usefully address Her Majesty's Secretary of State upon Foreign Affairs, sending in copies of this paper, and requesting that they might be placed in the hands of English Consuls on the coast and in the islands, with a view of calling the attention of the local authorities to the subject ; for it was not desirable to rely too much on the central government, which, like all other authorities in such a position, had a great deal to attend to. The Turkish government had of late been pursuing a policy of decentralisation, and giving considerable powers to governor-generals and local councils, for the purpose of encouraging agricultural improvement. In addition to the coast line, where the suitable conditions of air and climate, which Mr. Johnston had mentioned, were to be obtained, there were several of the islands which seemed likewise very suitable, such as Cyprus, Crete, Mytelene, Samos, and Scio. Tunis having been mentioned as a country producing esparto, he thought the Ottoman government might also stimulate the government of Tunis to encourage the cultivation. Now, if that friendly relation had been opened between the two states—one reason especially why the Society might with advantage take steps in this matter, was that there was no commercial organisation on the spot to which direct application could be made, for although Constantinople and Smyrna had such a great trade with this country, there was not a Chamber of Commerce in either port. On the other hand, if the matter was once put in train there was an ample supply of capital to carry it out. Individually, as a friend of these countries, he desired to express his obligation to Mr. Johnston for the clear manner in which he had described the process of cultivation, and he thought if it were translated into Turkish it would be very useful.

The Chairman said he had understood that the *Chargé d'Affaires* at Morocco, Sir John Hay, had pointed out that esparto was cultivated there, but he should like to know what quality was produced.

Mr. Johnston said it was many years since he was in Morocco, but, according to his recollection, the esparto grown there was of a rank, coarse description, and the quantity coming from there was at present comparatively small. No doubt the country was equally suitable, and the culture might be considerably extended.

Mr. Routledge said he had been identified with the introduction of esparto from the commencement, and could endorse all Mr. Johnston had said with regard to the growth of the plant, and much of its cultivation, but he could not speak as to its growth from seed; it only having been introduced some ten or twelve years ago, he did not think any paper-maker could speak to that point. Probably Mr. Johnston had got his information from people in Spain.

Mr. Johnston said he was much indebted to many of the most intelligent of the farmers and others in Spain, for the information received from them, but more in confirmation of his own personal experiments than otherwise, so little attention having been given to the plant that it was not in every instance reliable. His experiments with regard to propagating from seed, though not extending to the entire period of fifteen years, have, nevertheless, extended sufficiently far back to enable him to arrive at that conclusion. He had, for instance, now growing upon his own property plants raised from seed six years ago, and which were yet very far from being in a condition to produce serviceable esparto. He had also on the same property plants which, six years ago, presented the same appearance as the plants then sown now do, together with others of intermediate ages. He had, besides, had ample opportunity, and a wide field for observation, throughout the very extensive districts harvested by him, the result of which, confirmed by the most reliable and observant of the farmers in the district was, that esparto produced from seed will not, even under the most favourable circumstances, produce a full, serviceable crop till the twelfth or fifteenth year of its existence.

Mr. Routledge said he could not speak as to that, though he could as to improvement by transplanting and burning. It was vastly improved, and no doubt it could be propagated in the way Mr. Johnston had represented, and there was no doubt it would be a great advantage to the paper trade if the quantity could be increased. He could also speak as to its being almost extinguished in some districts, for last year he passed through a district which now represented by hundreds of tons the quantity which, ten years ago, was represented by thousands; in fact, large portions had been entirely laid bare, and the gatherers were thus driven farther into the interior, which caused the present high price, for this depended mainly upon the cost of carriage and collection. Up to 1861, he was the only person who used esparto in England, and then it was laid down for shipment at 30s. or £2 a ton, and could be sold for £4 here with a very fair profit. Gradually, as it got gathered, it became scarcer and dearer, until it reached its present price. Then Africa was pointed out as a field, and for the last seven years it had come from Morocco. He feared, however, that in Algiers, Tunis, and Morocco the plant was deteriorating, in consequence of its being pulled up by the roots, as had been so much the case in Spain, and unless fresh districts could be opened out, the paper makers would be positively suffering from a dearth. He fancied this year about 150,000 tons would be used, and what paper makers would do without it was very difficult to say, because it was calculated, by those who professed to know, that the consumption of paper had doubled since 1861, it being then 110,000 tons, while in the present year it would be over 200,000 tons; in fact, without esparto, paper could not be made. Rags had increased in quantity and diminished in price, whilst esparto had increased enormously in quantity and also increased in price—in fact, it had now found its level, and it really ruled the market, for esparto was being quoted against rags for price, though he remembered the time when he was laughed at for attempting to introduce it. There were several circumstances which tended very much to increase the price of esparto, some of which were not generally known. The principal one was that of freight. There had always been considerable freight to Spain for coal and coke for smelting the lead ores of that country, and most of the large ships engaged in this trade had to return in ballast, or go to seek a freight. In 1861 and 1862, from 9s. to 11s. a ton was the average price for bringing esparto, but it now averaged from 25s. to 28s. Shippers, therefore, had been enormously benefited by the trade. This, he believed, would be a great difficulty in the way of the scheme proposed by Mr. Hyde Clarke for cultivating it in Asia Minor. He (Mr. Routledge) knew nothing about that country, except what he had read, but he believed there would be a difficulty in bringing it to England. The peculiarity of the esparto trade had been, that there had always been a necessity for Spain to have coals and coke for smelting the lead ores, and now for her railways and iron smelting; and the vessels taking these cargoes, bringing back the lead ore, were obliged to pay 3s. or 4s. per ton for getting in ballast, and they were therefore, glad to bring esparto back for nominal freights. There was one difficulty he should like to have heard Mr. Johnston allude to, with reference to planting or reproducing esparto in any of the districts where it had been destroyed, and that was the peculiar tenure of the land in Spain. He thought this would be a great difficulty. In many parts the land was held under a very peculiar tenure, what might be called communal lands, belonging to the community at large; and, as Mr. Johnston had remarked that esparto had lately much increased in value, that land became very valuable, and after a certain time the government laid claim to many of these lands, and he fancied they would now endeavour to drive hard bargains with parties who wished to take land for growing this plant. The communal lands also presented many difficulties. No doubt private enterprise could do a great deal, but these were some of the difficulties that would arise, even putting aside the great length of time for sowing or propagating by transplanting. As to the importance of the esparto plant, there was nothing in the range of fibres that could touch it, even at the present price, for the purpose of paper-making, considering either quality or value. He had seen most of the fibres that came into England, and none of them could compete with it practically. Wood pulp was now used to a considerable extent in the shape of powder; indeed the cheap newspapers could not be produced without it, inasmuch as they could not buy the paper at the price at which they sold it. Still he looked upon it as an adulterant, like China clay, which was technically known as Devonshire linen. The time, however, might come when it would be produced in such a form as really to make paper, and it had almost arrived already by a process of boiling. In speaking of fibres, however, he referred to what were technically called such, as, for instance, jute, hemp, flax, banana and plantain fibre. In that room he had shown a machine for producing pulp from these fibres, and, in 1856, he exhibited for the first time esparto in the shape of half stuff and of paper, and the *Journal* of the Society was printed from it. On the 26th Nov. the same year, Dr. F. Royle read a magnificent paper upon the textile plants of India, the walls being covered with various specimens, and some of the fibres were truly wonderful, but they could not be brought from India for the purpose of the paper-maker in England. Time had proved that some of these fibres, which were admitted on all hands to be the most beautiful textile fibres, had not come into use. The fact was they could not be procured in quantity. The China grass was a most beautiful fibre, and the same might be said of the aloe, the plantain, and others. In 1860, Dr. Forbes Watson—Dr. Royle having unfortunately died in the *interim*—read another paper, and he then showed the progress that had been made in making paper from esparto; but, in spite of that, there was not a paper maker in England who would look at it; they called it rubbish. At length, he was obliged to tell them to take the paper or leave it, not asking what it was made from, but simply whether it was of good quality. Then the American war broke out in 1861, and, owing to the short supply of cotton, esparto began to come into use. In that year there were about 8,000 tons imported; the next year, perhaps 12,000; in 1863 or 1864, upwards of 50,000 tons, and the Spaniards began to ask almost any price for it. Up to 1865, almost the only port from which it came was Almeira, but, driven by the necessities of the paper makers, he, with the assistance of some friends, opened up the Alicante district. The trade quickly developed, and a large supply was obtained. Being first of all driven to use it, paper makers soon found out its value, and that, when the proper method of treating it was arrived at, there was no occasion for the complicated arrangements for devilling, cutting, and sorting, as was the case with rags. Then the printers found it answered their purpose better, especially for lithography and woodcuts, giving a beautiful picture and showing the lines well. The result was that, with the exception of paper for bank-notes, ledgers, and such like special purposes, there was scarcely a paper maker in the country who did not use it. For brown paper, however, and casings, which were used to a large extent in the Manchester market, it was now too expensive, and the paper makers were crying out for some other material. As it appeared from Mr. Johnston's statement that it would take 15 years before there were any returns from planting esparto, he feared capitalists would not be inclined to it; besides, what were paper makers to do in the meanwhile?

Mr. Hyde Clarke said he had not forgotten the question of freight, which was a most important element in the cost of esparto in England; but he did not think there would be any difficulty on that score in Asia Minor; there was a large trade in corn there, and he saw no reason why there should be any difficulty with esparto.

Mr. Routledge said esparto occupied about three times the bulk of any other material, and therefore it could only come home at what might be called a ballast freight. A ton occupied about 180 cubic feet. He had spent some time in perfecting an hydraulic press, for the purpose of packing it, and a good many had now been sent out to Spain, and it was found that when the grass was baled, there was a great advantage, because if done carefully there was no damage, and it occupied only about one-half the bulk. It was the bulk, however, which would form the difficulty in bringing it from a country like Asia Minor, where there was no heavy article of commerce to mix with it as dead weight, as was the case in Spain, whence iron ore, lead, and manganese came in considerable quantities, though there was a likelihood there would not be such a demand for the latter, now that there was a magnificent process for making chlorine gas without it. From Greece there might be more opportunity, for there had been lately discovered a deposit of ancient slag, or regulus, at Agosterea, which had improved that kind of freight, because vessels going out from Newcastle with coke for the smelting furnaces, brought back the lead, and coming home touched at the Spanish ports and snatched a freight of this esparto grass, which, when baled, could be quickly put on board, which was a matter of considerable importance. In fact, even steamers could bring it home in bales. The freight was very much heavier from Algiers than from Spain, because hardly any coal or coke went there. There were hydraulic presses there, however, Mr. Lloyd having been the first to introduce them. It might be suggested, perhaps, that the foreigners should make the esparto into "half stuff," but that had been tried several times and failed, and he did not think it was likely to suceeed.

Mr. Hyde Clarke said he spoke from practical experience. He did not apprehend any difficulty in the directions suggested. The people in Turkey were not such savages as some persons imagined, and they had introduced cotton presses long before they were used in Algiers. There was not, it was true, much mineral produce, but from two of the ports he had named, at any rate, there was a trade in materials with which the esparto could very well be mixed. And there was hardly a port on the coast of Asia Minor not furnished with a regular line of steamers, Smyrna, the centre of trade, being a very great steam port. The same difficulty with regard to land would not be found there, for the government would be willing to grant a freehold title for such purposes as Mr. Johnston had described, if likely to be practically carried out. He spoke from personal knowledge, having been Vice President of the Government Land Commission, and having also held the same office for the Cotton Commission in Australia. It was some Englishmen from Spain who introduced into this district the manufacture of liquorice. Mr. A. O. Clarke, of Sokia, and Messrs. Forbes, established liquorice factories there, which carried on a considerable trade. Messrs. McAndrew, a name well known on the Spanish coast, had always a line of steamers on the coast of Asia Minor. If the Society did not take the matter up practically, he intended to apply to Mr. Augustus Clarke, of Sokia, who had done a great deal to develop the trade of Asia Minor, and was a very successful experimentalist, to see if he would not endeavour to introduce the esparto plant.

Mr. McWilliam (Newcastle) had listened with great pleasure to Mr. Johnston's paper, and also to the remarks of Mr. Routledge, to whom the paper trade was more indebted than to any other person in connection with esparto. He had also pointed out the rock on which any attempt to extend cultivation would split, viz., freight, and he quite agreed with him. He had had a great deal to do with chartering ships, such as Messrs. McAndrews' and others, and no vessel over 500 tons would bring home loose esparto to the amount of more than half of her registered tonnage. There were two methods of baling, one followed by Messrs. Lloyd in Algiers, by which the bales were secured by iron hoops; the other, that generally adopted in Spain, of tying them with ropes made of the esparto itself.[*] A ship would bring about two-thirds of her tonnage weight of Spanish bales, and from three-fourths to seven-eighths of her full tonnage of such bales as Messrs. Lloyd produced. Spanish esparto at the present time was most valuable, because it was said to show a larger out-turn of fibre, the per-centage being, according to various opinions, from 50 up to 62 or 65. The Oran, or Algerian, on the other hand, was stated to yield from 48 to 60 per cent. of fibre, and took more decimals to reduce. In Lancashire, however, nearly all the esparto used came from Algiers, whilst north of Newcastle, Spanish fibre had the preference. The reasons for this were too long to dilate upon, but one was, that the African variety was about £1 per ton cheaper. The African esparto found its way to this country in consequence of the numbers of steamers and other vessels, which, having taken out coal to Port Said, came down the Algerian and Spanish coasts, and were glad of a freight; and these were generally a better class of vessels than traded to the inner ports of the Mediterranean, and they brought the Lancashire paper-makers their material into Liverpool at about 12s. 6d. per ton less than they would have to pay at Newcastle or Cardiff. The question of the freight from Asia Minor would, he thought, receive something like a solution from the immense amount of tonnage which now went to Port Said with coal for the purpose of supplying steamers. However, it seemed to him an impossibility that the cultivation of the esparto plant could be extended in Asia Minor or elsewhere within such a time as would be of any value to the paper trader, for, before there was any return, some other fibre might be discovered and esparto entirely forgotten. With reference to other fibres, such as wood pulp, while esparto was at £10, they heard a good deal about it, and no doubt would again under similar circumstances; and there was no doubt that every paper maker would be glad if it could come in as raw material. When, however, esparto went back to £7 or £8 a ton, little was heard of it, except as an adulterant. In that respect it seemed to him much the same as China clay; and he saw no reason why a paper maker should be ashamed of using either. The question was, was good serviceable paper produced, and if that end were accomplished, the paper maker might use nothing but the atmosphere if he liked. The Germans adulterated not only paper but wood-fibre with clay; sometimes it was used to such an extent that a piece of paper would not light in the flame of a gas-jet. He had no doubt that those who adulterated the most had the best balance at their bankers. In conclusion, he had only to say that he had come up twice from Newcastle on purpose to hear the paper, though he fully concurred in the statement expressed by the Chairman, that, in the critical state of the health of the Prince of Wales last week, it would have been out of place to hold the meeting. He rejoiced that that necessity for postponement no longer existed, and he did not regret the time and money he had spent in attending.

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[*] The cotton in Smyrna, &c., is baled or pressed with iron hoops. —Hyde Clarke.

Mr. Lloyd said he thought the last speaker had greatly over-rated the yield, which, in his opinion, was not above 42 to 52 per cent., and, at the same time, he had under-rated the quantity which vessels would bring when properly pressed, which he had known to be only 10 to 15 per cent. under their full registered tonnage. The propagation of esparto would only be carried on if it were a commercial success; and he thought when speculators heard that they would have to wait fifteen years for their money, it would be some time before capital was found for the purpose. With regard to propagating the plant in Asia Minor, he feared there would be great difficulty in taking the roots from Spain without great danger of their dying in the removal.

The Chairman, in proposing a cordial vote of thanks to Mr. Johnston, said he could assure the paper trade and others interested, that the Council would do all in their power which might appear likely to advance the interests of the paper-makers and the public in this matter.

Mr. R. Johnston, on acknowledging the vote of thanks, said that it was not so much the cultivation of new lands and propagation of new plants as the preservation of old ones now in existence that his paper advocated, though the means necessary to preserve the one would at the same time afford facilities for effecting the other; and he contended that to preserve a plant that was to-day threatened with total extinction, owing to the abuses committed in its collection, and one which, as Mr. Routledge and others had stated was so indispensable to the paper trade of this country was so important that no reasonable means should be left untried to effect it. As regards the tenure of land in Spain, and to which Mr. Routledge had also drawn attention, he thought that a question easily dealt with, the government themselves having already issued a commission to define and settle the boundaries of these lands with those of the municipalities and private owners. If that had not been already done, it would be in a very short time. In reply to the Chairman, he said he believed the Spanish Government would offer every security in their power to any private enterprise emanating from this country for the purpose advocated.

ANNOUNCEMENTS BY THE COUNCIL.

CHANNEL STEAMERS.

This Committee met on Tuesday, the 19th inst., at three o'clock. Present, Major-General Eardley-Wilmot, F.R.S., Admiral Inglefield, Capt. Robert Scott, R.N., Messrs. E. Chadwick, C.B., Grosvenor, Hodgkinson, C. W. Merrifield, F.R.S., M. Paud.

The Committee arranged the course of proceedings to be adopted, and directed certain information to be procured, for consideration of the Committee at its next meeting, which was fixed to take place on Tuesday, January 16th, 1872.

MOSCOW POLYTECHNIC EXHIBITION.

The Silk Committee of the Macclesfield Chamber of Commerce have recommended to the Chamber that the trade of the town should be represented at the Exhibition, and that a case of samples of the local productions of the town, properly arranged, should be contributed to it.

CANTOR LECTURES.

The Fourth Lecture, "On the Manufacture and Refining of Sugar," by C. Haughton Gill, Esq., was delivered on Monday evening, December 18th. These lectures will be published during the coming month.

The Second Course of Cantor Lectures for the Session will be delivered by the Rev. Arthur Rigg, on "Mechanism." The first lecture will take place on the first Monday in February next. Further particulars will be announced in a future *Journal.*

THE LIBRARY.

The following books have been presented to the Library:—

A Pamphlet on Free-Trade in Sugar. Dedicated to the Cobden Club. By J. B. Smith, M.P.

Proceedings of the Institution of Mechanical Engineers, for 25th and 26th July, 1871.

The Cry of the Children from the Brickyards. A Statement and Appeal; with Remedy. By G. Smith. Presented by the Author.

The Antiquary. A Weekly Paper.

Van Nostrand's Eclectic Engineering Magazine.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

Typography at the Exhibition of 1872.—It has been arranged that the new machines for printing, composing, and distributing type, which have been recently perfected at the *Times* printing-office, shall be completely exhibited in working at the London International Exhibition of 1872. The power of rapid production by these several means is probably three-fold in advance of any existing modes of printing. The *Mail* newspaper will be printed three times a week, and, if possible, the daily supplement of the *Times*.

Recent Scientific Inventions and Discoveries.—The following are the rules governing this department of the Exhibition :—

1. The Exhibition of Scientific Inventions and Discoveries will not be restricted to the classes of objects included in each annual exhibition, but will embrace all kinds of inventions and discoveries which may be deemed worthy of admission.

2. As a general rule, explosive and dangerous substances, including such as are liable to spontaneous combustion, or as would be deleterious to other objects placed near them, will not be admitted. Any imitations of explosive or dangerous compounds (such as the substitution of coal-dust for gunpowder in sections of shells and the like) must be the subjects of special application.

3. The name of the object, as well as that of the inventor, should be securely attached to each article, together with the price, if for sale.

4. In the case of objects requiring the use of fire, gas, steam, or water, or of any other motive power, the application must distinctly specify what provision is necessary to be made for working them, and what securities are required against danger or accident; but Her Majesty's Commissioners can only make the necessary provision for those applicants whose requirements in these respects are notified to them before the 1st of January, 1872.

The Royal Albert Hall.—His Royal Highness the Duke of Edinburgh presided at a meeting of the Executive Committee of the Royal Albert Hall, held at Kensington on Wednesday, to discuss the details of a series of subscription concerts to be given in the hall, consisting of oratorios by the Sacred Harmonic Society, operatic concerts by Mr. J. H. Mapleson, choral concerts by M. Gounod, and popular concerts by Mr. Arthur S. Chappell. The Hon. Seymour Egerton, Mr. Arthur S. Chappell, and Mr. J. F. Puttick, attended the meeting to give advice.

A performance of the *Messiah* is announced to take place in the Royal Albert Hall, on the morning of Christmas-day, to commence at two o'clock. Mdlle. Titiens, Mdlle. Anna Drasdil, Signor Foli, Signor Agnesi, and Mr. Sims Reeves are to appear.

ON THE PREVENTION OF NOXIOUS SEWAGE EMANATIONS.

By Edwin Chadwick, Esq., C.B.

From my special conversance as a sanitary commissioner with the subject of house drainage, and the intense interest taken in it by the members of our Society of Arts, on account of the reported cause of the calamity that has befallen his Royal Highness our President—a dreadful repetition of that which befell his father—it appears to me to be due that I should submit such information as I may possess on the means of prevention.

I conceive that it should follow any such calamities to persons in any station of life, low as well as high, that the condition of the premises where they have occurred should be examined by a responsible public officer, specially conversant with sanitary science, and with the special structural works it requires, to ascertain what were the conditions by which they might have been occasioned, and to prescribe effectual measures for their removal. There can, however, be no doubt in the mind of any one conversant with the subject, that the condition of the room in which his Royal Highness slept, and Lord Chesterfield after him, was—as described—a condition of danger; not merely, however, on account of the position of the water-closet opening into the bedroom; for this general fact should be known, that in all the recently-constructed military prisons, and in most of the new civil prisons, a syphon soil-pan, connected with a tubular drain, has been placed in every separate cell, and that fever has been unknown in them. This arrangement was objectionable, and the soil-pans have been removed from the cells of the military prisons; not, however, as I am assured, on account of the production of any fever. No evil of the kind was reported as having called for their removal, and no sanitary facts of improvement have occurred since their removal. Prisoners may be brought in with various foul-air diseases upon them, which do not spread, but cases of typhus, or of any epidemic diseases were and are unknown in well-drained prisons. If the habitations of the general population were as well drained, there would be, in England and Wales, twenty thousand less of fatal cases, and perhaps seven or eight times as many of attacks of disease of the species that has befallen his Royal Highness. The death rates from all diseases prevalent amongst the general population of the prison ages is about ten per thousand; amongst the soldiers of the Guards, the rate was twenty in the thousand, until, by the work of the Army Sanitary Commissioners, they were reduced to ten in a thousand. But in the military and in the new civil prisons, the death rates are only about three in a thousand. Ventilation, and forced personal cleanliness, contribute to these results, but neither dysentery, nor diarrhœa, nor others of the foul-air diseases and epidemics which are fatal to upwards of one hundred thousand annually of the population of England and Wales arise in those prisons. It is evident that if his Royal Highness and Lord Chesterfield—I ask pardon for the supposition—had stayed and slept in a place in the rudimentary sanitary condition of a well-regulated prison-cell, instead of in Lord Londesborough's mansion, as described to have been left by the architects, both would have been protected.

It is stated that the drains of Lord Londesborough's house were good and complete, and that they were regularly flushed (I think it was said) once a week. Those who talk of drains or sewers being good which require to be flushed, if they speak of regular flushing as necessary for the removal of regular accumulations of *deposit*, do not know what good drainage is. Good tubular sewers or drains should be so constructed in size, form, and inclination to the run of water, as to be self-cleansing, and to be always clear of deposit. I have made particular inquiries as to this point, and in every instance where the work has been done according to the instructions provided it is declared that when taken up after considerable periods that they were found to be "as clean as when they were first put down." If in any instance it is otherwise, the fact is one to be inquired into. Dr. Carpenter declares that at Croydon, where the death-rate has been reduced about one-third by improved drainage, he has not known a case of fever where there was not some defects in the drainage works about the house or the premises connected with it. And so, in other instances. The declaration of the officers in charge is that there is no smell from these self-cleansing channels, but that accidental stoppages occasionally occur, chiefly from servants' carelessness in throwing down what ought not to be thrown down; and the officers declare that the only need of traps and ventilators is to guard against these accidents. As a rule, where there is smell from the drains or the sewers, there is stagnant deposit.

The house drainage may be faultless, but in rural mansions it is commonly led to a covered tank in a garden, as in towns to a sewer or deposit, or to a tide-locked dead end, where deposit is occasioned. There it is kept for long periods. In the old sewers in London it is frequently kept for more than a year, or until the sewer, unless periodically changed, is choked up. Fresh human excreta is innocuous. If it were not so, mankind, in cities as they now are, would soon be destroyed. The period of noxious decomposition begins, in this country, usually not later than about four days in the sewer-tank. Then it is, and there it is, in the distant tank, or in the sewer of deposit, that danger arises. In my report, in 1842, on the sanitary condition of the population, I stated that the position of the sewer of deposit (like the *tank* of deposit) as commonly constructed, was as the bulb of a retort, and that the house drain, also usually of deposit, was as the neck, conveying the products of decomposition into the house, which was often, at night when shut up, as an inverted receiver for their collection. Of course, through a water-closet opening into a bedroom, the poisonous gases will be diffused there in conditions of more or less of intensity. In certain barometric conditions, or when decomposition is rife, the products are sometimes evolved from these retorts to an amount that overcomes all water-traps. I remember the instance of the owner of one large, palatial mansion, who wondered how, and to what malign influence it was to be ascribed that, just at the time when he had a large party, and at no other time, abominable smells pervaded the house, which was a new and well-built one. The fact was, that the extra fires and lights on the occasion, in winter time, when all outer doors and windows were closed, constituted a pump, lightening the pressure upon the water-traps or the house drain, and brought up the products of decomposition from the sewers. If there had been no fires, the traps might have acted perfectly. I have known many first-class mansions to be in the worst conditions, in which a Royal progress through them, attended by extra fires, would be a progress of danger to a susceptible person; the conditions being those in which foul air would be drawn in to commingle with the vitiated air from overcrowding, from lights, so as to create a more noxious mixture. First-class hotels on the Continent are, in these respects, often most dangerous places, where I have known frequent fatal cases occur from these causes. Dr. James Johnson, the editor of the *British Medical Review*, was killed (as he has described) by the air-poison in a house in Brighton, where he went for the recovery of his health.

Various means have been proposed and tried for combating the noxious gases evolved from the stagnant deposit. By some it has been proposed, as a complete remedy, to ventilate the neck of the retort, the house drain, at its entrance into the house, and by a shaft lead up the gas and distribute it at the house-top. Where this has been done, sometimes through the water spouts, the gas has been diffused with fatal effects amongst the occupants of the attics. Moreover, when the basement traps have been defective, and the warm air pump within doors, as described, has been active, the gas has taken the shorter cut of going into the lower premises. By some engineers it is proposed to ventilate the gases nearer their source, at the sewer, or the tank of deposit, and carry them away by high shafts. Where this has been done, as it has been on the Continent, the gases thus diffused have been found to be nuisances in the suburban districts;—a method of ventilation, in which people in the suburbs of Liverpool have had experience, in the ventilation of chemical works by tall chimneys. By one engineer a plan was proposed and tried of ventilating a sewer of deposit by means of a steam jet, with the result of a more rapid evolution of the gases than ever. By one engineer the plan was proposed and tried in Paris, of the ventilation of a sewer of deposit by an upcast shaft, or chimney, through fire. But the products distributed at a distance, if less noxious, were found to be a nuisance, and the process was abandoned. By some manufacturing chemists it is proposed to combat the noxious gases with disinfectants, the more correct name of which was proved to be deodorisers. By one, we of the General Board of Health were almost accused of manslaughter for not directing the general application of his preparation of an acetate of lead as a complete preventive. In the strength of his convictions, he, poor man, went with it to extinguish a cholera epidemic, and he was one of those who fell victims to it amidst his own preparations. By some chemists, charcoal powder was insisted upon as a specific. The crew of a ship sent loaded with it to the Crimea was attacked by the cholera, and the faces of the first victims were blackened by the charcoal powder they had been unloading.

By none of the *Times* correspondents does the fact appear to have been observed of the difference of condition between the stagnant sewerage, which is putrid and kills fish, and that of fresh sewage from self-cleansing drains and sewers, which, when discharged in rivers, feeds them and augments their numbers. By none does the evidence appear to have been known as promulgated in the "Minutes of Information on the Practical Application of Sewer Water and Town Manures to Agricultural Production, issued in 1852," that the most effectual course is not to combat with the gases when produced, but to prevent their production—to prevent the poison pits, and the need of their various materials and services for guarding against them.

I have stated that noxious decomposition usually commences in ordinary weathers in about four days. Not the chemist, but the horticulturist—not the druggist with his deodorisers, which commonly only mask, or at best mitigate, the mischief, but in rural districts the gardener is the person who should be made responsible for removing daily, or every other day, by pump and hose, the contents of the sewer tank, and distributing it to a piece of ground properly trenched and prepared to receive it as manure. His skill as a gardener will be in distributing it in appropriate doses, sufficient for the soil to receive it without excess, and as to the quantities and modes of application, his best authorities will be those horticulturists—like Sir Joseph Paxton, cited in the minutes—who have paid special attention to the modes of feeding plants, and who have been the most successful in raising prize fruits. He may be admonished that decomposed manure, or putrid manure, is wasted manure, and that his interest is in getting the manure in the ground whilst it is fresh, and before decomposition commences. If he applies the matter properly, not supersaturating the soil (on the erroneous intermittent system of treating sewerage), but giving the liquified manure in proportions adapted to its powers, and the feeding powers of the vegetation upon it, he will find less of space than is commonly supposed will suffice for the purpose, and prevent the escape, if not entirely prevent the development of the noxious gases. Where solid manures could not be removed, instructions were given that the best and cheapest disinfectant and means of saving the manures was a covering of fresh mould. Instead of preparing the earth and taking it into the house for the reception of only one part of the house manure, it will be better, more speedy, and more simple and safe to take all the manures of the house at once, and before mischief begins, to the earth.

The same principles that are applicable to the protection of the house, are applicable to the protection of the town or the city. Sewers of deposits, and tanks or reservoirs containing decomposing sewage, are poison pits, and they have to be guarded against, whatsoever may be the completeness of form and action of the house drains. With proper works, under competent agricultural engineers who have demonstrated them, of which there are samples in proof at Aldershot, at

Bedford, and at Romford, the whole of the day's deposit may be on a sufficient portion of land, not in mechanical suspension, but in chemical combination, before nightfall, before decomposition, such as goes on in the sewers of deposit in London, can have taken place.

I shall have more to say on this question, and shall now conclude by submitting again that the example should establish one general legislative measure of prevention—that every death from such preventible disease should be followed by a responsible official inquiry, by a competent officer of health, to ascertain what there may have been about the house or its vicinity to have caused the death, with authority to prevent further occupation, or to direct proper measures of protection, until the proved noxious condition has been removed.

CORRESPONDENCE.

INDIAN FORESTS AND INDIAN RAILWAYS.

Sir,—In your *Journal*, of the 15th instant, appears a letter from Mr. Horne, dated 2nd instant, with reference to the paper on "Indian Forests and Indian Railways," which I had the honour of reading before the India Committee of the Society of Arts on the 1st of this month.

It will afford me much pleasure to answer the questions put by Mr. Horne; and I quite agree with him, that it was to be regretted that so few persons met to discuss my paper, as the subjects connected with it are so vast and momentous; but, as a rule, India Conferences are left to the few, though, as so many persons are now professing to take an interest in Indian affairs, it is to be hoped that the numbers will augument gradually, and that future conferences will be enlarged; and I have already observed that each one successively has been attended more numerously than its predecessor was.

Mr. Horne evidently duly appreciates the importance of this question, when he observes, "that a month of conference would not exhaust the discussion;" yet only one hour was given to it. But, unfortunately, time flies, and discussion is compelled to terminate; but there is no reason whatever why such should not be prolonged in the pages of the *Journal*, and I will make use of them, with the permission of the Society, so to continue it.

The whole tendency of Mr. Horne's letter leads to a confirmation of my statements, as to the extreme difficulty that will be experienced in obtaining a sufficient supply of firewood, as fuel for the Indian railways, through either government agency or private enterprise, for he plainly shows that the cultivator cannot plant trees without the landlord's permission, and that the latter was diametrically opposed to the planting of trees, as they were not so profitable to him as tilled land was. He also shows how difficult it is to get young saplings to arrive at maturity.

In my remarks upon the cultivation of forests, I observed that they "should be created also on all river banks of navigable streams for convenience of removal;" but in the discussion upon the subject, I was rather led to infer that Mr. Horne was not agreed with me thereon, for he said "as to the suggestion which has been made that the banks of rivers should be utilised for the cultivation of trees, it should be remembered that the land near the rivers was the most valuable part of all the land, and the most luxurious in its cultivation." Yet in his letter he would appear to support the view so taken by me, for in remarking upon the sad denuded state of the country, he observes, "There should be set against this the course of the canals, with their planted banks and well-watered adjoining gardens." Surely the bank of a canal cannot be considered in any other light than that of a navigable stream; and what I meant to convey by my remarks was, that on all spare land, near a navigable course of water, forest should be formed, so that when it had matured, it should be in a position to be transported economically to a market.

The chief objects of his letter will, I think, be found in my previous paper, published in your *Journal* of the 3rd of Feb., 1871, pages 201 to 208, entitled, "On Peat and its Profitable Utilisation in Indian Locomotives, and for other Purposes."

Perhaps when Mr. Horne recollects that the paper to which he refers was upon the subject of "Indian Forests and Indian Railways," he will exonerate me from remissness in not having touched on some of the points he mentions with reference to peat, which was only introduced to show that its assistance could relieve the railways from their present fueling dilemma, which the Forest Department could not effect by means of a supply of firewood, as the government director of railways seemed to hope would be the case; and that in opening my address I particularly referred to such a previous paper, stating that it was published on the above date, and had reference to the utilisation of those natural deposits of fuel; and I think if Mr. Horne refers to that previous paper, he will obtain a great deal of the information he is asking for.—I am, &c.,

A Romaine Wragge.

19th Dec., 1871.

THROUGH RAILWAY TO INDIA.

Sir,—Mr. Hyde Clarke addressed the *Asiatic* on the 13th of June, 1870, and his views, as there expressed, are full of truth, and convey most practical suggestions regarding the comparative merits of the two positions, the ports of Seudia and Skanderoon (Alexandretta).

As Brindisi is in the direct line from Skanderoon, homewards, and will doubtless become the chief port of arrival and departure of goods, passengers, and mails, for many years to come, I have considered it advisable to give to that position the attention it deserves and commands as a connecting link in this highway, and should you think the subject one of sufficient importance, I shall be glad to send you a short paper upon this port and its present position, as an appendix to the general subject of the Overland Route.

I have addressed the Minister of Public Works of Italy upon this subject, dwelling upon the importance of the improvement of the harbour and town of Brindisi, and the general management of the through traffic in mails, passengers, and merchandise upon the following points:—

1. The extension of the line of railway from the present main trunk line and terminus, down to the sea-level and wharves, with necessary station works and goods accommodation.

2. The construction of government offices, new customs department, storehouses, removal of post-office, public markets, municipal buildings, government, military, and civil depots, pilotage offices and board, telegraph, overland and submarine, harbour board, and sanita.

3. The lighting of the port and soundings, with reference to securing safe navigation in and out, by day or night, together with a tidal and meteorological register office.

4. A more careful survey and levels of the shore-line of the harbour, and adjacent coast and lands, the securing the foreshore and marshes adjacent from the deleterious influence and miasma now so dangerous to the general health and salubrity of the town.

5. Sanitary measures, having reference to water supply, fountains, fire hydrants, and general drainage, with respect to rainfall and sewage, flushing, lighting, slaughter-houses, and obnoxious trades.

6. Conservancy as to the removal of nuisances, cleans-

ing, &c.; and watering the town during the hot months. with the dispatch and disposal of night-soil, general refuse, sweepings, &c., and its general utilisation.

7. The organisation of municipal labour from the unemployed poor, under registration, at the customs or sanitary office, and the organisation of a commissionaire porterage corps, appointed from the able-bodied men whose term of service has expired from the army and navy, the former to be attached to the duties of the town, markets, &c., and the latter to the port, and to act as public messengers.

8. The establishment of a hospital or sanitarium, for the accommodation of foreign seamen visiting the port.

I am, &c.,

George Latham, M.I.C.E., F.R.G.S.

18, Via del Forni, Trieste, November 23rd, 1871.

UTILISATION OF SEWAGE.

Sir,—I had the good fortune to be present at the meeting of the Society of Arts on Wednesday, the 6th instant, when Mr. Bailey Denton read a very interesting paper on the subject of "Sewage as a Purifier of Land, and Land as a Purifier of Water." I listened with much interest to the reading of the paper, which contained much valuable information, and also to the discussion which followed; but I observed that the subject was regarded principally from a commercial point of view, and the value of sewage per ton was variously estimated, and its importance to the farmer and market gardener was particularly dwelt upon. I did not, however, hear any statement respecting the quality of vegetables grown on ground saturated with sewage. It would be well if some attention were directed to this part of the subject, as being of equal importance with the profit to be derived from the sale of sewage; for it is highly probable that such vegetables as brocoli and cabbages, besides others, which absorb a large quantity of moisture from the soil, may contain some of the poisonous principles of the sewage, so that, apart from the natural repugnance which most people would feel at eating sewage-grown vegetables, there may be positive danger to health in doing so.

There is much more that might be said in reference to this particular part of the subject, but my object in thus troubling you is to direct attention to it, in the hope of eliciting further information.—I am, &c.,

David D. Logan, M.D.

London, December 12th, 1871.

NOTES ON SCIENCE.

Some curious actions in connection with the colour of fluorescent substances have been observed by Professor Morton, who, in the *American Journal of Science*, describes how, having recently obtained some very anomalous results when investigating that subject, he was led to mistrust the action of the Geissler tubes, in which certain solutions had been examined. These were of the ordinary kind of jacketed spirals, selected as being identical in size and other particulars. It had been observed, nearly from the first, that the internal spiral gave a faint blue fluorescence, which could only be seen on close inspection; and in all cases the tube being but partly filled, it was considered that a light appearing in the part covered by the fluid many times more bright than that from the uncovered part of the spiral, was sufficient evidence of fluoresence in the liquid. He has now found that this is not really the case, and that any liquid, however devoid of fluorescent properties, gives all the appearance of fluorescing in these tubes. The explanation of this phenomenon is, that the only fluorescent light that can be seen from the glass of the spiral is that which comes off tangentically from the outer surface, that emitted radially being marked by the bright, electric discharge behind. In passing from the glass to air, most of the light suffers total reflection at the outer surface of the glass; but if for the air, water or any other liquid be substituted, its greater refractive power causes much more of the light to reach the eye. The nearer the refractive index of the liquid approaches that of glass, the brighter is the light that is seen through it.

There has been, during the past month, a good deal of discursive talk about a proposed new method of lighting the Crystal Palace, by an admixture of oxygen and common gas. As these, when mixed together, form an explosive compound, it will be at once perceived that popular opinion, so far as it may have adopted this idea, is at fault. But oxygen, when judiciously used in connection with common gas, improves its purity as an illuminating medium in a very marked degree. Before, however, oxygen is universally or even generally used, it will have to be supplied at a very much cheaper rate than that at which it can be made on a small scale. That this will be done before long, appears to be reasonable. There is a method of making oxygen, which has been discovered by M. Tessie du Mothay, by which it can be made at very little more than the cost of labour. As it does not appear to be much known in this country, and as it will probably become the means by which oxygen in large quantities will, if it come to be adopted, be made, we give an outline of the process. A retort of a considerable size is charged with manganate of soda, a few hundred pounds of which may be operated on at a time. The retort having been heated, and connected with a steam boiler, superheated steam from the boiler is admitted for about ten minutes, the effect of which is that two equivalents of the manganate of soda and two of the water re-act upon each other. The water combines with the soda of the manganate to form a hydrate of soda. The manganic acid is changed to sesqui-oxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in a free condition. At the conclusion of this part of the process, the steam is shut off, and superheated air, for the production of which there must be an arrangement in the furnace, is admitted for about fifteen minutes, whereupon the sesqui-oxide combines with more oxygen from the air, and is converted back into its original form of manganic acid, which, of course, resumes its relation to the soda, reconstituting manganate of soda, ready for a repetition of the process. It will thus be seen that the manganate of soda, when once obtained, serves for an indefinite number of times; it becomes, in fact, a tool by which the oxygen of the air is abstracted and utilised. The cost of the original supply of manganate is the only one, and the interest on this, added to the cost of attendance and generating steam, represents pretty nearly the price of the oxygen. That it can be produced at a very low price, compared with what its cost has hitherto been, is very evident; while, from a consideration of the various chemical reactions that take place, its purity is of an excellent order. When once a cheap supply of oxygen is obtained, the question will arise, What is the best method of utilising it in the production of artificial light? Should it come to be adopted here, as it already has been in some parts of Paris and New York, double rows of pipes will have to be laid down, and carried up even to the gas burners; for, as already stated, the two gases, if mixed, would form a highly-explosive compound. If a small stream of oxygen be permitted to escape around the flame of the common gas, the purity of the latter is greatly increased, the yellow colour by which it is characterised becoming much whiter. The oxygen may also be admitted just inside of the burner, and the two thus be allowed to issue from the jet in a mixed condition. The light in this case is also very pure. The relative proportions of the gases required to produce the best results would have to be adjusted by stop-cocks on each pipe. But the greatest amount of illuminating power would be obtained by using the oxygen with a blow-pipe jet, so as to project a small stream through the flame of the common gas, and so on to a piece of zirconia, which would become incandescent, and emit a light rivalling that of the well-known lime light. The advantage of zirconia over lime is its comparative indestructibility. Everything tends to indicate that one or other of these methods of lighting will, sooner or later, be greatly used.

What is the best form of a lightning conductor? Professor Henry, in an essay on meteorology, answers this by stating that it should consist of a round iron rod, of not less three-quarters of an inch in diameter. Other forms of rods, such as flat or twisted, will answer nearly as well, although a drawback attending their use is that they are liable to give off lateral sparks from the sharp edges at the moment of the passage of the electricity through them, which might set fire to very combustible materials. It is a commonly received opinion that lightning rods need not be continuous, as it is supposed that the electricity will leap over short distances; but Professor Henry recommends that it be throughout its entire length in perfect metallic continuity, and that it be coated with black paint. As a general rule, he advises that large masses of metal within the building, especially those which have a perpendicular elevation, be connected with the road.

A new test for alcohol has just been published by M. Berthelot. The liquid suspected to contain alcohol is mixed with water, and a little chloride of benzoyl is dropped in, the whole being then mixed and gently warmed. When cold, a few drops of a solution of caustic potash are then added; if the liquid remains turbid, and an agreeable aromatic odour be evolved, alcohol is present; but if, on the contrary, the liquid becomes clear, or lose all odour, or merely give that of a benzoate, no alcohol is present. The action is as follows:—Benzoic ether, which possesses a fragrant odour, is formed by the action of the chloride of benzoyl upon the alcohol. This ether is but very slowly affected by caustic potash, whereas the excess of chloride of benzoyl used is at once decomposed by the caustic alkali into benzoate and chloride of potassium. The ether remains and can be identified, while the reagent employed in the first instance is removed completely. This test is exceedingly delicate.

A modification of Mr. Edwards's process of Heliotypic printing (which was brought before the notice of the members of the Society of Arts some months ago) has just been published by Captain Waterhouse, of the Surveyor-General's Office, Calcutta. The following are the details, as supplied by himself:—A clean piece of thick and finely-ground plate-glass is levelled, and coated with

Gelatine	1 ounce.
Tannin	10 grains.
Soap	30 ,,
Distilled water	8 ounces.

First dissolve the gelatine in six ounces of the water, and, having dissolved the soap and tannin each in one ounce of hot water, mix them, and add the mixture to the hot solution of gelatine very gradually, and stirring all the while. Filter through a coarse cloth into the jug, and pour, while hot, over the plates so as just to cover them. Should there be any air-bubbles they may be removed with the point of a penknife. The plates are now left till the gelatine has set, and care should be taken that as little dust as possible falls on the plates, or holes will be formed in the film. As soon as the gelatine is quite set, the plates are turned upside down, and supported on little blocks of wood at the four corners, and left for twelve hours to dry; when dry, the plates are sensitised in a bath of bichromate of potash—

Bichromate of potash	1 ounce.
Distilled water	20 ounces.

They may remain in this for about five minutes, and are then placed in a dark box or room, and dried with the aid of a gentle heat; when dry, they are ready to be exposed under a reversed negative. The time of exposure varies from about five minutes, in the sun, to fifteen and thirty minutes, or even longer, if the negatives are very intense. When the plate is judged to have been sufficiently exposed, the negative is removed from the frame, and the back of the sensitive plate is exposed to the sun for two or three minutes, to thoroughly harden the under surface of the gelatine, and prevent it from swelling up afterwards. The plate is then taken out of the frame and put into a dish of clean water, and thoroughly washed with many changes of water, till all the yellow bichromate salt is removed. The superfluous water is wiped off, and the plate is then ready for printing. If the subject be in line, the plate may be rolled in with tolerably stiff black ink, softened with a little olive oil, and not too much on the roller. After the plate is inked in, the superfluous ink is removed with a damp cloth, and the surface of the plate finally wiped with a clean damp cloth, to remove all traces of scumminess. The paper is laid on, and the plate pulled through the press in the ordinary way. Before inking in again, the plate is wiped with a damping cloth.

While on the subject of the printing of photographs by mechanical means, we may state that Mr. Edwards, the inventor of the heliotype process, has further developed its resources; first, by the invention of an inking roller, which he finds better adapted for it than any of those hitherto used. His new roller consists of the usual glue and treacle, or analogous bodies, to which have been added a considerable proportion of oil or grease, or oil combined with an alkali. A second feature in his new improvements consists in a method of producing the appearance of an Indian tint upon his prints. This he effects by mixing with the water with which he damps the printing surface a dye of any suitable kind. His third improvement is a method of producing colour plates, by multiplying the negatives so as to have a negative for each colour to be applied. Each of these has all its details painted out, except the part which is desired to print a certain colour. A printing forme is then made from each negative, and each such "forme" is inked with its suitable colour. In virtue of a peculiarity of the printing surface, two, or even more, colours may be used with each "forme"; for this purpose, the inks must possess different degrees of stiffness. There are other methods of producing coloured prints described by the inventor, who has shown, at the Photographic Exhibition, a fine chromo-heliotype produced by the process now given in detail.

GENERAL NOTES.

South Kensington Museum.—A beautiful silver cup, the work of Jamnitzer, the Nuremberg goldsmith, and cotemporary of Cellini, has just been added to the Art collection. The Educational division has lately received a very curious toy-house, made in Nuremberg two centuries ago, filled with models of utensils of the period illustrating German life and manners. It is at present shown in the North Court. Mr. William Smith's gift of water colours will be exhibited as soon as the room is prepared to receive them.

French Academy of Belles Lettres.—The following gentlemen have just been elected corresponding members of the Academy:—M. Deschamps de Pas, M. de Beaurepaire, Mr. Muir, of Edinburgh, and Mr. Cobet, of Leyden.

United States Whale Fisheries.—The following statement has been made by the Registrar of the Treasury at Washington, in regard to the whale fishing of the United States. In 1868, there were 328 vessels, in 1869, 311 vessels, in 1870, 299 vessels, and in 1871, 249 vessels. There appears to be a gradual diminution in this once important industry, owing to the discovery of coal-oil and petroleum.

Rare Bible for Sale.—A very rare book, in good preservation, namely, a copy on paper of the Latin Bible of Gutenberg-Fust, is offered for sale at Erfurt. It is the property of the Eglise des Predicateurs, and has been placed in charge of a bookseller of that town, who will receive offers for the work. Only sixteen copies of this early specimen of printing are known to exist, of which six are on vellum and ten on paper, two of the latter being very incomplete. The copy in question is not perfect, one sheet being wanting in the first and fifteen sheets in the second volume. The volumes are bound with metal clasps. In the year 1858, a copy, which was not only incomplete but also stained and worm-eaten, was purchased at a public sale at Augsburg for the sum of 1,400 thalers, for the St. Petersburg library.

The Bottom of the Sea.—An expedition is on the point of sailing from the navy-yard at Charlestown, Massachusetts, on a voyage of exploration, the results of which will be looked forward to with much interest by the scientific world. The object of the expedition is to investigate the bottom of the ocean in its deepest parts, to trace the sources of the currents, and to compare the Atlantic with the Pacific, in order to ascertain, among other things, whether the one is higher than the other, whether the temperature is the same, and what are the currents that come into conflict. The transparency of the ocean will also be determined, as well as the specific gravity and chemical constitution of sea-water. The nature of the animals inhabiting the sea-bottom, and of the fishes of the deep sea, will also be ascertained, for the purpose of deciding whether the oceans communicated with one another at any past epoch. The expedition is sent out by the Navy Department, at the suggestion of the Superintendent of the Coast Survey, and the naval officers composing it have been selected with special reference to their fitness for the work. Professor Agassiz is at the head of the scientific corps, and the general supervision of the operations is entrusted to Count de Portales, who has had extensive experience in deep-sea dredging. The plan laid down for the expedition is, in the first-place, to explore the South Atlantic, and to proceed thence to the West Indies, to investigate the origin of the Gulf Stream. The next task is to discover the greatest depth of the Atlantic, and thoroughly examine its bottom, after which the expedition will put into Rio. From Rio it is to explore the east coast of Patagonia and the Falkland Islands, ascertaining and tracing the course of the South Pole currents, whether they enter the Atlantic or the Pacific. The expedition will then continue its course through the Straits of Magellan, and pursue the same system of exploration in the Pacific. Its attention in that ocean is especially directed to the shore currents and open currents, the depth of the water and sea-bottom, and the visiting and examination of the islands off the coast of the continent, as well as that coast itself as far north as San Francisco, where the scientific corps will leave the vessel. The vessel—the *Hassler*—has but just been built, having been designed expressly for this service. Her internal arrangements have been planned by the Chief Hydrographer of the Coast Survey, and her construction has been carried on under the immediate supervision of the Superintendent of the Survey. Professor Agassiz, it appears, intends to pay special attention individually to the fishes of the deep sea, and to enable him to preserve the specimens he may obtain, 10,000 dols. have been subscribed in Boston. Another 10,000 dollars was still required, but no doubt was felt that this would be forthcoming.

Gold in Victoria.—The total amount of gold exported from this colony since the beginning of the year is 1,264,630 ozs., of which 183,254 ozs. were transhipments from New Zealand, against 1,135,578 ozs. exported during corresponding period of the previous year, of which 191,889 ozs. were from New Zealand. From this it appears that there is an increase of 136,687 ozs. in the present year over the same period of last year in the gold exported from Victoria, and a decrease of 8,635 ozs. in that exported from New Zealand.

National Gardens.—The *Garden* says:—The system we propose is, to treat all the public parks and gardens of a great city as a whole, and to establish in each a distinct type of vegetation. For example, we might devote one city park chiefly to noble deciduous trees; another, suburban one, as Richmond, to evergreen forest trees; another, to the almost countless flowering deciduous trees and shrubs that are the glory of the grove and copse in all northern and temperate countries. Or we might treat the subject geographically, and have a small square or park with British trees, and shrubs, and plants; another of European, another of American, another of Siberian, and so on. We could, by the system we advocate, define for each superintendent in what direction his efforts should chiefly tend; give each an entirely distinct aim. He could then get up a family, order, or flora, and develop its beauty and variety to the completest extent of our knowledge.

Statistics of Oregon.—From the recent census it appears that Oregon is not by any means the least important of our agricultural states. The following are the productions of that state:—

	Bushels.		Value.	
Wheat	1,750,000	..	1,500,000	dols.
Rye	5,200	..	5,200	,,
Oats	500,000	..	270,000	,,
Corn	200,000	..	200,000	,,
Barley	200,000	..	200,000	,,
Potatoes	500,000	..	300,000	,,
Hay	55,000 tons		637,500	,,

There were in the state, in 1869, 48,000 horses, 1,560 mules, 79,312 milch cows, 101,960 sheep, 112,700 swine, and 140,500 young cattle. The total value of the domestic animals is 7,956,255 dollars. Cheese was produced to the extent of 105,279 lbs. and 1,000,159 lbs. butter. Production has been prodigiously stimulated since 1869, by the building of railroad sand accessions to the population.

Coal Production in Belgium in 1870.—It appears from official Belgian documents, just published, that the production of coal in Belgium, which was 12,926,894 tons in 1869, was raised, in 1870, to 13,697,118 tons, which may be thus divided:—From the Hainaut basin, 10,196,530 tons; from that of Namur, 338,407 tons; and from the Liège basin, 3,162,181 tons. In Hainaut there are 129 collieries, of which only 85 are actually at work; 274 shafts, 78 of which are in reserve; 104 steam pumping-engines; 456 steam winding-engines, of which only 243 are working; 79 steam ventilating-machines; and employ 68,831 workmen, of which 53,327 work underground. Of the 39 mines in the province of Namur there are only 19 in work, employing 36 steam-sngines and 2,193 workmen, of which 1,580 work underground. Lastly, in the province of Liège, there are upwards of 20,000 miners and workmen depending on the collieries of that district. Of the 13,697,118 tons extracted in 1870, 9,967,524 were consumed in the country, and the remainder exported.

MEETINGS FOR THE ENSUING WEEK.

THURS...Royal Institution, 3. Professor Tyndall, "Ice, Water, Vapour, and Air."
London Institution, 4. Mr. J. C. Brough, "The Philosophy of Magic."
SAT.....Royal Institution, 3. Professor Tyndall, "Ice, Water, Vapour, and Air."

Journal of the Society of Arts.

No. 997. Vol. XX.

FRIDAY, DECEMBER 29, 1871.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

SOCIETY'S EXAMINATIONS.

The Council have passed the following resolution:—

That the time has now arrived when the present system of examinations is no longer necessary, and that the encouragement of particular subjects, bearing especially on Arts, Manufactures, and Commerce, should be promoted by special means.

It will therefore be seen that, after the next examinations, to be held in April, 1872, the present system will cease.

The following suggestions by Capt. Donnelly, R.E., for a scheme of technical examinations, have been brought before the Council, and they have been referred to a special committee for consideration:—

1. The Society of Arts to organise examinations in the science and technology of the various arts and manufactures of this country, conducted by a board of examiners representing the abstract science involved, as well as the practical knowledge and skill in its application. Thus, taking dyeing, soap-boiling, and gas making, the examination would embrace a knowledge of the chemistry, physics, and mechanics on which the various processes depended, and the technical skill required in their application; the modifications necessary to suit the varying qualities of the materials employed, economy in the manufacture, and so on.
2. To give notice annually of the three, four, or five manufactures which would be taken up the following year, with a slight syllabus of the examinations which would be held at a few convenient centres.
3. To enter into communication with the various guilds and companies interested in the special arts and manufactures taken up, with a view of obtaining their aid and assistance in framing the technical examination, and in the nomination of the technical examiners; and also with a view of seeing what encouragement they would give in the shape of prizes, &c.; the Society of Arts to arrange for the examinations in pure science, perhaps in concert with the Department of Science and Art.
4. To combine these examinations somewhat with the Annual International Exhibitions as respects the industries to be taken up for the year.

The Council will be glad to receive an expression of opinion on the scheme from the Institutions in Union, manufacturers, and others interested in the subject.

CANTOR LECTURES.

The Second Course of Cantor Lectures for the Session will be delivered by the Rev. Arthur Rigg, on "Mechanism." The first lecture will take place on the first Monday in February next. Further particulars will be announced in a future *Journal.*

THE LIBRARY.

The following books have been presented to the Library:—

Arpinium and its Antiquities in the days of Cicero. By L. Mariani, LL.D., &c., Corresponding Member of the Society of Arts. Presented by the Author.

Programme of the Opening of the Royal Albert Hall.

Programme of the Ceremonial of the Opening of the Annual International Exhibitions.

Catalogues of the Fine Arts and Industrial Divisions of the Exhibition of 1871. Presented, with the above programmes, by Messrs. Johnson and Sons.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ON THE MANUFACTURE AND REFINING OF SUGAR.

By C. Haughton Gill, Esq.

Lecture I.—Delivered Monday, November 27th.

The subject of sugar divides itself naturally into two branches—the preparation of the raw material, and the refining or rendering it fit for use. Taking these two branches of industry together, I find that the result is, that, in 1866, the total consumption amounted to something like three millions of tons, reckoning only that which came through European hands in some way or other, and of this amount nearly one million tons were manufactured in Europe from beet-root. No doubt some of you have heard that sugar made from beet-root is not so sweet as that ordinarily used in this country, which is made from the sugar-cane. This is quite a mistake. Sugar procured from the cane and from beet-root is exactly the same; and I wish to impress this upon you particularly at the outset, inasmuch as, in describing the operations of refining, I shall make no distinction between them, except in immaterial details. Sugar from either source is known as "cane sugar."

I must next assign limits as to what I have to tell you. You must understand that I have nothing new to say upon this subject, but simply to explain to you what is known to every chemist who has studied the subject of the production and refining of sugar. I shall confine myself simply to telling you what is done in certain cases, and why it is done.

But, in order to explain the reason why such operations in the manufacture and refining of sugar are carried out in the form in which they are, I must first bring to your knowledge certain facts in chemistry and physics, and as I cannot advantageously unite these explanations with the descriptions of the processes themselves, I propose to occupy this first lecture on bringing before you some of these physical and chemical facts which I shall have afterwards to apply; and though this may appear a somewhat round-about way of attaining my object, I think it will really conduce to brevity and clearness.

First of all, I must state that the sugar which we obtain from the sugar-cane or beet-root exists already formed in those plants. It is not created by the process of manufacture, but exists in the plant, dissolved in water, in the shape of juice. But together with the sugar we find dissolved a variety of other bodies. I have in this bottle some of the pure juice of the sugar-beet which has been pressed out, and from the colour, which is nearly black, you will readily perceive that it is not a solution of pure sugar. It contains, among other bodies, a substance which approaches very nearly to the white of an egg, or albumen, and also some bodies like gums, the presence of which I can show you by adding to the liquid a solution of tannin, the astringent principle of oak-bark. By adding this, you will see in a few moments that these albuminous matters settle down in flocks, having formed insoluble compounds with the tannin; or I can show their presence more readily by using another reagent called "basic acetate of lead," which precipitates most of these albuminous and gummy substances as insoluble lead compounds. This basic acetate of lead has now produced a thick greenish precipitate in the beet-juice, and on filtering the mass you see that a clear, colourless liquid comes through, which you must understand contains the sugar of the original juice. Cane-juice contains the same, or similar impurities as beet-juice, though in much smaller proportions. The object of the sugar-maker is to remove, at a first operation, as many of these impurities as possible, so as to make his juice approximate as nearly as may be to a solution of pure sugar; but preliminary to the treatment of the juice comes the question of winning it, or getting it out of the plant. The most obvious way of doing that is to crush or rasp up the plant, thereby destroying the little cells in which this solution of sugar and other bodies is contained, and this is the method which is most commonly employed. I will go more into detail with regard to the extraction of the juice when I come to speak of the manufacture of beet-root sugar, which is that branch of the subject upon which I shall more especially enlarge; but I may here mention that there is another way of obtaining the juice, which, at any rate in principle, is preferable, but to explain to you what this is, I must first give an illustration of an important physical fact.

I have in this glass a solution of a gummy body, called dextrine, which is perfectly soluble in water, and a solution of which will readily filter through porous paper. I will mix with this a solution of bichromate of potash, which is a coloured salt, and, having mixed the two together, I will now fill a small sac, which is part of the gut of a rabbit, or some small animal, with some of this yellow solution. The sac is what is called watertight, and I will now suspend it in a vessel filled with pure water. In process of time, we shall see the solution of this orange-coloured crystalline salt, the bichromate of potash, find its way out through the walls of the little watertight sac, whilst the gummy body itself will not pass through the membrane. While that is proceeding, I will start a similar experiment on a somewhat larger scale. Over the mouth of this glass vessel I have a piece of parchment paper, which is quite watertight in the ordinary sense, but still it will allow this curious passage of some soluble bodies to take place through it, although it prevents the passage of others. I will put some of this mixture of dextrine and bichromate of potash into the vessel, and then placing it in a dish of water, we have the two separated simply by that piece of parchment paper, and we shall see that the bichromate of potash will pass through, whilst the dextrine will not. To show you how we can demonstrate the truth of this, I must now show you the reaction of the dextrine and of the bichromate of potash. First, I will put a little of the dextrine into water, and add to it a solution of iodine. You perceive that the liquid immediately turns a dark purple colour. By this means, therefore, I can detect the presence of dextrine if it passes through into the water. The bichromate of potash has a very remarkable power of colouring water, and accordingly, even a small quantity of it would be manifested by the liquid turning yellow; but as that is not very visible in this light, I will add to it a solution of acetate of lead, which will form in the liquor a precipitate, the chromate of lead rendering it opaque and yellow. This difference between the two bodies with regard to their passing through moist watertight membranes, is one which is observed between two great series. On the one side we have those bodies which, when dissolved in water, will pass through most membranes, animal or vegetable, when there is water on each side; and we have again other bodies which, like the dextrine, do not possess that power. Those which can pass through are, for the most past, capable of assuming a crystalline condition, and the whole class, therefore, has been designated crystalloid. The others more or less resemble glue in character, and are called colloids. The constituents of cane and beet juice are partly colloid and partly crystalloid. The solution of them is contained in little cells, which you may compare to the cells of an orange, the walls of which are capable of acting in the same way as this piece of membrane or this parchment paper, causing the separation of the two constituents of the cells, when slices of the plant are immersed in water, the crystalloid constituent passing outwards by this process of diffusion, as it is called, and the colloids remaining behind. If, then, we cut up a sugar cane or beet root into slices of a convenient size, and immerse them in water, the sugar, which is a crystalloid, and the saline particles of the juice, pass out into the water beyond, while the gummy bodies, to a great extent, remain behind; whereas when we rasp up the plant and squeeze out the juice, we get in it the whole constituents, colloid and crystalloid together. Theoretically, therefore, the diffusion process is preferable to the other. It is attended with some practical difficulties, which, however, have been got over very successfully in India, with regard to cane juice, and which I have seen worked suceessfully with regard to the beet-root, though people are not quite agreed about it.

I will now come to the subject of the solution of bodies. Everyone knows, more or less, what is meant by solution, but there are some limitations to the process which are not always understood. If we take a body which is soluble in water, you know it disappears like sugar or salt when stirred up with water. Here is some of the yellow salt which I used just now, and dissolving some in water, you see that the liquid is immediately coloured, and it will go on increasing in colour up to a certain point, but the water will not dissolve more than a certain amount at this temperature. In this bottle there is some of the same salt which had been shaken up in the bottle for some days; the liquid is saturated with salt at this temperature, but, though saturated at this temperature, it would not be so at another. For instance, if I put some of this saturated solution of bichromate of potash into a test tube, and add some more of the solid salt and warm it, we shall find that when the liquid is heated, the power of solution of the water increases, and the solid salt disappears. I may possibly have added too much, because hot water has limited powers of solution as well as cold, and if we continued adding the salt to the hot liquid from time to time, we should at length arrive at a point when no more could be taken up, and then the liquid would be saturated at a high temperature. But if, instead of heating this up to the boiling point, I had stopped short of that, and only saturated it at a temperature half-way between the boiling point and the ordinary temperature of the room. I should have dissolved more of the salt than at the lower temperature, but less than at the higher. You must understand, therefore, that it is not because a liquid is what is called warm that it will dissolve as much of a given body as it will when it is boiling hot. As a rule, that is not the case, especially in the case of sugar. The large quantity of salt which I added here is now entirely dissolved, but on cooling the liquid again you will see, of course, that that portion of the salt which has become dissolved in virtue of the heat will again be deposited, leaving above it a cold, saturated solution. It is important to recollect that this is the case, because on this fact depends the final extraction of sugar from its solutions. When the particles of salt, separated in this way from the hot, saturated solution, have time to arrange themselves in any way which the forces acting upon them may direct, they generally do so in very definite forms, and produce what are called crystals. On the table are two or three examples of crystals which have been formed in this way, by the slow cooling or evaporation of a liquid containing them in solution; the crystals are regular and of large size. But when the crystallisation produced is rapid—when it deposits more quickly—then we find that the deposit takes the form of small irregular crystals or grains. There is another way of obtaining a saturated solution of a soluble body, besides this one of dissolving it in a hot liquid, and then cooling it, which is this. If you take a weak solution of a body, and take the water out of it, you will obviously arrive at some point at which the body itself will remain relatively in excess. For instance, if I take a solution of common salt, and put it into a basin, and boil away the water, you will find that the salt will gradually crystallise out. Thus we arrive at the same result. We will now examine the result of our experiment on diffusion. I do not know whether it is very visible in the room, but to me it is perfectly clear that the water in the little jar, in which the sac was placed is coloured yellow, especially at the bottom; and on examining the dish of water in which the vessel with the parchment paper was placed, I think we shall find the same result. I will divide the water which was outside the dialyser, as it is called, into parts. To one I will add a solution of iodine, and although I have added a larger quantity than I did before, you see there is no perceptible increase of colour. If, however, I add some acetate of lead, which I will do to the other portion, the precipitation shows at once that a considerable portion of "bi-chromate" has passed outwards. This is merely to show you, by a rough method, what takes place when the juices of plants are subjected to diffusion. Now, taking the liquid within the dialyser, we find that the iodine solution at once acts as vigorously as before upon the dextrine.

I have treated this subject very shortly, but I hope you understand distinctly the point which I wish to impress upon you about the solubility of bodies in cold and hot liquids, that there is a limit in each case, and that between a cold liquid and the hottest which you can make, for every temperature there will also be a special limit to the power of solution. I am speaking in general language, because every chemist present knows that there are exceptions to this rule, and some few bodies are more soluble in cold liquids than in hot; but still the great majority of bodies behave in the same way as sugar, and sugar is far more soluble in hot water than in cold; and for every temperature between the boiling and freezing points of water there is a specified limit of solubility. I have shown you that when a hot saturated solution is cooled, it deposits the salt which was dissolved in it by virtue of the high temperature, but when hot saturated liquids are cooled slowly and carefully, they pass through the limit of saturation in a most curious manner. I have here a flask filled with a perfectly transparent and very strong solution of a salt called sulphate of soda. It is quite cold, having been heated at about 12 o'clock, and it has been standing for some hours in cold water. Still there are no crystals formed, although there is a great deal more salt dissolved in the water than could have been dissolved if I had merely shaken it up with the salt, that is, at present the liquid is what is called supersaturated, and this state of supersaturation will continue until the liquid becomes disturbed in a peculiar way. Some liquids require to be disturbed in one way, and some in another, before this state of supersaturation is destroyed. It may suffice in this case to simply admit the air by withdrawing the cork. As I do so, probably a small particle of dust falls in, and you see, extending from the upper part downwards, an extremely rapid crystallisation. So it will continue until the whole mass appears solid, the flask being in reality filled with large numbers of very minute crystals. At the same time, the temperature is somewhat risen, but we need not go into that. But what I wish you to understand from this experiment is that a liquid of a given temperature may at a given moment hold in solution more of a solid than it ought to, and in that case we call it supersaturated. We know nothing, I believe, at present why it is so, at least in many cases; in this particular case, I believe it has been fairly explained. I will illustrate the same point in another case, in order to show you that in some cases we must disturb the liquid in a particular way if we wish to obtain this sudden crystallisation. Here I have a solution of another salt, which has been dissolved for some days. It is one which will admit of considerable rough treatment in the way of shaking without crystallisation; but if I open the jar and drop in a very small crystal of the same salt which is here dissolved, in a few minutes the whole liquid will become solid from the formation of crystals of dissolved material. This shows you that it is more difficult to disturb the equillibrium of some liquids than others, and that you must seek special means for disturbing them in the right manner. If you dissolve in a liquid, sugar or any other body which is somewhat impure, which contains an admixture of foreign bodies, and then obtain crystallisation either by cooling a strong hot solution, or by evaporating off some of the water, you will attain a very considerable purification of that substance. In the process of crystallisation, the particles of the body come together and form a solid, leaving in solution those bodies which are present in quantities too small to crystallise out of the quantity of water still present and those which cannot crystallise at all. The crystals, when freed from their mother-liquid, must necessarily be considerably purer than the original material. This is an important point, because the purification of the crude sugar of commerce and rendering it into that beautiful white state in which we see it, depends in a great measure on the power of crystallisation to separate impurities.

Having thus treated, as far as I am able at the present time, the subject of crystallisation, both in the ordinary case and from supersaturated solutions, I must proceed to describe what we understand by the term boiling, and to show under what conditions liquids can be boiled, and how the temperature at which they boil will vary under certain circumstances. You have all seen water boiling, and you know that when water is contained in a vessel, and heat applied to the bottom, large bubbles, not of air but of steam, are formed there, and rise through the liquor, creating quite a commotion, which we term boiling. Let us go back from that for a moment to the evaporation of a drop of water. If you spill a drop of water, you know that in short time it dries up and disappears, it passes away into the air. This, of course, arises from the particles of the water gradually arising from the surface of the liquid into the air, and in so rising they had to overcome the pressure of the air on the surface of the liquid. You know that air presses with a force of about 15 lbs. per square inch, and that force tends to keep the particles down—to press them back into the water again. If that is the case, we should naturally suppose that if we could remove the atmosphere, the particles would rise more freely, and that is so. If we put a drop of water under the vacuum of the air pump, it dries up very quickly indeed, there being nothing to keep it back. But what do we do when we apply heat to a liquid in a vessel? You know that you can dry wet, moist writing, or any other liquid, before the fire more quickly than if you simply expose it to the air at ordinary temperatures. This must be because the heat causes the particles of water to rise more quickly and readily, that is, it gives them a greater force to overcome the pressure of the atmosphere. If you put water into a tube and heat the bottom, you give the particles a tendency to separate and fly apart from one another, and at a certain temperature they succeed in flying apart and form what is really a true gas, water vapour or steam, which, being lighter than the surrounding water, rises through it and disappears. Is it not plain, then, that if the pressure on the water is rendered less, we shall not have to heat the water so much to give this vapour an elastic force or tension sufficient to overcome the pressure? The lower the pressure to which the water is subjected, the less is the temperature to which we shall require to raise it, in order to make its vapour overcome the remaining atmospheric pressure on it. I can illustrate that by experiment. I have here a flask which is connected by a flexible tube with the receiver of an air-pump, so that when the air-pump is set working, it will draw more or less of the air out of the flask, and accordingly I shall be able to put warm—not boiling—water into the flask, and submit it to a less pressure than that of the atmosphere. Before doing so, I must first put a few little bits of some metal into the flask, or else the water will boil very irregularly. Water boils in metal regularly, but in glass very irregularly and with great commotion; but by putting in a few fragments of metal you overcome this difficulty. This water which I put in the flask is hot, but still it is much below the boiling point. Upon working the air pump a few moments, as the atmosphere is withdrawn, the force which the vapour will have to overcome will become less and less, and presently the pressure will fall so low that the vapour of this merely warm water will be able to come away out of the liquid as freely as it could if I had been applying a powerful heat to the bottom of the vessel, and thereby increasing the tension of the vapour. This boiling of water under these conditions is a thing which everybody is acquainted with, but still it is one which I am bound to bring before you at this time, because it is the principle of the vacuum pan which I shall have to speak of hereafter.

From this point I may pass on to a few reactions and decompositions of sugar itself, which I must mention, although they are somewhat tedious, and admit of very few experimental illustrations, which are visible at any distance. The precautions which are, or rather ought to be, observed in sugar-making depend on a knowledge of these decompositions, to which sugar is subjected when these precautions are not attended to. Sugar itself, in the purest form in which we have it, is a white crystalline body, sometimes occurring in very large crystals, composed of three elements only, carbon, hydrogen, and oxygen. The proportion in which they are united I need not trouble you with, but I may say that if other considerations allowed of it, we might regard it simply as a compound of carbon and water, the oxygen and hydrogen being in the same proportion as that in which they combine to form that liquid. When sugar is submitted to a variety of chemical actions, the first change which it submits to is a change of this kind, that the elements of water are either abstracted from it, or are added to it. The changes which occur where water is removed from may be illustrated thus:—When sugar is heated, it melts; then if the heating is continued slowly and arly, it parts with one molecule of water, then with another, then another, and so on, becoming successively converted into a variety of bodies, the names of which I need not trouble you with, but which, I may remark, are all uncrystallisable, and not sweet, and passing at one stage into a mixture of bodies having very dark colour, which I dare say is known to most of you under the name of caramel. This conversion into a dark coloured body, by the action of the heat, occurs, not only when sugar is heated by itself in a dry state, but also when it is heated for a long time in concentrated aqueous solution to a somewhat high temperature. If you take a very strong aqueous solution of sugar, and heat it in contact with a hot surface, a portion of it gets converted into this brown material, and colours the whole mass. One of the main improvements in the manufacture of sugar has consisted in evaporating the solution of that body at so low a temperature that this change of sugar into caramel can only take place to a very small extent. There is another change which I must refer to, of an opposite character, which consists in adding water to the molecules of sugar, not merely in the same way in which we add water when we dissolve it, but in a chemical sense, really adding water to its constituents. It is thereby converted into a mixture of two other bodies, very different in character, but having exactly the same composition. The one is known by the name of grape sugar, or dextrose, and the other under the name of fruit sugar, or levulose, specimens of which are on the table. These are the two substances which are produced by the addition of one molecule of water to a molecule of sugar; a change which can be effected only too easily in a variety of ways.

When a solution of sugar is heated, or only allowed to stand, in an acid state, the change takes place; even very minute proportions of one of the mineral acids, such as sulphuric or hydrochloric acids, act with extreme rapidity, converting the valuable, easily crystallised cane sugar into a mixture of these two other sugars, which are uncrystallisable and comparatively worthless.

I have prepared such a mixture here by the action of dilute acid on a weak solution of cane sugar; and then, by removing the acid employed, and by concentration of the resultant liquid I have obtained a body which is something like set honey. This change from cane sugar into that mixture of grape and fruit sugar is one which I cannot very readily illustrate, but I will endeavour, at any rate, to render evident that some change takes place. I will take here a solution of cane sugar, which I will divide into two parts. To the one I will add an alkaline solution of a copper salt, that is sulphate of copper dissolved in caustic soda by the aid of Rochelle salt, and which has, as you see, an intense blue colour. I add it to this solution of cane sugar, when you perceive the liquid remains blue, and on boiling it, unless the sugar was impure you will see no perceptible effect produced. I have boiled it, and the liquid is still of as bright a colour as before. Now, to the other portion, first diluting it, I will add one drop of hydrochloric acid, and heat it momentarily to the boiling point, or hardly that; you will now see that a marked change has taken place, for, on adding some of the sugar solution, so treated, to another portion of the boiling blue copper solution, a bright-red colour of suboxide of copper is formed at once, and the liquid loses its blue tint. The action of a very small quantity of acid for a very short time has so utterly altered the nature of the sugar, that whereas while it remained in its original state it was incapable of action on this alkaline solution of copper, now, when it has once been submitted to that action, it exerts a startling influence; it has, in fact, taken oxygen away from the copper, so that whereas you may conceive that this blue solution contains protoxide of copper, a compound of copper, with a certain quantity of oxygen; in this red precipitate which is formed here, we have a compound of the same quantity of copper with half as much oxygen, that is, half the oxygen of the copper is taken away by this altered sugar. Another way of illustrating this is, by boiling a portion of unaltered sugar in solution, somewhat diluted with water, with a strong solution of caustic soda. We shall find that it undergoes no alteration if it is perfectly pure. You may find it turn a very little yellowish on account of an accidental impurity, but if it is quite pure no visible change whatever will take place. This I wish you to remark particularly, because one of the principal processes in the preparation of sugar from the sugar beet consists in heating the solution with a quantity of lime, which is, in its action, perfectly analogous to soda, being a very strong alkali. It exerts no action on cane sugar, but a very powerful action indeed on the altered sugar, or, as it is sometimes called, invert sugar. I will now repeat the experiment in the same form, only replacing the unaltered sugar by some which has been momentarily heated with a drop of acid. Both the new sugars are totally destroyed as sugar, and the whole liquid turns dark brown, almost black; in fact, the sugars are literally burnt up by the alkalis, although the true cane sugar submits to no alteration.

I must now show you another change which sugar undergoes, or rather, it is the same change as that which takes place when it is acted upon by acids, but produced by different re-agents. You recollect that a solution of pure sugar, when boiled with an alkaline solution of copper, which has a brilliant blue colour, does not undergo any change. I will now get the solution of copper boiled, and add to it presently a solution of sugar which has undergone another alteration. I have here a solution of sugar which gives no reaction with this blue liquid; it is very gently warmed, about ordinary summer temperature, and I will add to it a small quantity of yeast, stirred up in water, and allow it to stand a minute or two. You know what yeast is—a body which rapidly produces fermentation in a decoction of malt or any sugary liquid. It will not in this case have time to induce fermentation, but it will have time, even in a few minutes, to produce the initial change of fermentation; the conversion of this crystallisable cane-sugar into the uncrystallisable mixture of dextrose and levulose, the so called inverted sugar. This copper solution is now boiling, and I must first show you that the yeast itself is not capable of producing precipitation. Being a cloudy body it will render the liquid rather turbid, but it does not precipitate the red oxide of copper which, as I showed you just now, the altered sugar does in a ready manner. I have here a portion of the same blue liquid boiled in another flask, and now, after the sugar has been only a minute or two in contact with the yeast, on pouring some of it into the copper solution, you perceive the whole of the blue colour has been destroyed, and the liquid has turned red, owing to the precipitation of the sub-oxide of copper. The importance of these experiments is this, that it illustrates how excessively pernicious to a sugar-maker it must be to allow even incipient fermentation to occur. If the least trace of fermentation occurs, it inevitably causes the conversion of a very large proportion of valuable crystallisable sugar into the almost worthless uncrystallisable variety.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Lieut.-Colonel Scott, R.E., secretary.

Belgian Annexe.—This Annexe is being erected by "La Société Belge pour l'Encouragement de l'Art et de l'Industrie aux Expositions internationales de Londres et Brussels." The tender of Mr. S. W. Aries, Atlas Building Works, Putney, under revised plans and specifications, has been accepted. The amount of it is £2,400.

EXHIBITIONS.

EXHIBITION OF IRISH ART AND INDUSTRY.

At a recent meeting of the promoters of this exhibition, presided over by **Lord Talbot de Malahide**, the following rough draft of the general plan was read:—

"In order, as far as possible, to utilise the Exhibition Palace for the legitimate purposes for which it was originally destined, and at the same time to furnish it with resources available for educational purposes, the proprietors have decided to set apart that portion of the building known as the Leinster-hall for the purpose of a special exhibition of the arts and manufactures of Ireland. For this great national undertaking space will be allotted, entirely free of cost, for the advantageous display of the various products of nature, art, and industry. Through the co-operation of an influential committee of noblemen and gentlemen, under the special patronage of his Excellency the Lord Lieutenant, this project will be carried out in a manner worthy of its importance, and cannot fail to be attended with results beneficial to the commercial and manufacturing interests of Ireland. The movement has already received the active and cordial support of the leading manufacturing firms. While no reasonable person will deny the utility of museums of technical education, as helping to cultivate and improve the tastes of the masses, it is at the same time a fact that such institutions do not in themselves possess sufficient elements of attraction to render them even self-supporting, and, as a consequence, they seldom exist unless by government support. Now, the present favourable opportunity for the introduction of such a valuable and important adjunct to the general plan of utilising the Exhibition Palace, independent of government aid, ought certainly to commend itself, and it can no doubt be accomplished at the present time under circumstances exceptionally favourable. The establishment of a permanent exhibition, to apply some of the advantages to Ireland which England possesses in the unrivalled collection of art-treasures which are available for educational purposes at South Kensington, but for all practical purposes are of little or no benefit to those engaged in this country in the higher branches of industry, would no doubt be a great boon. The loan collection will comprise objects of artistic and historic interest, and a movement will be made in this department, by the organisation of a committee, to bring together, for purposes of reference, comparison, and study, some of the art treasures of private collections, which are usually accessible only to a limited few, thus giving students and others an opportunity of enriching the domain of artistic industry. The question, too, of establishing a national portrait gallery has also met with marked approval. The sculpture and picture galleries will be replete with objects of art of a high character, and will embrace the best examples of the British and foreign modern schools. An attractive selection of works of art will thus be insured, to which the general public will have access, and opportunities will be thus afforded to purchasers for negociating sales direct with the artist, and thus avoiding any intermediate profits. To insure to a large extent the sale of pictures and other works of art exhibited in the Exhibition Palace, it has been decided to set aside 20 per cent. of the gross amount realised by the sale of season tickets, to be devoted to the purchase of pictures, statuettes, and works of art exhibited for a period of not less than three months previously, so that at the end of each year every holder of a guinea season ticket will be entitled to draw by lot for prizes, and the holder to exercise the right of selecting some work of art to the extent of its money value. For example, if 2,000 season tickets are issued, the respective holders would be entitled to draw for prizes to the *bona-fide* value of £400, or if 5,000 season tickets are sold, the prize would then amount to £1,000. The element has been introduced with a special regard to the interests of exhibitors and artists, and will be the means of securing annually a large and important sale of their works, and their rendering some recognised assistance to the cause of art. The exhibitors' department will be specially represented by an attractive and comprehensive display of British and foreign goods, exhibited on a system similar to that which has been so successfully adopted at the Crystal Palace. It is intended that the interior of the Exhibition Palace, which will be appropriated to useful as well as ornamental purposes, shall represent the highest example of floral culture, and the garden and grounds an artistic, and, as far as practicable, perfect display of ornamental gardening. Fountains, statuary, and other appropriate devices will be introduced, to add effect, and otherwise tend to render the Exhibition Palace in every respect worthy of public patronage as an attractive winter and summer resort. The general public will have access to the building and grounds every day in the week, on payment of 1s., except on Saturdays, when the charge for admission will be 2s. 6d. Season tickets, available for one year, will be issued, at a charge of £1 1s. for adults, and 10s. 6d. for children under twelve years of age, with a reduction of 25 per cent. if three or more are taken by members of one family. It is to be hoped that these measures for utilising the Exhibition Palace, so worthy of public support, will prove a credit to the capital, by placing in its possession a national institution, established for the purpose of combining high-class amusement and legitimate and intellectual means of recreation, with the more laudable object of helping to nurture and develop the commercial and manufacturing interests of Ireland.

In answer to a question whether it was intended that the manufacturers of other countries—England and Scotland—should be invited to send in their manufactures to compete with the Irish, or was it intended that all they exhibited should be of Irish origin?

Sir Arthur Guinness said that, so far as he knew, it was intended that English and Scotch, and all other manufacturers who wished, could exhibit.

Sir W. Wilde suggested that in the exhibition they should have a collection of ancient Irish art. When the Prince of Wales was in Ireland he (Sir William) had the honour of escorting him through their museums, and he then and subsequently expressed in strong terms the very great interest he felt in the collection, as being more truthful than any picture that could be exhibited.

Mr. Pim, M.P., proposed—"That it is expedient that a committee of ladies be formed, for the better collecting and selecting of laces, embroidery, and other fancy work."

Mr. Kenehan seconded the resolution, which was also passed.

The Chairman said that although somewhat out of the usual course, he begged to propose a resolution to the effect that the council earnestly solicit his Excellency the Lord Lieutenant to intercede and help to induce her Majesty's government to lend a portion of the magnificent collection from the Science and Art Department of South Kensington.

Mr. W. H. Fry seconded the motion, and said that as on a former occasion there appeared to be no difficulty thrown in their way to obtain a portion of the collection, he trusted, now that a building had been provided for them through the munificence of the Messrs. Guinness, that their request would be acceded to.

The resolution was passed.

EXHIBITION AT BOGOTA.

This exhibition, says a correspondent, although not fully illustrating the natural wealth of the States of Columbia, presents such a variety of objects as to be well worth the inspection of European visitors, whose more extensive experience in utilising the spontaneous production of countries, the resources of which have been but little developed, may be most profitably turned to account in applying the many new and valuable raw materials to the requirements of the arts and sciences, and to manufacturing purposes.

In the halls, and on the tables, and in show-glasses at Bogota are to be found united and classified a large collection of metals, precious stones, valuable woods, textile materials, industrial and medicinal plants, exportable articles of food, dyes, and cotton. Besides caucho, coffee, and quina, are also shown agricultural produce, the silkworm, wax, animal and vegetable wool, with a great variety of useful varnishes. The exhibition of the varieties of the silkworm and its cocoons, sent from Santander, Casanares, Cundinamarca, Tolina, Cauca, and Antioquia, speak well for the satisfactory condition of the silk culture and manufacture in those states. Vegetable wax, produced by a species of laurel found in the cooler altitudes of the republic, has been sent in great quantities, more especially from the state of Cauca, which produces it beyond all expectation. The tree is successfully cultivated from the seed in Silvia. This kind of wax is used in the form of candles, and is also made into soap. A species of resin or wax is also obtained from a palm in Antioquia, which is found useful for light and for giving stiffness to felt hats. It would not be an easy matter to displace from the public mind the superiority of tea and coffee over any substitutes, but the tea of Bogota, discovered and introduced by the Columbian botanist, Mutis, may be worth a trial, as a cheap addition to other nitrogenous articles of diet. The specimens of indigo now rival those sent from Bengal, Java, and Madras.

With regard to the State of Antioquia in particular, which contains 370,000 inhabitants, an article, published in *El Buen Publico*, of Bogota, by Senor Aucozar, says that there are in the exhibition 72 specimens of cabinet and building woods, many of them admitting the finest polish, and with varied colours and veins; the timber for construction possessing all the qualities of elasticity or rigidity, size, or incorruptibility suitable either for subaqueous, open-air, or underground structures. There are gums and resins; caucho of excellent quality, from Zaragoza and Porce; the *anime* and *algurroba* gums, so efficacious against cutaneous diseases. Other resins give an oil very suitable for illumination, and one from the *Higueron* is as compact and elastic as caucho, and would be a good substitute for it. It is found in abundance near the city of Antioquia, and on the banks of the Magdalena, between Nare and Honda. Specimens of *tagua*, or vegetable ivory, and *toparos*, a smaller nut, exceedingly hard, which is made often into tinder boxes adorned with silver. Besides these, and very remarkable, is the *coca de mona* (monkey's cup). It comes from a tree about fifty feet high, of which it is the fruit, and is suspended from the branches, presenting an appearance like small-sized cocoa nuts, full of nuts, and furnished with a lid. The monkeys are exceedingly fond of the inner nuts, which taste like chesnuts, and take the lid off with great dexterity. Medicinal plants fill up the whole of two large shelves; the most notable being the yellow quina of Zaragoza, and the sarpoleta, which is even more febrifuge than quina itself; *Canafistolus* of all sizes; the cocoa leaf, preferable to the Bogota tea; China root, for purifying water; *valdivia*, a most powerful poison; *gavila*, an antidote for snake bites; hæmostatics, purgatives, caustics, for healing wounds, and drugs for almost all diseases. Cotton of three kinds, one giving fibres a decimetre long and very white, and a variety of other fibres suitable for manufactures. Among vegetable dyes, are three varieties of green. The *achirilla* dyes golden yellow, and the *bruja* a splendid red. The *ojo venado* gives an intense black, and the leaves of the *ojo de beuy* have hæmostatic qualities. The fruit of the sagua dyes a beautiful blue, equal to indigo. From the mines were 176 specimens of metalliferous rocks; three geologic; nine different kinds of limestone; four of sulphate of soda, magnesia, and iron; six of fire-clays and kaolin, all of which filled three large tables, proclaiming the richness of Antioquia in minerals, coal, cinnabar, and mispickel. This splendid collection, too numerous to mention, is finally destined for the National University. 171 specimens of crystalline gold in every geometric form; 90 of gold jewels, worked by the native Indians before the conquest. The iron works at Amoja sent specimens of malleable iron of all shapes and colours, and of the best quality. It has been observed in Bogota, that the foreigners who have visited the exposition were more attracted by the beautiful and valuable woods than the mineral riches of Antioquia, the pearl shells of Panama, or the magnificent emeralds of Muzo.

TRIAL OF COTTON GINS.

The trial of cotton gins, which commenced at Manchester on the 28th of November (see *Journal* 995, p. 92), terminated on Saturday, the 23rd inst. The *Manchester Courier* says:—

The total number of gins entered at the commencement of the trials was 19, but three of these withdrew from the competition. The gins entered for competition may be arranged in three principal classes, as roller gins, knife and roller gins, and saw gins. The only example of a pure roller gin is M. Chaufourier's "churka," an adaptation of the native cotton gin or "churka" of India. It consists of two steel rollers, each about half an inch in diameter, spirally grooved to increase their hold on the fibre. The seed cotton is brought up to the rollers on an endless band. The interval between the rollers is too narrow for seeds to pass, and their circumference is too small for seeds to be grasped and crushed between them. The seeds are, therefore, simply held back, while the fibre is carried onwards, and they fall into a receptacle, where they are completely detached. The weak points of the instrument are, that the rollers are liable to become heated, and that their small size renders it necessary to have them very short, or to interrupt their continuity by many points of bearing. M. Chaufourier has devised an ingenious fan by which to keep his rollers cool, and the difficulty about many bearings is one that he hopes soon to overcome. The knife and roller gins in competition are 11 in number. They all depend on what is called the Macarthy roller, a spindle usually of iron, covered with closely-packed rings of hard leather, scored on the surface by lines forming lozenge-shaped divisions, and producing a sort of roughness which assists in dragging the fibre in the direction of the motion. These Macarthy rollers are all in relation with some form of blunt knife, the edge of which drives back the seed as the fibre is drawn forward. In some forms, the knife is a single blade; in others there are two blades, one behind the other. In one form the two blades meet like jaws. In others the continuity of the blade is broken in various ways. Circular knives are placed obliquely upon a spindle, or short knives are arranged at intervals on projecting arms. In one, a two-edged knife is made to play to and fro between two rollers, and thus to accomplish more work in a given bulk of machine. But in all the principle is the same—that the knife prevents the seed from following the fibre as the latter is drawn away. The saw gins are of American origin, and are believed to be best adapted for American cotton. Three examples are at work, one made for American planters by Messrs. Dobson and Barlow, the other two from the government factory at Dharwar. The saw gin consists essentially of an iron plate cut into alternate bars and interspaces like those of a gridiron, and with the blades of circular saws projecting through the interspaces. As the saws revolve, their teeth drag the fibres with them, and the bars hold back the seeds from following. On the other side a spindle carrying brushes revolves behind the saws, and clear their teeth of the entangled fibre, which, thus set free, is blown by the current of air produced by the machine into a room or space enclosed to receive it. Saw gins are said to lacerate the fibre, and it is considered necessary that the intervals between the teeth should be rounded off, and not left sharply angular at the apex. A modified form of a saw gin, called "toothed roller gin" by Messrs. Garnett, the makers, presents many peculiarities of interest. Its teeth are cut in the edge of a piece of flattened steel wire, which is then wound spirally round a roller, and affords great facilities for rapid renewal in case of wear or breakage. The roller is fed from above by another roller, grooved in the direction of its axis; and the machine admits of being equally well made in any size, so that it may be worked either by one man or by steam or water power. A further trial of gins is announced to take place in January.

CHANNEL STEAM-FERRY.

The French government has appointed a commission to report upon a projected line of mammoth steamers, which is intended to run between the Admiralty Pier, Dover, and a new harbour to be constructed at Calais.

The new scheme is brought out under the auspices of M. Dupay de Lôme, the celebrated French naval architect, as president of the Conseil d'Etude, M. Dupay de Lôme acting both in his own name and also in the name of the Société des Forges et Chantièrs de la Méditerranée, MM. Drouyn de Lhuys, Scott Russell, and others.

The leading features in the new project are the construction of three large and powerfully-engined steamers, the dimensions of which will be:—Length over all, 450 feet; breadth at water-line, 50ft.; depth, from deck to bottom of the hold, 32ft.; deckhouse, 8ft.; draught of water when loaded, 13ft. 3in.; displacement, 4,000 tons; diameter of paddlewheel, 50ft.; immersion of paddlewheel, 10ft. Each wheel will be driven by an engine of 700-horse power nominal, capable of working up to 3,500, giving an aggregate of 7,000 horses to each vessel. The two wheels will be distinct from each other, this allowing them to be worked at different rates of speed, or in opposite directions, to assist in bringing the steamer alongside the wharf or to turn the ship round in little more than her own length. On a lower deck will be a double line of rails, each line being of sufficient length to receive 15 railway carriages and waggons, making in all a train of 30 carriages. The estimated rate of speed will be 18 knots an hour, whereby it is hoped to perform the passage in one hour and ten minutes in fine weather, and in one hour and 30 minutes in bad.

By using two steamers, and having one in reserve, the projectors would be enabled to make six passages each way daily, thus carrying 2,680 passengers and 2,640 tons of goods per day, or 978,200 passengers and 963,600 tons of goods a year. The cost of these steamers is estimated at about £138,200 each, or, in round numbers, £500,000 for the three.

To receive these mammoth steamers it will be necessary to construct a new harbour or dock. The site selected is a mile and a quarter to the north-east of Calais pier-head, and at a distance of three-quarters of a mile from the shore. The dock is intended to be built in the form of a quadrant, with its convex or north side towards the sea. This sea-wall will be constructed of very solid masonry, 52ft. 6in., with a parapet ten feet high and five feet thick. The extreme measurement of this sea-wall will be 3,000 feet. From the north-east extremity a stockade 1,500 feet long will run in a slightly-convexed line towards a similar stockade 470 feet in length, starting from the north-west horn. Between the two stockades will be a space 262 feet wide, to serve as an entrance. These stockades will be made of wood, like the existing jetties at Calais. The area of this dock will be 147,094 square yards. The north-east horn of this dock will be connected with the shore by an iron bridge, on arches of 170 feet span, and carrying a single line of rails in connection with the Northern of France railway. The height of the bridge at its junction with the dock will be 23 feet. It is the hope of the projectors that, by having such a wide span as 170 feet, a current will run between the dock and the shore, thus preventing any silting up. Trains arriving by this bridge will continue on an inclined line of rails running round the outer circle of the stone wall, yet protected by a stone parapet. A train having reached the north-west or furthest horn of the dock, will then be pushed backwards on to the line of rails in connection with one or other of the three landing stages (which are adapted for different heights of the tide), and these, by means of a movable gangway, will connect the line of rails on shore with the rails on board the steamer. The steamers will lie alongside a stage, with their sterns backed into a small dock, which will form the end of each line of rail; the train on board the steamer will immediately get under way, and the passengers will be at liberty to leave the carriages, and walk about the vessel's deck. The steamers will be fitted with saloons and ladies' cabins for first and second class passengers, as also with state cabins for those who desire privacy.

The projectors ask of the French government four things:—

1. The authorisation to construct a *gare-maritime*, or dock, at their own risk, such dock to remain their sole property in perpetuity.

2. That the bridge to connect this dock with the shore and the Northern of France Railway shall be made at the cost of either the French government or the Northern of France Railway.

3. That the French government will use their good offices to induce the English government to execute the necessary works at Dover for embarking and disembarking the trains brought from the steam ferries.

4. That the French government will enter into a mail contract for twenty years, with an annual subsidy of £20,000.

The projectors hope, if all these are granted, to obtain a similar contract and subsidy from the English government, for carrying the English mails. The projectors calculate on two years and a-half to put their plans into execution, and propose that the contract of twenty years begin to run two years and a-half after the state concession shall be granted.

EDUCATION IN SWEDEN.

Education is well attended to in Sweden, judging from the printed documents issued by the Swedish Department of the late International Exhibition. From these it appears that popular or elementary schools *(folkskolan)* are established and supported by each parish, with certain help from the State. They are divided into two distinct kinds; the fixed school *(den fasta folkskolan)* and the movable or migratory school *(den flyttande folksholan)*, local difficulties having prevented the establishment of fixed schools in all places, but their number is increasing. In 1868, the whole number of parishes amounted to 2,500; the number of fixed schools to 2,303. Where forests, hills, or lakes have hindered the establishment of fixed schools, instruction has been carried on in these movable or migratory schools, many of which by degrees have become converted into fixed schools. As the elementary schools are for the benefit of the community, each parish is bound to maintain its own elementary schools; but, since 1842, when the school law was enacted, grants from the State for the support of the schools are given on certain conditions. The great proportion of the grants for popular education is raised by a general tax, called the school tax *(folkskoleafgift)*, which every taxpayer must contribute for himself and his household. This tax is levied on the principle that each member of the community able to work should pay something towards the education of poor children. Besides this tax, the State grants are:—Aid for the payment of the teachers at elementary and preparatory schools; aid for higher elementary schools; help for poor parishes; help for the supply of school appliances at a reduced rate.

According to the general principle that the communities ought to bear the principal expenses for their schools, the State gives its help on condition that the parish pays for the schools a sum equal to the above school tax *(folkskoleafgift)*; and the parish must, besides this, pay a proportion for each kind of support from the State, namely, while the State pays two-thirds to the higher elementary schools, the parish pays one-third. The State pays half the teachers' salary, the parish the other half. The State pays one-third the expenses of the preparatory schools, the parish two-thirds. The State bears the expenses of the education of teachers and the payment of inspectors. Ninety-seven per cent. of the whole number of children at the school age, which is considered to be between the age of seven and fourteen years, are under instruction in Sweden. The other three per cent. are without instruction in consequence of infirmities or some other reason. The salary of an examined teacher at the elementary schools is fixed at not less than 400 riksdaler Swedish (£22), including eight barrels of corn, paid in kind, besides emoluments for lodging, fuel, fodder for a cow, and land for planting, as well for his own wants as for instruction in planting of trees. Examined mistresses receive the same income as masters. In about eight hundred parishes the teachers are, at the same time, clerks, who have an annual income of at least fifty barrels of corn; and at some few places the clergymen are also teachers in the elementary schools, and then receive a higher pay than usual. Those teachers whose service exceeds eight months in the year receive two barrels of corn for each extra month. When a teacher has attained sixty years of age, and after thirty years' service, he becomes entitled to three-fourths of his annual income as a pension. Pensions are also given, on some conditions, after twenty-five years' service.

The subjects taught in elementary schools are—Religion, the Swedish language, arithmetic, geometry, history, writing, drawing, singing, gymnastics, drilling exercises, gardening, and the planting of trees. The treatment of religious instruction has, during the last years, greatly improved. This instruction begins with Biblical history, orally during the first period to the little children, and illustrated to them by pictures. Much attention is paid to reading aloud, which alternates in several schools with writing exercises, in such a manner that children learn to write and read at the same time. Orthography is generally taught, and the children are not only taught to read fluently, but to understand what they read, and to be able to tell it in their own words. Exercises for children to express their own thoughts in writing have been generally introduced. Considerable progress has of late been made in the teaching of arithmetic, which is taught in a practical manner. Oral arithmetic has become more general. Geometry has hitherto not been much taught in schools. It is taught practically by measuring and calculating the most simple figures. By the use of stereometrical models, this subject has gained greater interest. Swedish history and geography are principally taught, but the history and geography of other countries are also attended to. Wall maps are used for instruction in geography, and the Department for Public Instruction has published various maps, as well as terrestrial globes. About thirty per cent. of the children instructed have been taught natural history. This instruction becomes more general every year, and is given by means of physical apparatus and collections of plants, minerals, and other natural objects. Many of the pupils write in a very good style, and the number taught writing during the last four years has considerably increased. Drawing is taught only at a few places, but as it is a subject which, during the last few years, has gained greater interest, no doubt it will soon be taught at many of the schools.

Instruction in singing is now given in most schools. In some places the sol-fa method is used, but in very few. Gymnastics are now introduced in most elementary schools, and drilling exercises become more and more common. Gardening is a subject in elementary schools which has hitherto been generally much neglected. In the most part of the inspecting districts gardening has made very little progress; in other districts it has begun to advance; 2,078 schools in the kingdom have their own ground for planting. Teachers are now obliged to learn gardening before leaving the normal schools. In case a child, for some reason, cannot remain at school a sufficiently long time to learn the abovementioned subjects, he may leave after having learned to read and write well, and being able to do the first four rules of arithmetic; he must, besides, have gone through a course of religious and Biblical history, for confirmation. The instruction is gratuitous, but the parishes have the power to enforce a small fee from every child who is not poor, if necessary for the support of the school, but this demand is rarely made. All children of the school age must go to school, excepting those who are taught either at home, at a public college, or private school. Children taught at home must undergo examination every year at the elementary school, in order that the school board may ascertain if the instruction they receive, in quality and extent, equals that given at schools. If parents and guardians do not follow the rules laid down in regard to children going to school, the children may be separated from their parents, and placed in the care of other persons. The vicar of every parish is bound twice a-year to make out a list of the children who during the last half-year have entered upon the school age. Before leaving school, children have to pass an examination, to show the progress they have made at school.

Elementary schools are kept open eight months a-year, and the instruction is given five days a-week, and six hours a-day. Private schools are also under the inspection of the school board. If anyone wishes to establish a school, application must first be made to the school board. If the person has a good character, and proves himself to possess the necessary qualifications for teaching, permission is granted. It is the duty of the bishop and the chapter in each diocese to look after the education of the people; and, since 1861, the State has employed inspectors, who are chosen by the Minister for Public Instruction, generally for a term of three years. It is their duty to look carefully after the public instruction within their districts; to acquire a knowledge of the state of the schools; to ascertain if they are in want of anything, to give notice to the school board; and to give the teacher directions and advice. The inspector has to make an annual report of the schools to the chapter of the diocese, and every third year to the Minister. In this report to the Minister, the inspector has to give information respecting the progress of the schools, and to give an account of each establishment. These reports are printed at the cost of the State, and distributed to the school boards throughout the kingdom. The State pays an annual income of 40,000 riksdaler, or about £2,200, for the salaries of the inspectors and their travelling expenses.

There are nine normal schools *(folkskolelärareseminarier)* in Sweden, for the training of masters and mistresses of elementary schools; seven for male and two for female teachers. A normal school has three classes, the lowest being called the first. Pupils generally remain one year in each class. An elementary school is attached to each school, to give the pupils an opportunity of practising as teachers. Religion, the Swedish language, history, geography, arithmetic, geometry, natural history, writing, drawing, music, singing, gymnastic and drilling exercises, gardening, and planting of trees, are taught in the normal school. Besides this, instruction is given in pedagogy, or the art of imparting instruction. In the normal schools, instruction is given 36 weeks a-year, 42 hours in a week. The rector of a normal school must be doctor of philosophy, and the teachers have to pass the examination necessary for admission into the university. No one can be received in a normal school till he has reached 17 years of age. The instruction is gratuitous. Public examinations of pupils take place every year, and those who pass their examinations satisfactorily receive a certificate.

Besides the above elementary schools, there are public secondary schools supported by the Swedish government, for the purpose of imparting a general practical education of a higher class than that given in the primary schools.

The secondary schools are divided into higher and lower. The entire course of school studies extends over nine years. After pupils have passed through all the classes of a complete secondary school, they are subjected to an examination, in order to ascertain whether they have acquired the degree of knowledge which it is the purpose of secondary schools to impart. At the higher secondary schools, those pupils who have passed through the entire course of school studies are subjected to a final examination, which takes place under the control of censors (generally university professors) appointed by the king. The examination is partly in writing, and partly oral. Pupils who pass this examination receive testimonials of their acquirements in the several subjects of study, and also of their general education. A certificate of having passed the final examination entitles to admission to the universities. The bishop is the general superintendent of all government secondary schools within his diocese.

In addition to the general qualifications requisite for government appointments, proofs of competency must be given by candidates for the post of teacher in the secondary schools. Assistant-masters in the higher and lower schools are required to have passed the university as graduates in philosophy; to have attended and acted for one year as student teachers in some secondary school, and to have gone through a special test of competency in connexion with the appointment sought. Masters, who are called "lectors," are required, in addition to the foregoing, to have taken the degree of Doctor of Philosophy, and head-masters, called "rectors," to have passed the test of a Latin disputation. As regards the competency of teachers of music, drawing, and gymnastics, special regulations are provided.

The pay of teachers is proportioned to the time they have served. On proof of having served a certain number of years with zeal and ability, teachers are promoted to a higher grade as regards pay, on the recommendation of the chapter, subject to the royal sanction. The salaries are paid by the government. In addition, the head-masters are supplied by the corporations of those towns in which secondary schools are established with dwellings, or an equivalent for house-rent. In some cases other teachers beside the head-master have the same privilege.

Pupils are admitted to the secondary schools at ten years of age; and as the complete term of study extends over nine years, the normal age for leaving school should be nineteen, but as many of the pupils are older when they enter school, the real medium age of pupils leaving school somewhat exceeds nineteen years. There are no schools in connexion with which lodging is provided for pupils. Pupils either live at home with their parents, or are boarded and lodged with private families. The superintendence of pupils out of school hours is, consequently, mainly left to their parents or those with whom the pupils reside. Each term the pupils pay certain fees, which amount to a very small sum, and poor pupils can be exempted from paying these fees by the general superintendent. At every higher secondary school there is a library open for use, both to the teachers and pupils of the school and to other persons residing in the town or neighbourhood. Some of these libraries contain very valuable collections of books, engravings, and manuscripts. At many of the higher secondary schools there are very considerable collections of objects in natural history, especially in zoology, and many schools are provided with instruments and apparatus for experiments in physics, chemistry, and other sciences.

In each diocese, the following funds must be provided for the requirements of the secondary schools:—

1. A building fund, the principal income of which is derived from the savings of one year's pay of functionaries—other than teachers—in the ecclesiastic service, who have either resigned or been dismissed from the service, or who have died without leaving widow or children entitled to enjoy a "year of grace."* This fund is applied to building or repairing school houses within the diocese.

2. A prize and poor fund, the proceeds of which are annually distributed amongst the schools of the diocese, and applied in awarding prizes and granting assistance to deserving pupils.

3. An "Emeritus" fund, which is applied to pensions, or the increase of pensions granted to teachers who have retired on account of age or infirmity.

In connection with each secondary school, the following funds must be organised:—

1. A fund for school requisites and appliances, employed in the purchase of school materials.

2. A prize and poor fund, the proceeds of which are applied in awarding prizes for diligence and progress, and in granting aid, attendance during sickness, or relief to the most needy pupils.

3. A library fund, for the purchase and binding of books.

4. In addition to the foregoing, every school must have a special fund, which is chiefly applied to defraying the wages of the school porter, and the expense of lighting and fuel. This fund is supported by the entrance fees and the additional contributions, proportioned to requirements, imposed upon pupils each term.

Foundation funds, established by private individuals for the encouragement of poor, well conducted, and diligent pupils, are connected with most schools. The school laws enacts that every school-house shall be built so as fully to answer the purposes for which it is intended. The class-rooms must be of sufficient number, spacious, light, cheerful, airy, furnished with stoves, and generally arranged with a careful regard to the health and requisite comfort of pupils during school-hours. At some places it is the duty of the town corporation to erect and maintain school-houses. When this is not the case, school-houses are erected and maintained from the common building fund of the diocese, and the special building fund of the particular school in question. The town corporations, also, are bound—even when it is not incumbent upon them to build and maintain school-houses—to grant, free of cost, open, healthy, and well situated building plots, sufficiently extensive to afford space for gymnastic exercises, and for the play-ground of pupils.

A general idea of the approximate cost of erecting buildings for higher secondary schools may be obtained from the following statement of the cost of building some of the school-houses lately executed. The cost of building the school-house of Upsala, exclusive of the purchase of the ground, was about £17,700, of which about £11,500 was for the building itself and a hall for gymnastic exercises; about £1,390 for a warming and ventilating apparatus, about £770 for laying on gas and water, and fitting up a lightning conductor; about £1,388 for furniture; about £388 for organ and organ loft; about £360 for laying out, planting, and fencing the premises; about £360 for building the lodge of the attendant on the warming apparatus, and the remainder for fittings and appliances in the gymnastic hall, the architect's fee, and other items. The building contains twenty-six class-rooms, a large hall for prayer and special occasions, a drawing room, a library with an adjoining reading-room, a music-hall, a laboratory, rooms for the collection of objects of natural history, store-rooms and apartments for the school-porters. A separate house is erected for the residence of the head master at a cost of about £700.

There are only seven private secondary schools in the kingdom. Four of these schools have obtained the right of instituting final examinations, on the same system as that adapted at the public schools. The remainder of the schools are more or less incomplete. All the schools hitherto described are established for the education of the male sex. For the education of females there is, with the exception of primary schools and the normal schools instituted in connection with them, only one school supported by the government, viz., the normal school at Stockholm, for the education of female teachers and governesses, to which is annexed a secondary school for girls.

For the maintenance of the above institutions, the government has granted 25,000 riksdaler, equal to about £1,390 per annum. The question of establishing secondary schools for girls has frequently been mooted. By royal command, of the 7th December, 1866, a commission was appointed to examine and report whether, and to what extent, it would be expedient to extend the principle of establishing public schools for females at the cost of the government, and the manner in which such schools should be organised. The report of the commissioners recommended the establishment of secondary schools for girls, with seven and five classes, to be maintained chiefly by the government, but with certain obligations on the part of the communities to which they should belong. In most towns in Sweden there already exist private secondary schools, or so called pensions (day and boarding schools), for girls, of various degrees of importance. The expense of these private schools is defrayed by the pupils.

THE UTILISATION OF SEWAGE AT MILAN.

Now that the sewage question is prominently brought into public notice, and especially as an important branch of the subject has again been raised by Mr. Bailey Denton's recent paper on "Sewage as a Fertiliser of Land, and Land as a Purifier of Sewage," some particulars as to what is being done at Milan by the Società Vespasiana, a company established about two years ago for dealing with the liquid refuse of the public urinals in that city, will be of interest.

The urine is sold at the rate of 50 centimes per 100 litres (or less than one farthing per gallon) in petroleum barrels, holding about 175 litres each, so that the value of a barrel would be nearly 90 centimes. The barrels are lent gratis to the purchasers for ten days, after which time five centimes per day are charged for the hire of each barrel.

The urine sold as manure is mixed with water or earth, in the proportion of one part urine to two parts earth or water. This mixture forms an excellent manure for almost every kind of crop, but more especially for cereals and meadow lands.

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* It is the practice in the ecclesiastical service, on the decease of a functionary, to leave his post vacant for the succeeding twelve months, in order that his widow or children may enjoy the proceeds of the saving thus accruing. This is called a "year of grace."

A mixture of peat and urine is sold at 2·50 fr. per quintal (about 1s. per cwt.), and is highly recommended as a manure for mulberry trees and for market gardens.

A chemical process, introduced by Dr. Cardone, is adopted by the company for precipitating the fertilising part of the urine, especially rich in nitrogen and phosphates. The powder so obtained is sold in sacks, at the rate of 20 francs per quintal (8s. per cwt.), and is used for manuring maize, in the proportion of about a table-spoonful to each plant; some farmers add also a small quantity of ashes.

For potatoes, 30 kilogrammes of precipitate to about the same quantity of dry earth, well mixed together, should be used and scattered over the land. Other crops are manured with a mixture of precipitate and earth in the proportion of one part of the former to two of the latter. For wheat, it is found advantageous to add to the above-mentioned mixture an equal quantity of ashes.

The quantity of precipitate required to manure a hectare is fifteen quintals, or twelve cwt. per acre. The residue liquid from the precipitating process, containing a large amount of potassa, is used most advantageously as a liquid manure for meadows, and is sold for this purpose at the rate of 40 centimes per barrel, containing 175 litres.

THE FORESTS OF INDIA.

The forests of India, which extend over an area greater in extent than the British Isles, have very recently engaged a considerable share of the attention of the Parliamentary committee upon the financial resources of that country. From the evidence given by Mr. H. Cleghorn, a practical botanist, and Mr. C. B. Philimore, one of the officials in the Revenue Department of the India Office, may be gathered some interesting and important particulars respecting the former, present, and prospective condition of the forests. For many years, there was great neglect and numerous complaints, until the begining of the present century, when the Court of East India Directors, for the first time, desired the Government of India to assert the royal rights which had been held by the native princes over the forests of Malabar. Again, in 1830, the want of timber was severely felt by the Indian Navy Board of Bombay, and the appointment of a conservator was then urged upon the government. The neglect still continued, when Sir Robert Grant took up the question, and, in 1846, Dr. Gibson was appointed to that post. In Burmah, the question was first taken up earnestly in 1841, by Mr. Colvin, the Chief Commissioner in the Tenasserim Provinces, and Dr. Falconer was specially employed. At about the end of the year 1855, the Madras government followed in the same course, and Dr. Cleghorn was called upon to organise the department there. It appears, therefore, that conservancy first commenced in Bombay, Burmah, and Madras. The permission given imprudently to persons to cut the timber in the forests of the Irrawaddy, induced the Secretary of State to write a dispatch to the Governor-General, calling his particular attention to the matter, and this led to the formation of a separate department for the whole of India.

Since that time (the year 1863), all the great provinces have been placed under conservators, with deputy and assistants, and the administration has gone on improving. The staff now consists of 88 European officers, some of whom are scientific botanists, practical engineers and surveyors, the subordinate posts being filled by natives, whom it is intended to employ in the higher grades, so soon as a school of forestry can be established for their education. This cannot be accomplished until the forests are in such order that they would present an example of what a forest should be, and there is a sufficient number of skilled people who can instruct others. At present, the Secretary of State is training young men on the Continent of Europe—in France and Germany—where they are sent for three years' tuition, before they proceed to India. The reason we have not attempted to establish a forest school of our own, arises from the fact that such an admirable training can be gained on the Continent, where the forests are upon a large scale, and the service has come to rank with the other great services of the State, such as the engineers and the artillery. Both in Italy, France, and Germany, there is a very large forest literature; and it would be highly advantageous to graft forest training upon such a school as the Royal Agricultural College at Cirencester, or the Highland Society of Scotland. The persons employed in the administrative department need all the knowledge that can be acquired in botany and geology; whilst the making of roads and the tending of water-courses demands a like acquaintance with surveying and levelling. One of the circumstances which has induced the government to look after the forests is the increased price of fuel and timber all over India. The introduction of railroads, locomotives, and steamboats has made a demand for fuel and also for timber for the construction of the railroads. The increase of the population, and the general increase of their wants, has also led to this demand. The duties of the department consist, therefore, in the demarcation of the spaces, the felling of the timber, and the reproduction or planting according to the best method. In the reserved forests, where they have not been ill-used, the object is to place them under regular management, so that the timber can be brought to market in better condition, and a supply be always ready in rotation. At present, it is scarcely possible to state with any accuracy the extent of the forests. In the Central Provinces there about 21,000 square miles; in Burmah about 2,400; in Assam about 4,000 square miles. When the forests have been surveyed and demarcated in the North-western Provinces—Bombay, Madras, and the Punjaub—we shall know better the whole area, although it will be difficult even then, so great and scattered are the tracts of country which they occupy. In the original surveys, the forests were included under "wastes," and unscrupulous contractors, or persons who had received permits, were enabled to cut down the trees without any regard to the number. There was no check on the license-holder as to the quantity of timber that he took, and he was not restricted to cutting the trees level to the gronnd; he cut them three or four feet high, so that the best part was lost, and frequent fires, besides, did great damage. Under the improved system all that is now forbidden; no trees in the first class have been cut except under the supervision of the government officers. They are systematically inspected, both by the forest officer and by the revenue officers; and the department, although in its infancy, is year by year improving. The profit was apparently greater from granting licenses, because there was less outlay, but the waste under this system was excessive; it led to the destruction of the forests. Many of the native chiefs have adopted our method of conservancy, and have admitted the advantages. By the appliances of machinery, it has been endeavoured to facilitate the cutting down of the timber, and to supersede the use of the axe as much as possible, by the introduction of the cross-cut saw and other instruments. By the introduction of timber-carts, many large pieces of timber have been carried out that would otherwise have been lost, and every encouragement has been given to the extension of saw machinery, for the saving of time and labour. There are saw companies in Burmah, Bombay, and Assam; there are also saw-mills at Madrepore, in the Punjaub. The increasing scarcity of elephants has added to the anxiety for additional saw machinery. The trained elephant, it appears, is worth nine or ten rupees a day, or equal to the labour of fifty coolies. The Rajah of Travancore, and the Rajah of Cochin, both excellent forest managers, preserve their elephants with great care, whilst our legislation has generally tended towards destroying them. The capture of wild elephants has several times been entrusted to the forest officers, who, from their position, are specially able to perform the duty. They have been extremely valuable to the department, and the mischief which they they do when in a wild state is more than outbalanced by the services they perform when captured and trained. Every year they are becoming fewer, especially in southern India, and their destruction must be considered a mistaken policy.

For revenue purposes, the forests are divided into reserved and unreserved, the reserves being for those from which everybody, except the government officers, are excluded; but cuttings are allowed in the unreserved, with the permission of the department. There are also forests which have been appropriated to the villagers in some cases, where they have, by custom, the right to cut wood to make their implements, and to procure leaves for manure, and twigs for fuel. The government officers cut in the reserved forests as the timber is required, and for the purpose of keeping the rotation of the forest. The trees that are fit for cutting are cut, and then sold, and brought to the account of revenue. The mode in which the revenue is collected from the public who are allowed to cut timber is, sometimes by licenses, and sometimes by a royalty or seignorage upon the timber taken away. The summary of the different reports shows that, in 1869-70, the total receipts were £493,496, and the charges £323,312, giving a cash balance of £170,184; but upon a difference of the valuation of timber at the commencement and at the end of the year, the net profit of the department was £316,600. The gross revenues have steadily increased since 1863-64, when the accounts were first kept separately; and although the expenditure has largely increased, it is because trained establishments were necessary from the damaged condition in which, through long neglect, the forests were suffered to fall. The gross receipts for 1871-72 are estimated at £573,220, and this average is, without doubt, due to better management. According to the present system, an annual forest budget is prepared and submitted to the Government of India, who scrutinise it with great particularity, whilst necessary establishments are liberally sanctioned; the greatest economy in management by controlling officers is insisted on. One great item of expense now being incurred is for the demarcation of the forests, the vast area of which have been but little known. This work is important, as it will enable the government to concentrate, and so to economise establishments and labour. Not much has yet been acomplished, but the work is proceeding steadily in all parts of India. Another source of expense arises from the necessity of sending out skilled people from England, and the employment of skilled people in India; but when the training school is established, and the natives can be employed, the expenditure may be less. There is also a liberal allowance in every budget for the improvement of the communication, for roads, for the blasting of rocks in the streams, and also for forming new plantations. There are indirect influences connected with the progress of forest management that have had important bearing upon the general property of the country. In certain districts the dwellings of the natives are constructed of better materials, more especially in the Mahratta country, where the rich ryots use seasoned timber, and have better door-posts, and better constructed dwellings than they had a few years ago. The inland depots have enabled them to get seasoned in place of the coarser wood which they had formerly to use for the purpose.

The railway and other public departments receive their supply on half-yearly indents, which was not the case formerly, when there were great delays and uncertainties as to the quality of the wood, from want of seasoning. The department has greatly aided and expedited the formation of the railways and diminished their cost. By correspondence and otherwise, the officials have often been required to indicate the nearest points where various articles should be obtained, for instance, telegraph poles, handles of tools, and other necessaries for the ordnance department, and for gun-carriages; for the medical department, supplies of gamboge, kino, sarsaparilla, and other minor productions; for the school of arts, supplies of box-wood and satin-wood, for wood-engraving and picture-frames. Considering the vast territories with which the forest service deals, and the present imperfect knowledge of the botany of India, there are probably a great many products as yet unknown, which will become commercially important.

The village forests, which come more especially under the Board of Revenue, have only received the attention of the officers of the forest service by way of advice, supplies of seed, and general recommendations. The officers have been fully occupied with the large areas, and the village tracts do not come properly within their duties. The fees paid for cutting down the wood go into ordinary revenue or local funds. In Madras, inducements have been held out to villagers to plant topes and groves, by giving them land, rent free, for a certain number of years, and, in some cases, advances for wells. Circulars in the vernacular have been circulated by the collectors and civil officers, recommending particular trees for particular soils, and the agri-horticultural societies of the different provinces have distributed seeds. Some of the wealthier zemindars take a pride in having trees, and have done a great deal to forward their growth. The natives generally cultivate fruit trees more, and other wood sufficient for their wants; but they do not anticipate the wants of future generations. The cultivation of trees is highly desirable, both for their own use and for climatic considerations; there is more moisture in the air from the presence of trees, less suffering from the hot winds, and less desiccation of the ground. The general effect may be seen to some extent in the north-west and in the Punjaub, where great inducements have been held out, but the extraordinary pressure for wood on account of the new railway has latterly induced the natives to sell their trees. There has been an enhanced value for all minor forest produce, such as gums, dyes, oils, lacs, bees-wax, &c., which were formerly not taken any account of at all in the revenue. Any person brought away ivory or bees-wax, or anything that he chose, from the forest; now, in most provinces, these are put up to auction.

(*To be continued.*)

COMMON SCHOOL EXHIBITIONS IN VICTORIA.

On January 1st, 1872, the rules framed by the Board of Education in Victoria, and approved by the Governor in Council, come into force with regard to the establishment of exhibitions to be open to the pupils in the common schools. During each year the Board of Education will award exhibitions to eight scholars of common schools in Victoria, under the following conditions:—The exhibitioner shall be selected upon competitive examinations open to all candidates under fifteen years of age, who shall have been during the year immediately preceding the examination continuously on the rolls of, and in attendance in, any of the common schools in Victoria. The subjects for examination shall be those set down for examination of the upper sixth class, together with Euclid, Algebra, Latin, or French. Each exhibition shall be of the annual value of £35, tenable for six years, upon the following conditions:—That the exhibitioner shall, at the commencement of the session following the award of the exhibition, become a student in one of the public grammar schools, and that during the time he continues to attend such school he shall obtain, at the end of each year, a favourable report from the authorities of the same. If an unfavourable report be received, or if at any time the Board shall be satisfied that the conduct of any exhibitioner has been disorderly or immoral, they may terminate his tenure of the exhibition, and of all the advantages connected therewith. That at the end of the second year of his tenure he shall pass the matriculation examination at the University of Melbourne. That during the fourth, fifth, and sixth years of his tenure he shall be a student of the Melbourne University, enrolled as attending lectures, and that he shall in each year have kept as many courses of lectures as would have entitled him to admission to examination under the regulations of the university. That at the end of the fourth year of his tenure he shall pass the first B.A. degree examination at the university. It will not be compulsory upon exhibitioners to become boarders in the grammar schools, but, if they should elect to become so, they will be received at the rate of £17 10s. per annum, to be paid by the exhibitioner, in addition to the £35 per annum payable by the board. Should they attend as day scholars only, residing with their friends, the board will pay £10 per annum to the authorities of the school, and the balance of the annual value of the exhibition, namely, £25, to parents or guardians of the exhibitioner. In each case, payments will be made quarterly. All payments, however, by the board shall be conditional on monies being placed at their disposal by the Legislature.

The Education Bill of South Australia proposes that the board shall consist of nine members—three to be nominated by the government, and six to be elected by the corporations and district councils; provides for the establishment of normal, national, and district schools, where a sound secular education is to be given, based on the Christian religion and morals; disallows all denominational teaching during school hours; and empowers the corporation and the district councils to make bye-laws for compulsory education in case of need.

CORRESPONDENCE.

UTILISATION OF SEWAGE.

Sir,—Dr. Logan, in his letter published by you on the 22nd inst., expresses a very unnecessary uneasiness lest brocoli, cabbages, and other vegetables, which absorb much moisture, may, if grown upon sewage-irrigated land, "contain some of the poisonous principles of the sewage, so that, apart from the natural repugnance which most people would feel at eating sewage-grown vegetables, there may be positive danger to health in doing so." Any one reading this quotation might suppose that the writer imagined that sewage was something different from ordinary manure largely diluted with water, and had forgotten that vegetables growing upon land dressed with the like manure will be quite as wholesome, if the manure be put on diluted, as if it be diluted after it is put on, as it must be before it can be available as food for plants. Nay, if there be any danger at all of vegetables becoming unwholesome from the manure (which experience has shown there is not, unless excessive quantities be used), there would be far less danger from that conveyed in the form of sewage, than from that put into the soil in the solid form, because the solid manure itself may, in the latter case, be in immediate contact with the roots of the plants, while in the former, that part of it only which filters through the soil can reach them, by which any putrescent matter is absorbed and decomposed, and any germs must be intercepted.

Though the opponents of sewage irrigation have eagerly sought for instances of unwholesome food raised by it, they have utterly failed in finding any, no doubt for the simple reason that none are to be found, though instances of good food being so raised are abundant. As to "the natural repugnance felt" at eating food raised from sewage, those must have queer minds who object to eating cabbages the roots of which have been fed by sewage filtered through the soil, but do not object to eating potatoes which may have been, and often are, planted in actual contact with night soil. Unless vegetables are over-manured, they do not become unwholesome, and they are little likely to be over-manured when it is applied very largely diluted, because if put on in excess of the absorbing power of the soil, it is almost certain to be washed away.

It has often been said, and sometimes by those who fully believed the statement, that sewaged land becomes a putrid swamp. Such a statement, not intentionally untrue, is palpably absurd. The plants which do grow and flourish on sewaged land could no more live on a swamp than fish could live out of water; they would die as inevitably, though not so quickly. Though the land may sometimes be made swampy during the short periods the sewage is actually running upon it, unless it be so drained that the water will not remain, land plants would not flourish; and if the land were swampy, in the only true sense of the term, permanently, or, at least, generally wet, they would soon die. It is quite misleading to apply that term to land which, however wet it may be one day in about three weeks, is as dry as other land during the remaining twenty days, and 95 per cent. of which is, therefore, at all times not unusually wet.—I am, &c.,

P. H. Holland.

Sir,—I have read with much interest Mr. J. Bailey Denton's valuable paper on "Sewage as a Fertiliser of Land, and Land as a Purifier of Sewage."

The advantage of sewage irrigation is fully proved on a small scale in the neighbourhood of many towns in Northern Italy, where *marcite*, or winter meadows, irrigated by canals that receive part of the town drainage, and charged with an abundance of fertilising matter, are found not only to retain a higher temperature than the air, but to stimulate the productive powers of these meadows by rich deposits.

The *marcite* meadows in the vicinity of Milan, watered by the Vettabia, a branch of the Naviglio interno that penetrates into the heart of the city, receiving a considerable part of the sewage, are for this reason rendered so fertile that they yield from six to nine crops of grass annually, equal in weight from 45 to 50 tons per acre. These crops are cut about every 40 days, while the ordinary *marcite* meadows in Lombardy, irrigated with pure spring water, can only be mown every 60 or 70 days. The vegetation in this manner receives a constant stimulus, and supplies the dairy keepers throughout the year with a sufficient quantity of green food, with the exception of about a month in the spring, when the canal is closed for cleaning and repairs. This has a marked effect upon the production of milk, which during this period is considerably diminished.

I am not aware that anything has yet been done with regard to establishing *marcite*, or winter meadows, in England, irrigated with sewage waters, but I am disposed to think that it would be practicable, and worth a trial.

With regard to the remarks made by Mr. Denton on ordinary irrigation in Italy, I certainly cannot agree with him as to the loss he says is estimated by Italian irrigators, in carrying forward the waters for distribution over their land, and which seems to me to be greatly exaggerated, and not likely to throw much credit on Italian engineering.

Nadault de Buffon gives the following results of three experiments, made in Lombardy, on the loss of water in canals by filtration and evaporation, meaning the total quantity introduced and that taken out for irrigation, &c. From this it appears that the loss was:—

Naviglio Grande	0·129	of total amount.
Naviglio Martesana....	0·107	,, ,,
Canal Muzza..........	0·161	,, ,,

There would, of course, be a further loss in the distributing channels before reaching the land. These remarks, however, do not refer to the irrigation of winter meadows, which it is impossible to establish without having a great deal more water than is absolutely necessary for the mere irrigation of the land. Under ordinary circumstances, only a quarter of the total quantity of water required would be absorbed by the land, leaving a surplus of three-quarters to flow away to waste, or, where the land is adapted, to do duty at a lower level. This surplus water is most valuable, as in its passage over the surface of the meadow it carries away a portion of the manure. These meadows are established at different levels. It is the custom of farmers to manure more highly the upper ones, the water itself bearing the fertilising matter to the lower levels.

Although Italian agriculturists are far from indifferent to the loss of water in conducting it from the source to the fields, the above-mentioned loss of water in *marcite* cultivation is comparatively of little consequence, as it is only during the winter season that it is carried on, the land being irrigated in the summer in the ordinary manner, when water is considerably dearer, and in great demand for rice and other crops.

The following table, taken from a paper published by the College of Engineers at Pavia, shows the value of a cubic metre of water in that province :—

	For winter irrigation.	For summer irrigation.
	Frs.	Frs.
Lowest price	0·002	0·0001
Average price............	0·004	0·0003
Highest price	0·008	0·0005

The power of regaining the water which is absorbed by the soil, by tapping it at a lower level, is not as advantageous as it appears from Mr. Denton's paper, for in the majority of cases no individual proprietor is directly benefited by the tapping of the water that he has lost, but which probably benefits other landowners some miles distant.

The irrigated plain of Northern Italy stretches away southward from the Alps to the Po, in one continuous slope. Supposing, for sake of illustration, this fall to be 1 metre in 1,000, and that springs are met with at a depth of four metres below the surface, it is evident that, in order to tap them for irrigating a lower part of the plain, one would have to make a canal; and, giving this canal a fall of 60 centimetres per 1,000 metres, its length from the source to the land requiring irrigation would be 10 kilometres. This is far from an extreme case, and a large landed proprietor near Mortara, in order to obtain an abundant supply of water for irrigation purposes, has tapped springs at a distance of not less than 20 kilometres north of his farm, which is brought down by a canal in deep cutting at its source, the depth of which gradually decreases as it descends, until it reaches the land to be irrigated, when the water is on a level with the surface of the fields. This canal, which has less fall than the natural slope of the country, loses a considerable quantity of water by filtration at the lower part of its source, and so probably tempts other proprietors some miles further south, who are enabled to tap it at a lower level, and bring it on to their lands by another canal.—I am, &c.,

P. Le Neve Foster, Jun., C.E.

Mortara, Lomellina, Italy, December 16th, 1871.

INDIAN FORESTS AND INDIAN RAILWAYS.

Sir,—Mr. Horne, in the *Journal* of December 15, puts certain questions regarding the distribution of peat in India. I believe it is to be found in large but unknown quantities all over Southern India, but, unfortunately, at high elevations. In some villages to the north of the Kistnah, the natives use a fuel which was described to me to be "unlike wood, dung, and even coal." This material is no doubt peat. The question discussed by Col. Wragge and Co. are, as Mr. Horne justly observes, of vital importance. I have no objection to railways (state or private), but ought India to have them at the risk of her agricultural prosperity? The felling of timber for railway purposes has already affected our rivers in a most alarming manner, the freshes in the Bhowany, Cauvery Plain, and Penan are some ten days earlier than in former years, and their duration is much reduced. Good common roads and navigable canals are India's real wants. If we are to extend and multiply our railways, we must get our fuel from China, Australia, or Europe.—I am, &c.,

R. F. Taylor, Captain.

30, Cave's-terrace, Shepherd's-bush,
20th December, 1871.

SANITARY PRINCIPLES OF SCHOOL CONSTRUCTION.

Sir,—A friend has sent me two numbers of your *Journal*, containing a paper by Mr. Chadwick and a letter by "Cosmos." The former deserves our thanks for much valuable information and many useful hints, but my present business is with the subject of bullying.

"Cosmos" asks, "Can we make a system of laws for the use of schools, and can we enforce them?" And again, "Who is to be the judge ?" Our boys are street Arabs, the government inspector says, of the roughest kind. Our school, under the Industrial Schools Act, 1866, has been established three years and a half. The smallest boy has all the privileges of a free citizen; if he is molested, he prefers his complaint in open court, which assembles every evening. The case is regularly tried, witnesses examined, and the sentence reported to the chief officer. There are three "justices of the peace" elected by the boys from six named by me; their jurisdiction, bullying in all its phases; the limit of penalty, three bad marks, of the value of about one fourteenth of a penny. I have had one case of contempt of court, but never an appeal from the decision of the magistrates. I have never been present, but a friend told me that proceedings were conducted with the greatest care and solemnity, and the J. P's. were inclined to severity.

I need scarcely remark that this is the result of much that has gone before,—a clean punishment book, a training in self-respect and independence, and those personal qualities required in a free country to make law-loving and law-abiding citizens. There is also an invaluable training for the justices in the qualities of a commander of men or a statesman, "to do justice, love mercy, and walk humbly."—I am, &c.,

C. A. B. Pocock, Commander, R.A.

Wellesley Training Ship, South Shields,
December 19th, 1871.

NOTES ON COMMERCE AND TRADE.

The latest Board of Trade returns indicate that the commerce of the country has reached a point which for magnitude is without a parallel in our history. The declared value of British manufactures and produce exported during October was £19,947,873, showing an increase of £2,397,074, or nearly 14 per cent. over those of the corresponding month of last year, or more than 21 per cent. over those of 1869. For the ten months ending with October the figures are quite as startling. The total value of our manufactures exported for that period this year was £183,538,265, being an increase of

10 per cent. as compared with the same ten months of 1870, and 15 per cent. over the same period in 1869. All our leading staple manufactures have shared in this increased prosperity. As regards our imports till the end of October, the result is still more extraordinary. During the ten months the gross value was £272,704,422, as against £239,510,874 for 1870, and £229,191,430 for 1869. Our trade with Germany is rapidly recovering from the depression which it suffered during the war. Our trade with France, so far as exports of goods are concerned, has also improved, but in nothing like the same ratio as in the case with Germany.

The imports of wool into the United Kingdom (wool of sheep, lamb, alpaca, and the llama trade) reached 263,250,499 lbs. in 1870, the largest quantity ever reached in a year. The export of foreign and colonial wool from the United Kingdom amounted to 92,542,384 lbs., leaving for our use 170,708,115 lbs., a quantity which has once been exceeded—namely, in 1866, in consequence of our export of wool being much smaller in that year than in 1870. The supply of wool from abroad has increased enormously in the last 30 years. In 1840 the import was under 50,000,000 lbs., and the export (of foreign and colonial wool) was little short of 1,000,000 lbs.; in 1850, the import had risen to 74,000,000 lbs., and the export to 14,000,000 lbs.; in 1860 the import reached 148,000,000 lbs., and the export was nearly 31,000,000 lbs. The increase in the last ten years, 1860-70, has been enormous. The import in 1870 consisted of 259,361,963 lbs. of sheep and lambs' wool, of the computed value of £15,357,619; and 3,888,536 lbs. of alpaca, llama, and vicuna, of the computed value of £454,979, or 2s. 4d. per pound. This last class of wool is from Peru and Chili. Of the sheep and lambs' wool, Australia supplied 175,000,000 lbs., being two-thirds of the whole quantity; it was valued at an average of 1s. 3¼d. per pound, or above £11,000,000 sterling. The supply from South Africa, nearly 33,000,000 lbs., was valued at the same rate. The 11,000,000 lbs. from British India was estimated at only half that value. From Egypt above 3,000,000 lbs. were received, valued at nearly 11d. per lb.; and 1,000,000 lbs., the produce of China, valued at 7½d. per lb. Turkey sent us 2,000,000 lbs., valued at little more than that from China; and Morocco 2,000,000 lbs., of nearly the same value as that from Turkey. The 6,500,000 lbs. from Russia was estimated at 9d. Nearly 2,000,000 lbs. from Portugal are stated at 10¼d. value, and 1,500,000 lbs. from Denmark and Iceland at 9d. Only 25,000 lbs. arrived from Spain. The South American wool imported included nearly 3,000,000 lbs. from the Argentine Confederation, and a rather less quantity from Uruquay, both valued below 6d., and above 2,000,000 lbs. from Peru, valued at nearly 10d. per lb. The value of the whole 259,000,000 lbs. gives an average above 14d. per lb. Our imports in 1870 included also 23,378 lbs. of coney wool, valued at £7,013, and 3,078,516 lbs. of goats' wool or hair, of the computed value of £536,162. The exports of foreign and colonial wool from the United Kingdom went chiefly to European countries—France, Belgium, Germany. The export of the British and Irish (sheep and lambs') wool in 1870 amounted to 9,101,405 lbs., of the value of £580,570.

The success which has attended the projecting and opening of the Suez Canal has given birth to many other projects of a similar kind. The Darien canal across the Isthmus of Panama is apparently about to be undertaken, and another American scheme has been proposed. A convention of the governors of the New England and North-Western states was held at Detroit on the 27th ult., for the purpose of promoting the construction of a continuous water and steam navigation route from the Mississippi to the Atlantic Ocean. It is proposed to excavate a ship canal round the falls of Niagara, and the route would then proceed by way of Lake Ontario, the river St. Lawrence, Lake Champlain, and the Hudson river, to the harbour of New York. Congress is to be petitioned to make appropriations for this great work, and to regulate the rates of toll and transportation.

A project for a great canal to connect the Black Sea with the Caspian has also been attracting much attention in St. Petersburg. It has been for several years a subject of discussion among Russian engineers. Recently, however, Captain Blum, of the Russian topographical engineers, having made some extensive explorations, has presented a report to his government, in which he advocates the construction of the work. All the necessary calculations have been made, and it is proposed to carry the canal through the Valley of Manitch, supposed by geologists to have formerly united the two seas. The canal, which would pass through several lakes, and run for fifty miles alongside the river Don, would be 450 miles in length; its cost is estimated at £11,000,000, and its completion would occupy six years.

Another scheme for establishing a new port at the mouth of the Neva has been designed by M. Nicholas Putiloff, the noted iron manufacturer, the details of which are given by the Moscow correspondent of the *Levant Herald.* The plan is to open a passage for goods direct from the Upper Neva to the Gulf of Finland, without transhipment, by cutting a canal twelve miles in length from Alexandrovski (some distance above the capital) to M. Putiloff's factory, on the shore of the Gulf beside Voloni Island. To construct a harbour, traversed by a custom-house-quay two miles in length, and containing three basins—one for outward-bound shipping, another for vessels arriving from abroad, and a third for lighters, as also a floating dock for repairs. To cut a canal through the Gulf in the direction of Cronstadt from the extremity of the harbour (where the water is twelve feet deep) to the eighteen feet level, a distance of nearly four English miles. To lay a railway parallel, or nearly so, with the overland canal, from Alexandrovski to the Putiloff factory, and thence in three branches along the custom-house quay and the outer embankments to the extremity of the new harbour, connecting itself *en route* with the Moscow Tsarskoe-Celo, Warsaw, and Peterhoff railways, and also with the Alexandrovski mechanical works and the great warehouses at the mouth of the Obvodni canal. According to the prospectus issued by M. Putiloff, the harbour works are to include two quays, three sets of warehouses, a custom-house, an hotel for the reception of passengers, a complete apparatus of cranes, &c., for the loading and unloading of goods, a system of gas, and a quenching apparatus in case of fire. The total cost of the undertaking is estimated by him at 18,000,000 silver roubles, or £2,700,000. Shares are to be issued to the number of 48,000, at 125 silver roubles each, 20 per cent. of the purchase-money to be paid down on the spot, and the rest within two years. In his contract with the government, M. Putiloff binds himself to complete the undertaking within three years from the day of its commencement.

There appears to be great competition at present between the Dutch and Belgians for the trade of Central Europe. While the Dutch are expending large sums in making extensive commercial docks at Flushing, in anticipation of getting more of this trade, new railways are being constructed in Belgium and Germany which are likely to make Antwerp, even more than it is now, the most favoured port for the direct trade to Central Europe. Already the port is crowded, and the dock accommodation is inadequate to the wants of the trade and community. Before the late war between France and Germany broke out, an arrangement had been made to purchase the citadel of Antwerp, covering about 800 acres, and to transform it into docks. But the war disarranged all the plans for that purpose. The interest in the undertaking is now in the hands of a local company, which is working hard to raise the requisite capital to proceed with it. It is also proposed to construct docks on the lowland facing Antwerp, connecting them with the city by means of a bridge, which is to carry a railway, a foot-road, and a carriage-drive. It has also been suggested that a coast port should be constructed near the mouth of the Scheldt, with direct railway communication to the docks and city of Antwerp, so that when the river is frozen up, traffic may be uninterrupted. At present, when the frost closes the upper navigation, vessels are discharged at Flushing.

The *Scientific American* says that, according to Wagner, it appears that Saxony produces 33,000 lbs. of bismuth annually, and as the yield of this metal in other countries is unimportant, Saxony rules the market of this article. A few years ago, the pretended discovery of a method of making gold from bismuth led to the purchase of all there was in the market on the part of a credulous London firm. This produced considerable fluctuation in the price at the time, but as the firm were subsequently glad enough to get rid of their useless purchase at any price, the supply soon became abundant.

The United States Consul in Birmingham has issued a return, compiled from official papers, of exports from the Birmingham, Leicester, Wolverhampton, and Kidderminster districts to the United States, for the year ending September 30, 1871, together with a comparative statement of the aggregate totals for the four districts for the last six years:—

	£	s.	d.
Hardware, cutlery, steel, and iron..	337,229	13	2
Needles, fish-hooks, and materials	101,429	16	11
Buttons and materials	64,315	7	10
Watches and materials	8,685	13	3
Chemicals	25,147	0	4
Cotton and silk goods	34,405	5	7
Boot web and materials	14,736	16	10
Sheet glass and ware	35,008	15	5
Pens, tips, and holders	16,776	18	4
Fancy goods and jewellery	108,420	1	4
Chains, hoes, and scythes	85,556	6	8
Guns and implements	100,609	14	1
Saddlery and skins	40,773	18	8
Optical goods	10,813	18	0
Tin-plates	14,005	12	4
Chandeliers and fittings	10,282	2	1
Nickel and cobalt	6,938	12	0
Anvils and vices................	16,356	11	3
Jet (real and imitation)..........	10,409	3	10
Cotton bale hoops	70,414	12	4
Sundries	16,230	1	5½
Total for Birmingham agency..	1,128,546	1	11½
Leicester ditto	159,559	10	10½
Wolverhampton ditto	111,881	15	11½
Kidderminster ditto ..	239,332	11	11
Grand total	1,639,318	0	8½

The following is a comparative statement of the exports to the United States, from the four midland districts, for the last six years:—

		£	s.	d.
Total for the year ending Sept. 30,	1866	1,021,844	12	3½
,, ,, ,,	1867	878,306	8	10½
,, ,, ,,	1868	597,425	6	8
,, ,, ,,	1869	769,190	14	7
,, ,, ,,	1870	1,165,147	10	8½
,, ,, ,,	1871	1,639,318	0	8½

These figures, of course, are only approximate indications of our trade with the United States, as a large proportion of the orders received by Birmingham merchants go for execution to Sheffield and other places outside the districts embraced by the return. It will be seen that, since 1868, our trade with the States has nearly trebled itself.

The importation of foreign watches into this country has shown a steady increase during the last three years. During the month of September, 1871, the value imported was £32,370. In the corresponding period of 1870 the value was £15,166, and in 1869 £18,105. The value of watches imported into this country during the first nine months of the present year was £382,698. The value imported in the same period during the two preceding years was £143,211 in 1870, and £146,509 in 1869. The number of foreign clocks imported into England during the month of September in the present year was 36,112, value £49,072; in the same month in 1870, 23,099, value £27,887: and in 1869, 29,240, value, £26,279. There has been little variation in the number and value imported during the nine months of the present and two preceding years.

It is estimated that the wine crop in California this year will produce from 6,000,000 to 7,000,000 gallons of must or raw wine; this is worth about 30 cents per gallon, making a total value of 2,100,000 dollars. The grapes for wine-making sell at 1 cent per pound. There is also a large quantity of table grapes raised. The choice varieties sell in the home market at much lower rates than formerly. The cost value of the grapes grown for other than wine purposes is estimated at 400,000 dollars, making the total value of the vintage in California 2,500,000 dollars. It is stated that the grapes are of very good quality this year. The proprietor of one vineyard, containing about 20 acres of choice varieties, estimated that the net return would not be less than 10 cents a pound, the entire crop having been engaged for the home market.

The exportation of the principal articles from Carthagena consists of lead, minerals, and esparto, each of which has exceeded the respective exports of 1869. Of lead there was exported into England and France 32,000 tons, containing about 75,000 ozs. of silver; zinc and iron ores, 496,000 tons; and esparto from this and Aquilas amounting to 39,726 tons. This branch of commerce is greatly on the increase, and the demands are much beyond the supply, the prices for good quality ranging from £9 10s. to £8 per English ton. The year 1871 was expected to be most prolific in the produce of this fibre. There has been a falling off in the number of British vessels during the year, but an increase in tonnage of 10,000 tons, and 122,000 tons over and above all other foreign shipping entering this port. The silk crop also has been superior to many years past, and the looms in the city of Murcia have been at work for the last six months; their produce is generally purchased by French agents.

MEETINGS FOR THE ENSUING WEEK.

Mon. ....Entomological, 7.
Anthropological, 8.

Tues.....Royal Institution, 3. Prof. Tyndall, "Ice, Water, Vapour, and Air."
Pathological, 8. Annual Meeting.
Biblical Archæology, 8½.
Zoological, 9.

Wed.....Microscopical, 8. 1. Dr. Carruthers, "Fossils of the Coal Measures." 2. Mr. James Bell, "Fermentation and its Results."
Obstetrical, 8.

Thurs...London Institution, 4. Mr. J. C. Brough, "The Philosophy of Magic."
Royal Institution, 3. Professor Tyndall, "Ice, Water, Vapour, and Air."

Fri.......Geologists' Association, 8. Mr. D. C. Davies, "On the Overlapping of several Geological Formations on the North Wales Border."

Sat.....Royal Institution, 3. Professor Tyndall, "Ice, Water, Vapour, and Air."

Journal of the Society of Arts.

No. 998. Vol. XX.

FRIDAY, JANUARY 5, 1872.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

SOCIETY'S EXAMINATIONS.

With reference to Captain Donnelly's suggestions for the establishment, by the Society, of "special examinations in the science and technology of various arts and manufactures," the particulars of which were given in last week's *Journal*, the following letter has been received:—

Perryn House, Twickenham,
Dec. 11th, 1871.

My Dear Sir,—I much regret that I was unable to attend the meeting of Council, as I should have felt great pleasure in giving my hearty support to Captain Donnelly's motion. I consider it, indeed, as an excellent preparatory step towards the establishing in this country of a sound and practical system of technical instruction; and, if it should be adopted in such a manner as to secure the satisfactory realisation of its purposes, I should be glad to see Captain Donnelly, with a view to placing at the disposal of the Council a certain amount to be distributed in appropriate prizes.

Believe me to remain, my dear Sir,
Yours very truly,
T. Twining.

P. Le Neve Foster, Esq.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

January 17th.—"On the Oral Education of the Deaf and Dumb." By G. W. Dasent, Esq., D.C.L. On this evening, the chair will be taken by Sir Charles Trevelyan, K.C.B.

January 24th.—"On Improvements in the Process of Coining." By Ernest Seyd, Esq.

January 31st.—"On Individual Providence for Old Age as a National Question." By G. C. T. Bartley, Esq., Treasurer. On this evening, the Right Hon. the Earl of Derby will preside.

CANTOR LECTURES.

The Second Course of Cantor Lectures for the Session will be delivered by the Rev. Arthur Rigg, M.A., on "Mechanism." The first lecture will be given on Monday evening, February 5th, at Eight o'clock. Tickets for the course will be forwarded with the *Journal*.

Lecture I.—Monday, 5th February, 1872.

Structures, Machines, and Mechanism—Equilibrium and Motion—Force and Motion—Kinetics and Kinematics—Various motions required—Classification of Mechanism—Early contrivances.

Lecture II.—Monday, 12th February, 1872.

Motions produced by Rolling—Forms of Wheels—Circular, Elliptic, Logarithmic, and Lobe Wheels—Mangle Wheels—Star Wheels—Examples.

Lecture III.—Monday, 19th February, 1872.

Motions produced by Sliding—Forms of Teeth on Wheels—Teeth for Velocity—Teeth for Power—Cams—Screws—Worm Wheels—Examples.

Lecture IV.—Monday, 26th February, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies—Cam Pullies—Shafts not parallel—High Velocity Cords—Fusees—Illustrations.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links—Cranks—Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

MOSCOW POLYTECHNIC EXHIBITION.

By the rules of the Exhibition (Art. 17, Programme, p. 14), it will be seen that foreign exhibitors, as well as Russian exhibitors who do not attend personally or by agent at Moscow to look after the delivery and reception of their goods, "may address themselves to the Agency of the Exhibition, which will undertake to receive, sell, or return all articles confided to its care, on conditions convenient to the exhibitors." In a letter received from the Secretary of the Exhibition, it is stated, in reference to this point, that M. Alexandre Leontjew, representing the commercial house of A. Pancke and Co., of Moscow and St. Petersburg, is the agent for the Exhibition Committee; and exhibitors may apply to him direct, his address being Twanowsky Pereoulok, Hotel Tschastouchin, Moscow. Another house, also well-known in Moscow, undertakes to act for English exhibitors, viz., M. Gustav List, who may be addressed Miasnitzkaia, Maison List, Moscow.

The Exhibition Committee at Moscow undertake to do everything in their power to secure for English exhibitors, whose articles arrive in time, that is to say, not later than the middle of May, suitable places for their goods, in accordance with the requirements given on their notices to exhibit, and this space will be kept up to that time, after which it will be allotted to others. All applications for space accepted by the London Committee up to the 13th of January will be placed in the first line.

The Secretary gives the following as the rates of charges by the "Grande Société des Chemins de Fer Russes":—

The carriage of articles sent by English and American exhibitors—

Viâ Kronstadt, costs 37½ cop. (*i.e.*, about 1s.) for a package less than three pouds (*i.e.*, not exceeding 108 lbs. English; every poud beyond (a poud = 36 lbs. English) will be charged 12½ cop. For example, a package of 360 lbs. English will cost, from St. Petersburg to Moscow, 1 rouble 25 cop. = 3s. 4d.

Viâ Riga, from Düneburg to Moscow, each poud (36 lbs. English) will cost 22,32 cop.; a package under 108 lbs. will cost 66,96 cop. For example, a package weighing 8⅔ cwt. will cost from Düneburg to Moscow 6 roub. 69½ cop. = about 18s.

Viâ Prussia (Wirballen, the frontier), from Wirballen to Moscow, a package weighing 108 lbs. will cost about 2s. For example, a package weighing about 3 cwt. English will cost 6s. from the frontier to Moscow.

Exhibitors, in order to obtain the privilege of these reduced charges, must obtain the proper certificate referred to in the Programme (p. 13, Art. 10), and for this purpose should communicate direct with M. Saenger, the Secretary of the Exhibition, Moscow.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ON THE MANUFACTURE AND REFINING OF SUGAR.

By C. Haughton Gill, Esq.

Lecture II.—Delivered Monday, December 4th.

After giving a brief recapitulation of the points mentioned in the previous lecture, Mr. Gill proceeded as follows:—

Time will not allow me to dwell longer on the chemical reactions of sugar, and I must now pass on, and give you an outline of the process of manufacturing sugar from the cane. As I stated last time, I have no first-hand knowledge of this process, and consequently can only give you an outline description, referring you to others for exact technical information. The sugar cane, which you have all seen, either in the Botanical-gardens or represented in drawings, I need not stay to describe; it is a species of grass growing to a height of from six to ten feet. When ripe it is cut; the tops are lopped off, and the canes, tied up in bundles, are carried to the mill. The process most usually employed for extracting the juice from the cane is a very rough mechanical operation. The canes are brought up to a set of three rollers, so placed as to form two pairs, the first being set wider apart than the second, so as to only just bruise the canes, whilst they get a much severer pinch on passing through the second pair. The juice being thus squeezed out, falls into the bed-plate of the mill, and from thence is carried to the pans in which it is clarified before being boiled down, whilst the trash, or cane residue is dried and used as fuel. The juice is carried first to a series of large round vessels of about 400 gallons capacity each, where it is brought nearly to the boiling point, and treated with a small quantity of lime, to neutralise the acid and to assist in making the albuminous constituents set, so as to form scum which it is possible to remove. The juice, which was previously of much the same dark colour as the beet-root juice which I showed you last week, leaves these clarifiers transparent and of a more or less pale yellow colour. From these defecating pans the juice now goes to the first and largest of a series of hemispherical pans, bedded in brickwork and having a flue passing beneath them, from a furnace close to the smallest pan of the series to the chimney shaft at the other end.

The clarified juice goes, as I said first, into the largest vessel, where it is boiled until a considerable proportion of the water has been driven away. When another lot of juice is ready to come on, the contents of the pan are ladled into the second, and so it is gradually ladled from one pan into another until it comes to the smallest vessel called a "teach," which lies immediately over the fire. By this time it has got very thick indeed, being about the consistency of treacle; and you can imagine very easily what must happen to it after all this work.

The cane juice which runs from the mill is slopping about over the place; bits of dirt, &c., have time to accumulate, and it turns a little sour; in fact, the whole juice, to begin with, is rather acid, and a portion of it begins to ferment. A change (such as that which I illustrated last week with the yeast), takes place to some extent, and a portion of crystallisable sugar is "inverted." When the juice goes into this pan it is still slightly acid, and, as I showed you last week, the action of acid at a high temperature is to convert another portion of the sugar into that uncrystallisable modification, and the longer the action is allowed to go on, the more sugar is thus converted. The juice is a long time passing from the first pan into the last, and therefore there is plenty of opportunity for this change to take place. Again, a high temperature is prejudicial to the sugar, as it destroys the crystallisable power of a portion of it; and, moreover, destroys another portion altogether as sugar. When the sugar has got as far as the last and smallest pan, it is so thick that it will not boil in the open air at a temperature of less than about 230° to 235° Fahr.; this is a temperature at which it is subject to great alteration and decomposition, and not only so, but we must also consider how much higher a temperature part of it is really being subjected to. Every mistress of a family knows perfectly well that thick things, like starch or soups, will "burn" if not kept stirred; and you can readily understand why that is. They do not move about freely enough in the pot to get heated equally throughout. The bottom of the pot gets exceedingly hot, the fire upon which it is placed being three or four times as hot as boiling water, and any liquid which is pasty or thick, such as this sugar juice, cannot move freely, and flow up from the bottom, so as to cause a continual renewal of the parts exposed to the heated surface. Some portion, therefore, remains too long in contact with the highly-heated metal, and gets burnt, and the consequence is that the juice which enters the first of these evaporates as a clear yellow liquid; when it is dipped or "skipped" out, as it is termed, of the "teach" it has assumed the appearance of very dark treacle. The ordinary constituents of cane juice are—water, 81 per cent.; sugar, about 18; organic bodies, like gum, ·6; and inorganic, like salts, about ·4. This is only a rough general analysis, which takes no notice of the presence of any inverted sugar, and so far, therefore, it is incorrect, inasmuch as cane juice always contains a small quantity of this altered sugar ready formed, amounting generally to about ·5 or ·6 per cent. of the whole amount of sugar; that is in sound, ripe, canes; in those which are rotten, or half rotten, the proportion is much higher. After the liquid has been boiled in the first of these evaporating pans, it has been found that there is sometimes as much as 10 per cent. of this altered sugar for every 100 parts of real sugar, while in the last, the "teach" where it has received its final concentration, and attained the highest temperature, and been subjected for the longest time to all these mischievous influences which I have mentioned, the proportion of this altered sugar has risen to 22 or nearly 23 per cent. The mischief of this is, not only that you have destroyed so much of the sugar, but the presence of this altered sugar renders extremely difficult, even if it does not absolutely prevent, the recovery of another equal portion of still unaltered cane sugar in a marketable form. The liquid containing a considerable propoetion of the altered sugar has the consistency of treacle, and is not easily deprived of so much of its water by evaporation as to leave the unaltered sugar in a state of a hot saturated solution, capable of crystallising or cooling. Even if crystallisation is actually obtained, the crystals are formed in a thick, adhesive, semi-fluid mass, from which you cannot separate them; consequently the mischief of converting a portion of your cane sugar into this altered sugar is not confined to the simple loss of the quantity so converted, the actual loss being nearly double; for one part of this altered sugar appears to practically prevent the crystallisation of an equal weight of cane sugar.[*] This is one great source of loss, but previous to this there was another. I have said nothing at present about the yield of juice by this method of pressure between rollers; but it is a very poor one indeed. Average canes of good quality contain about 90 per cent. of juice, there being only about 10 per cent. of actual woody matter; yet it is considered a very good yield to get out 60 per cent. If, therefore, you only get 60 per cent. out of 90, you have left in the residue half as much as you have won. That would not answer in most manufacturing operations, and it is a very poor yield as compared with what is obtained in working beetroot. Only two-thirds of the sugar is got out of the cane in the form of juice, and when that is obtained the manufacturer immediately proceeds to waste a great portion. At a moderate computation, an acre will grow 30 tons of sugar-cane, and in those you will have 90 per cent. of juice, containing, say, 18 per cent. of sugar; working this out, I find that the sugar produced from an acre is about 4·86, or nearly five tons. Then, taking the 60 per cent. yield of juice, and allowing very moderately for loss, the sugar actually won is only equal to two-and-a-half tons, so that the quantity of sugar sent into the market is about one-half of that which is taken off the ground. As the concentrated juice is "skipped" out from the teach, it is transferred to round, shallow coolers, and allowed to stand until it is of the right consistency, when it is put into hogsheads, the bottoms of which are pierced with a number of holes, loosely stopped with some convenient material, such as the stalk of a plantain leaf, and there it is allowed to remain for a considerable time, in a warm temperature, over a grated floor, until in fact the crystals of sugar are formed, surrounded by a cool saturated solution of sugar, containing also many impurities, being what is called syrup. This syrup is allowed to drain away gradually, leaving behind a mass of soft, brown sugar, which is known in the market as raw sugar. The quality of this product so obtained varies greatly on different estates, with the amount of skill applied in the manufacture, the quality of the cane, &c. Sometimes it is very bad indeed, as you may see by a sample on the table, and the colour varies with the quality. There is one sample of nearly pure sugar, which is really raw cane sugar; but it was not made in the mode I have described, the manufacturer having exercised some little skill and judgment, and brought into use some of the more modern appliances which science has devised.

I will next describe an important method of getting the juice out of the cane, by which a much larger yield is obtained, whilst the juice itself is much purer, containing a smaller proportion of the organic salts, which are the bodies which most assist fermentation, which, as you know, produces a serious loss of sugar. The process is known by the name of diffusion, and it will, I dare say, suggest to you the means by which the juice is won. It is carried on upon a large scale at the Aska Sugar Works, near Madras, and Mr. Minchin, the able and energetic manager, assures me that it really leaves little or nothing to be desired. The yield of juice, instead of being only 60 per cent. amounts to over 85, leaving only 5 out of 90 per cent. instead of 30, as in the old process. This is a very considerable gain at once; but in addition, the juice is much purer than that got out by means of rollers; it is therefore more easily worked, and a larger quantity of sugar of finer quality is obtained. And when you recollect that every ton of sugar lost represents a loss of about £25 to the manufacturer, you will see that it is a matter of primary importance to get every cwt. possible. The principle of the method is this. The canes are cut up by suitable machinery into thin diagonal slices. These are filled into a cylindrical iron vessel, about 6 or 7ft. high, and from 4ft. to 4ft. 6in. in diameter, the size being merely a matter of convenience. Room is left for the addition of so much water as will keep the slices afloat, so that they are surrounded by water on all sides. The vessel is allowed to stand for 15 or 20 minutes, while a second vessel of like capacity is filled with cane cuttings, but no water being added. By this time, a considerable proportion of the sugar contained in the cells of the plant has passed out through the cell walls into the surrounding water by the process of diffusion, similar to that which I exhibited to you, the organic non-saccharine bodies, which are mostly colloids, remaining behind. But, as you will doubtless have remarked, this process of diffusion must come to an end when the water surrounding the cells contains as much sugar as that in the inside, and, practically, the extreme limit is not quite reached. However, when the water in the first vessel has got considerably charged with sugar, it is passed into the second, which contains fresh cane cuttings filled with highly concentrated juice. Diffusion then begins in the second vessel, the sugar in the cane cells, being undiluted, passes out into the diluted liquid, and increases the strength of the solution, and at the same time the first vessel has been filled up with fresh water, so that the sugar remaining in the cane cells in it may also diffuse out. The stronger solution in the second vessel is then passed on into a third diffuser, containing fresh cuttings, and sometimes into a fourth, which is about the limit to which the process can advantageously be carried; and from thence, being now sufficiently concentrated, it is drawn off and taken to the clarifiers, and thence to a vacuum-pan, for I need hardly say that where such a scientific method of obtaining the juice is followed, they do not boil it in the open air. While this is going on, the second supply of water has been passed on to the second diffuser, and so on consecutively, until it is found that the water from the first vessel contains no more sugar, and when that vessel is disconnected from the series and emptied, the second becomes the first of the series, and so on in succession, a vessel of fresh cuttings being added at the end, when one is removed at the beginning. It is a somewhat complicated system to describe, but it is very simple in work, and is found to yield very good results.

In some of the colonies, both English and Frenche improved methods of manufacturing sugar from th cane are coming, though slowly, into use; and taking into consideration the weight of canes which can be grown to the acre, the richness and the purity of the juice of these canes, it seems hard to believe that the makers of sugar from the comparatively poor beet will be able to hold their own, when they no longer possess a monopoly of skill and science. These improved processes of manufacture I must leave undescribed, time only allowing me to sketch in outline one of the many methods in actual use.

I must now pass on to some chemical facts which will concern us in the manufacture of sugar from beet-root, which is a more complicated process than that I have described as applied to the juice of cane. I have treated of the cane sugar manufacture in this order simply to show you how very small an amount of chemical knowledge is necessarily brought to bear in the manufacture of sugar from cane. All this, and much more, is required in the case of the beet-root sugar manufacture.

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[*] This statement must not be taken as an expression of a fully-ascertained fact as regards the quantity.

In the first place, I must show you that lime, which is an agent very largely employed in the manufacture of sugar from beet-root, is much more soluble in solutions of sugar than in water. I cannot very well exhibit this to you in quantitative fashion, for naturally quantitative experiments consume a good deal of time, but I can show you that lime is taken up very largely by a solution of sugar. In a solution of sugar, to which I will add some slaked lime, after filtering it, we shall find that a considerable portion of the lime has passed into solution. Lime is an alkaline body, *i.e.*, possessed of powers like those of potash or soda, having the power of neutralising acids very effectually indeed; it has also the property, when in solution, of preventing fermentation. Thus a solution of caustic lime will prevent a solution of sugar from fermenting. Here is the filtered solution of sugar into which I put the lime, and I shall be able to show you that it is alkaline. Here is a slip of paper impregnated with tincture of turmeric. It is, as you see, of a yellow colour, but in the presence of alkalies it becomes of a reddish brown. You see it turns brown on being dipped into our solution. Here again is a slip of paper reddened with litmus, which has the property of turning blue on the application of an alkali, and this also answers to the test. I do this that you may see how readily the presence of lime can be detected, because I want to show you by-and-bye how completely we can remove lime from a solution of sugar after it has been added. In the manufacture of beet-root sugar, lime has to be added at one stage in considerable excess, and it has to be removed afterwards with tolerable completeness, and you thus see how we can detect its presence.

I must now show you another property of lime, viz., that of very readily absorbing carbonic acid gas. I have here a ready-made solution of lime in sugar, which I take because it happens to be a convenient form in which to employ the lime. I will now prepare a little carbonic acid gas, with which I will fill a long glass tube; then, pouring some of the solution of lime in sugar into this glass basin, I introduce the mouth of the tube into it, so as to allow a small portion of the solution to enter, and on closing the mouth of the tube with my finger and agitating it, you will find that the lime present absorbs the whole of the carbonic acid gas. The liquid you see, has turned quite milky, owing to the fact that the carbonic acid combining with the lime has converted it into carbonate, and the carbonate of lime is not soluble in sugar. You see at once, therefore, that there is a method of removing an excess of lime from a solution of sugar; and this process is all the better for this reason, that carbonic acid is so very weak an acid that it is not capable of inverting the sugar itself. So that, when you have a solution of sugar containing lime, you can remove the lime without fear of injuring the sugar, by passing carbonic acid gas into it until no more is absorbed. On opening the mouth of the tube under water, I find that I did not pass in quite enough sugar-lime to absorb the whole of the carbonic acid gas, but there is only a very small quantity left.

A reaction which illustrates the same thing in another way, though perhaps not quite so clearly, is by passing the gas into a solution of sugar-lime, which I will now do, putting some of the sugar-lime into a glass vessel, into which I insert the delivery-tube of the apparatus for evolving carbonic acid gas. You will observe that precipitation will not take place for a short time, and for a reason which is not thoroughly explained at present, but the fact, I believe is, that an intermediate compound is formed between lime and carbonate of lime. Carbonic acid can be passed into a solution of sugar containing lime, until nearly a third of the lime is really converted into carbonate, without any precipitation taking place, and then, almost of a sudden, the solution will become thick and opaque, and the lime will be deposited as insoluble carbonate.

I will now briefly describe the properties of animal charcoal, which is a body of considerable importance in sugar-making. Animal charcoal is prepared from bones, and bones, as you know, consist mainly of two parts, one being an animal part, a sort of gelatinous material, which is stiffened by the other, an earthy body, diffused throughout the mass. I have here a mutton bone, out of which I have taken the earthy material, and you observe that although it keeps its form, it is quite flexible and elastic, that is the animal part. When the animal part is destroyed, which can be done by exposing the bone to a high temperature in contact with the air, the animal matter is entirely burnt away, and there is left behind an extremely brittle material, the earthy phosphate of lime. The earthy material of bone consists essentially of phosphate of lime, which is left behind when the animal portion is entirely destroyed by oxidation at a high temperature. But instead of carrying the burning process to this stage, if we may simply expose a fresh bone to a high temperature without allowing the access of air, as is done by ordinary charcoal-burners, the volatile constituents of the animal body will go off in the form of various gases, and a considerable portion of carbon will remain behind in the solid form. But of course the earthy matter also remains behind, and consequently we shall get such a mass as I have here—a bone which has been heated to redness for two hours, but without the access of air; the volatile constituents, the oxygen, the hydrogen, the nitrogen, and some of the carbon have gone off, leaving behind a great part of the carbon dispersed over the surface of the particles of phosphate of lime. We have, therefore, in animal charcoal, a quantity of very finely divided carbon, spread over the surface of the phosphate of lime. Bones which have been treated in this way, and subsequently crushed into coarse grain, such as I have here, are largely employed by the manufacturers and refiners of sugar, under the name of animal charcoal. I have here some of the animal charcoal from which the phosphate of lime has been removed by the action of acid; it is an exceedingly light powder, so much so that the bottle, on giving it a shake, appears full of it, and on removing the stopper it escapes almost like smoke. The action of the animal charcoal resides entirely in this carbon, the phosphate of lime with which it is usually conjoined having no other use than to render the material firm, hard, and heavier than the sugar solution, and consequently usable on a large scale.

The action of this animal charcoal, to which I wish particularly to direct your attention this evening, is the power which it possesses of absorbing from an aqueous solution certain bodies which are exceedingly prejudicial to the sugar-maker, namely the organic bodies, the colloids which get into the juice more or less in the process of manufacture. Again, as a sample of these colloid bodies, I will take dextrine, not because it is better than others, but because I can more readily prove to you its presence or absence. In this flask there is a solution of dextrine, which I will prove, as before, by its action in the presence of iodine. I will now pour it into this tube, which contains a quantity of finely granulated animal charcoal, and by turning a cock at the bottom, will allow it to run through slowly. I cannot on the present occasion allow sufficient time for the action to be complete; but if it stood for some hours the absorption of the dextrine would be very complete; as it is, it will probably be only partial; still, on treating the solution which has run through with iodine, you will see that there is a very perceptible difference in the quantity remaining in solution, as evidenced by the intensity of the colour produced.

In my next lecture I shall treat of the manufacture of sugar from beet-root by one of the most approved methods. I see that I shall not be able to enter into the question of the different modes of extracting juice from the beet and their relative advantages and disadvantages, but must confine myself to the process most largely in use, and from that pass on to the method of purification most usually employed. I will now add a little iodine to the solution which has run through the animal charcoal, and you see it is scarcely coloured, showing that the dextrine has been in great measure absorbed.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, R.E., secretary.

Exhibition of Jewellery for 1872.—List of countries, with their subdivisions and dependencies, from which representative examples of peasant jewellery now in use are being sought for this year's Exhibition. The figures on the right-hand of the names show the number of specimens now in the South Kensington Museum:—

Europe.

Austro-Hungarian Empire:—	
Austria, Upper and Lower	4
Bohemia	
Bukowina	
Carinthia	
Carniola	
Coast Districts	
Dalmatia	
Galicia	
Istria	
Moravia	
Salzburg	
Silesia	
Styria	
Tyrol and Vorarlberg	
	4
Belgium:—	
Antwerp	
Brabant, South	
Flanders, E. and W.	13
Hainault	
Liège	
Limburg	
Luxemburg	
Namur	
General	13
	26
British Islands and Dependencies:—	
England and Wales	123
Scotland	
Ireland	6
Channel Islands	
Malta	1
Hindostan*	
India beyond Ganges*	
China*	
Cape Settlements	
Canada	
South American Possessions	
West India Islands	
Australia	
New Zealand	
	130
Denmark:—	
Denmark Proper	
Faroe Islands	
Greenland	
Iceland	8
General	10
	18
France:—	
Alsace	
Angoumais	
Anjou	
Artois	
Auvergne	2
Bretagne	1
Burgundy	
Champagne	
Dauphiny	
Flanders, French	
Isle de France	
Gascony	
Guienne	
Languedoc	
Limousin	
Lorraine	
Lyonnais	
Maine	
Normandy	47
Orléanais	
Picardy	1
Poitou	
Provence	
Savoy	
Touraine	
Corsica	
African Possessions	10
East Indian Possessions	
West Indian ditto	
General	30
	91
German Empire:—	
Alsace and Lorraine	
Anhalt	
Baden	
Bavaria	
Brunswick	
Hanse Towns	
Hesse Darmstadt	
Lippe	
Mecklenburg Schwerin	
Mecklenburg Strelitz	
Oldenburg	
Reuss Greiz	
Reuss Schleitz	
Saxe Altenburg	
Saxe Coburg and Gotha	
Saxe Meiningen	
Saxony	
Saxe Weimar	
Schaumburg Lippe	
Schwarzburg Rudolstadt	
Scwarzburg Sonderhausen	
Waldeck	
Würtemburg	
Prussia	
Brandendurg	23
E. and W. Prussia	
Hanover	
Hessen Nassau	
Hohenzollern	
Lauenberg	
Poland	
Pomerania	
Prussian Saxony	
Rhenish Prussia	
Schleswig-Holstein	
Silesia	
Westphalia	
General	11
	34
Greece:—	
Hellas	
Morea	
Archipelago	
Ionian Islands	
Holland:—	
Brabant, North	
Drenthe	
Friesland	
Groningen	
Holland Proper	
Limberg	
Luxemburg	
Overyssel	
Utrecht	
Zealand	
Java and other East Indian Possessions	
West Indian Possessions	
Italy:—	
Genoa	26
Lombardy	20
Modena and Massa	11
Naples	122
Parma	12
Piedmont	33
Romagna	49
Rome	11
Sardinia	21
Sicily	58
Tuscany and Lucca	192
Venetia	51
General	122
	728
Norway and Sweden:—	
Norway—	
Bergen	
Christiana	
Christiansand	
Drontheim	
Nordland	
Islands	
General	5
	5
Sweden—	
Gothland	
Norrland	
Svealand	
Isles of Gothland and Oland	
Portugal:—	
Alentejo	
Algarve	
Beira	
Entre Douro-e-Minho	
Estremadura	
Tras-os-Montes	
African Possessions	
Azores	
Cape Verde Islands	
E. Indian Possessions	
Macao (in China)	
Madeira	
General	12
	12
Russia:—	
Baltic Islands	
Bessarabia	
Circassia	
Crimea	
Don Cossacks and Astrakan	
Finland	
Georgia	
Lapland	5
Lithuania	
Livonia	
Poland	
Remainder of Russia in Europe	
Siberian Provinces	
General	50
	55
Spain:—	
Andalusia	139
Arragon	40
Asturias	
Biscay	
Castile	11
Catalonia	33
Estremadura	
Galicia	
Granada	
Leon	
Murcia	115
Navarre	
Valencia	23
Balearic Islands	1
Canary Islands	
East Indian Islands	

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* See under Asia.

West Indian Possessions	
General	67
	430
Switzerland:—	
Appenzell	
Argau	
Basle	
Berne	5
Fribourg	
Geneva	
Glarus	
Grisons	6
Lucerne	6
Neuchâtel	
St. Gall	5
Schaffhausen	
Schweitz	3
Soleure	
Tessin	
Thurgau	5
Unterwalden	7
Uri	1
Valais	
Vaud	5
Zug	1
Zurich	
General	6
	50
Turkey in Europe:— (See also under Asia).	
Albania	
Bosnia	
Bulgaria	
Montenegro	
Roumania	
Roumelia	
Servia	
General	20
	20

Asia.

Arabia.	
China:—	
China Proper, with Formosa and Hainan.	
Corea	
Mantchuria	
Mongolia	
Thibet	1
Turkestan	
British Possession—Hong Kong	
General	1
	2
Hindostan:—	
British India—	
Bengal	5
Bombay	
Madras	
N. W. Provinces	45
Ceylon	
Native States—	
Afghanistan and Beloochistan	
Cashmere	
Cutch	
Gwalior	
Hyderabad	
Indore	
Kattywar	
Kolapore	
Mysore	
Nepaul	
Rajpootana	
Saugor	
Sikh States	
Travancore	
	50
India beyond Ganges:—	
British Possessions—	
Aracan	
Assam	
Chittagong	
Malacca	
Pegu	
Tenasserim	1
	1
Independent States—	
Birmah	
Malay States	
Shan States	
Siam	
Japan:—	
Kinsiu	
Niphon	
Sikok	
Yesso	
General	4
	4
Turkey in Asia:—	
Algezira	
Anatolia	
Armenia	
Caramania	
Cyprus	
Irak Arabi	
Kurdistan	
Palestine	
Sivas	
Syria	

Africa.

Abyssinia	40
Egypt and Nubia	24
Morocco	2
Tripoli	
Tunis	
Madagascar	
	66

North America.

Costa Rica	
Guatemala	
Honduras	
Mexico	
Nicaragua	
San Salvador	
United States	1
	1

South America.

Bolivia
Brazil
Chili
Eucador
La Plata
New Granada
Paraguay
Peru
Uruguay
Venezuela

Popular Typography.—Her Majesty's Commissioners are desirous of obtaining for the Exhibition of 1872, with a view to show the decennial progress of popular typography, specimens of the newspapers and periodicals published in all parts of the world during the months of January or February, 1872. In order that such specimens may be properly arranged, it is desirable that they should be forwarded to the Exhibition as soon as possible after they are published.

Australia.—Measures are being adopted with the view of having this colony adequately represented at the forthcoming International Exhibition of 1872, in London. The government has given the matter into the charge of the trustees of the Industrial and Technological Museum, who have issued a public announcement requesting exhibitors who desire to send goods to the next exhibition, in May, 1872, to come forward. The trustees have also issued circulars to the principal firms known to be interested in the manufactures to be exhibited on that occasion, inviting them to communicate with the secretary, and to forward particulars of exhibits. Arrangements are to be made to insure as far as possible the safe return of all articles transmitted to London.

M. Regnault's Pictures.—The pictures by H. Regnault, which were among the specimens of French Fine Art exhibited last year, namely, the "Execution in a Moor's Palace," and the portrait of Marshal Prim, are to be purchased for the Luxembourg.

Season Tickets.—The prices for the coming Exhibition, to be opened on the 1st of May next, will be:—For a gentleman, £2 2s.; for a lady, or for a youth under 15 years of age, £1 1s. The owners of season tickets will be entitled to admission to the Exhibition on all occasions when open to the public, to ceremonies and private views, to the galleries of the Exhibition two hours before the public, to the gardens of the Royal Horticultural Society, whenever open to the public, and to the musical promenades in the Royal Horticultural Gardens. For admission to the flower shows of the Royal Horticultural Society, a separate charge will be made by that society. Season tickets must be signed before presentation. The owners must produce them each time they enter the Exhibition or the gardens; and when required must write their names in a book. Season tickets are not transferable, and if presented by any other person than the registered owner will be forfeited. Tickets lost cannot be replaced. The following will be the prices of admission:—On Wednesday, the 1st, and Thursday, the 2nd of May, 10s. each day; on Friday, the 3rd, and Saturday, the 4th of May, 5s. each day; from the 6th May to the 30th September, on Mondays, Tuesdays, Thursdays, Fridays, and Saturdays, 1s. each day; on Wednesdays, 2s. 6d. each day. Her Majesty's Commissioners reserve the right of altering the prices of admission for the general public from time to time, as they may see fit. Members of the Society of Arts have the privilege of obtaining season tickets at one guinea each.

Albert Hall.—His Royal Highness the Duke of Edinburgh presided at a meeting of the Executive Committee of the Royal Albert Hall, at Kensington, on Saturday. Present, Sir Thomas Biddulph, Mr. Bowring, Mr. Cole, and Major-General Scott, secretary. Sir Francis Sandford and Dr. Lyon Playfair attended the meeting.

THE PROGRESS OF THE NATION.

In a lecture recently delivered at the new Mechanics Institute, Bradford, by Mr. Alexander Redgrave, Her Majesty's principal inspector of factories, some interesting facts were given relative to the progress of the nation as to population, manufacture, and commerce, and the moral and social condition of the people.

With regard to population, Mr. Redgrave said the census was taken this year, and the general results were published. The increase of population from 1851 to 1861 was at the rate of 5·74 per cent., while from 1861 to 1871 it was 8·60 per cent. The number of persons living on the 8th April, 1871, was greater by 2,524,637 than the number living on the 3rd April, 1861. But in this country our numbers are reduced, not by death alone, but by emigration. The deaths are counterbalanced by an increase of births, but immigration is no counterpoise, for the number of foreigners who settle in this country is infinitesimal. Taking, therefore, the actual increase on April 8, 1871, as 2,524,637, we have to add to these the number of emigrants, 1,674,544, and we shall arrive at a gross total of 4,199,231. During the ten years the due proportion of emigrants would have died, but on the other hand there would have been the due proportion of births, and the actual increase of population in this country has therefore not been less than that above stated, viz., upwards of 4,000,000.

As the first proof of the progress made in manufacture and commerce, Mr. Redgrave turned to the trade and navigation accounts, and it will be found that the value of imports of foreign and colonial produce, and exports of the produce and manufacture of this country, in the year ended 31st December, 1870, was £455,666,017, or, including gold and silver, £499,000,000. Thirty years ago the value was £51,634,623. But the progress during the present year has been more marked than ever. In the first ten months of 1871 the imports and exports (including gold and silver) amounted to £488,242,687, and if the last two months of the year are as prosperous as the preceding ten, the close of the annual account will show a total of £584,000,000. The average value then will be £19 per head, contrasted with £3 10s. per head in 1841. The means of carrying on commerce lie in shipping and railways. Thirty years ago the tonnage of ships which cleared inwards and outwards with cargoes was under 10,000,000. In the year ended 31st December last, the tonnage was 31,626,340, and for the first ten months of the present year the tonnage was 28,793,214; and if the proportions continue for the next two months, the amount for the present year will be upwards of 35,000,000 of tons. Then there is the coasting trade, which is not included in the above. The tonnage of vessels, inwards and outwards, for the year ended 31st December, 1870, was 18,240,744, and for the first ten months of this year it was 15,283,010, and by the end of the year it will still show an increase, but not equal to that on the foreign trade. The number of vessels registered in the United Kingdom in 1841 and 1870 was as follows:—1841, 23,461 vessels, tonnage 2,935,399; 1870, 25,643 vessels, tonnage 5,617,693. The great alteration in the shipping trade has thus far been in the size and carrying power of the ships; for instance, in 1841, each ship was, on the average, about 110 tons; in 1870, the average tonnage was 216; and this appears more markedly if we look to the new ships built in 1841 as compared with 1870. In 1841 there were 1,192 vessels of an aggregate tonnage of 168,309, or an average tonnage of 141 tons. In 1870 the number of new vessels was less, viz., 1,043, but the aggregate tonnage was 362,877, or an average tonnage of 342 tons. But again, the progress of the year 1871 is remarkable also in the increase of shipbuilding. Mr. Chichester Fortescue, the President of the Board of Trade, recently stated that there were at this moment 300 important steamships being built in the North, and that one yard alone was adding 27,000 tons of shipping to the mercantile navy. Railways are the creation of the present century; their progress has been rapid. In 1843 there were 1,798 miles of railway in the United Kingdom, upon which £4,535,180 was received for traffic. In 1870 there were upwards of 11,000 miles of railway, upon which £45,078,143 had been received for traffic, upwards of 300,000,000 of passengers and upwards of 140,000,000 tons of minerals and merchandise having been carried. The total amount of capital, loans, and debentures was, in 1870, £529,908,573. By the aid of ships and railways, the enormously increased transit of produce and manufactures had alone been possible.

One of the most important manufactures of the country is that connected with textile fabrics. Unfortunately, the materials for a proper comparison of this branch of industry are not at hand. We have returns of the number of cotton, woollen, worsted, flax, and silk factories, which were under the supervision of the inspectors of factories at different dates; but it is only recently that these returns have been presented with sufficient detail to form a basis for future comparisons. To go back thirty years we shall find mere numbers disappointing rather than satisfactory, and we must possess more data than are at hand to judge with approximate accuracy the progress of the textile manufactures of the country. The figures of the returns collected in 1839, with those collected in 1870, are as follows:—

	1839.	1870.
Cotton	1,819	2,483
Woollen	1,322	1,940
Worsted	416	630
Flax	392	606
Silk	268	500

The number of persons employed:—

	1839.	1870.
Cotton	259,385	449.087
Woollen	54,818	129,000
Worsted	31,628	100,557
Flax	43,487	124,772
Silk	34,318	41,124

To make the comparison of these figures complete, it would be necessary to know the quantity of goods produced. We have knowledge of the quantity of cotton retained for consumption; but in the other fabrics, except silk—which is small in importance compared with the others—there is home as well as foreign produce manufactured, and of the quantity of home produce consumed there are no means of acquiring a knowledge. As to cotton fabrics, however, we learn this fact, that although the number of factories increased by one-third, and the number of persons by about two-thirds, the consumption of raw cotton has increased at least six-fold. We see here the great characteristic of the English manufacturer — the power of producing economically. So long as an Englishman can continue to improve machinery to save labour, he will not be left behind in the great competition. He has only to look back to the triumphs which he has achieved in the self-acting mule, the combing machine, the perfection and marvellous accuracy with which tools are now constructed, and he need never despair of the future. The progress of the metal trade, and particularly of iron, is well worthy of remark. For the purpose of this comparison, Mr. Redgrave referred to the account of the mineral products of the country, published annually by Mr. Hunt, of the Geological Museum in Jermyn-street. The first account which can be used for the purpose of comparison is that for the year 1854, and the quantities of metal produced in that year and in 1869, the last account published, were:—

		1854.	1869.
Iron	tons	2,069,838	5,445,757
Tin	,,	4,425	9,760

		1854.		1869.
Copper	tons	14,191	......	8,291
Lead	„	64,005	......	73,259
Silver	ounces	562,659	......	831,891

The coal produced at the same periods was respectively, in 1854, 64,661,401 tons, and, in 1869, 107,427,537 tons. The great demand for coal for manufacturing purposes has rendered the question of the supply of coal for future use one of the most intense interest to every inhabitant of this country. The enormously increasing consumption led to various and conflicting estimates, and at last a Commission was appointed to inquire and publish the best data that could be obtained. Sir W. Armstrong estimated that if we go on consuming coal at the same increasing rate that we do now, we should exhaust our coal-fields in about 200 years. Mr. Stanley Jevons, calculating a greater rate of increase than Sir W. Armstrong, concluded that the supply would be exhausted in 100 years. It is possible that some exception may be taken to the mode by which Mr. Jevons estimated the increase, but, at any rate, his calculations have been not far wrong to the present time. In 1864, he calculated the future upon the actual increase of the preceding five years, and, according to him, the consumption of coal would be 118,000,000 in five years—the actual consumption, according to the inspectors of mines, having been 113,000,000 tons in 1870. Mr. Porter estimated that there where 402 blast furnaces in blast in 1870; and the factory returns show that there were, in 1870, 672 in blast and 179 out of blast, and 6,189 puddling furnaces in blast, and 629 out of blast. But the increase in the mere number of blast furnaces is no criterion of the progress of the trade—we must look also to the producing power of the furnaces. It was stated in a paper read by Mr. Jones, at Middlesborough, recently, that the improvements in this respect have been really marvellous since 1857—that is, within the last twenty years only, in that district. In 1851, the furnaces were 42 feet in height by 15 feet bosh, and now they are constructed 90 feet in height and 30 feet bosh, having a cubical capacity of 41,149 feet, compared with 4,506 in 1857. Regarding the economy of manufacture, thirty years ago a spinner of cotton yarn was only expected to mind a pair of mules containing 300 or 324 spindles, having three assistants. Now he minds mules containing 2,200 spindles, with perhaps five assistants, producing at least seven times the quantity of yarns that he produced in 1841. Some time since, Mr. Redgrave said, "I was greatly struck with the altered appearance of woollen mills. Formerly they were filled with women and children; now machinery seems to do all the work. I asked a manufacturer to tell me the different proportions of hands he employed at different dates, and the following is the statement given to me:—Under the old system he employed 63 persons; he then introduced improved machinery, and reduced his hands to 33; and, lastly, he again made great changes, and was able to reduce his hands to 13. In this country the only limit to the enterprise of manufacturers is, as far as I have able able to observe, the quantity of raw produce to be turned into manufactured articles. Giving a raw produce, the ingenuity, the power of adapting means to an end, and the energy of an Englishman can fashion it at a reasonable yet remunerative price. As a manufacturing nation, we have abundant supply of coal and iron of the best quality. We can, therefore, make machinery and drive it with steam at a moderate cost. Each individual in this country can, as a working man, do an enormous amount of work compared with the working men of other nations. A few years ago, I collected, through the different embassies abroad, statistics of manufactures, and I found the following was the comparison of textile fabrics, and the powers of production:—In France, the average number of spindles in a factory was 1,500; in Prussia, 1,500; Belgium, 4,000; Saxony, 4,500; Austria, 7,000; Switzerland, 8,000; United Kingdom, 12,000. When taking cotton factories only, I found that the proportions of spindles to persons employed was—In France, 14; Russia, 28; Prussia, 37; Bavaria, 46; Austria, 49; Belgium, 50; Saxony, 50; Switzerland, 55; smaller States of Germany, 55; United Kingdom, 74. And incidentally the following statements have been made to me by managers of cotton factories, showing the relative capacity for work of the Englishman and a foreigner:—In Germany, the hours were from 5·30 a.m. to 8 p.m. every day, including Saturdays. In a cotton factory there, he calculated that the same weight was produced, when superintended by English overlookers, as in sixty hours in England; but if the work was superintended by German overlookers, the weight produced would be much less. As another instance, in Russia, the factories work night and day, 150 hours per week, there being two sets, each working 75 hours per week. Taking the year round, the manager of a cotton factory there considered that in England as much would be produced in 60 hours per week. He also said that no weaver ever had more than two looms, and that the speed of the machinery was about one-third less than in this country. Some few years since, I had opportunities of inquiring into this subject, both in France and in Germany, and from every quarter, and especially from English overlookers. I received the strongest assurances that the English workman was unapproachable in the amount of good work turned out, and in steadiness; and that the relative cheapness of wages did not counterbalance the steadiness and quickness of the Englishman while at his work."

After alluding to the social and religious condition of the people, the consumption of spirituous liquors was referred to. In 1742, each individual in England and Wales consumed three gallons. In 1841, the consumption was at the rate of ·51 per head—a rate at which, with some fluctuations, it has remained to the present day. The consumption of malt has slightly increased. In 1841, it was at the rate of one bushel and one-third per head. In 1870, it was at the of one bushel and two-thirds per head. The consumption of wine has increased, but it is clear that the consumption of intoxicating drinks by the masses has not increased. Spirits and beer are the beverages of the labouring classes, and although there are drunkards still, yet the consumers of unintoxicating drinks bear a larger proportion to the population now than they did in 1842.

With regard to the homes of the people, the condition of the people in their social improvement is mainly influenced by their ability to procure the necessaries of life, by the comfort and sanitary condition of their houses, by the relative prices of food and clothing, and by the improved and extended means for the diffusion of knowledge. There is no occupation scarcely that does not bring its followers a higher rate of remuneration than has existed at any previous period. Formerly, when the means of communication were limited, it was not known in one town what was done in another, and the prices which ruled in one trade were little known beyond the circle of the buyers and the sellers. But now, what are the wages and terms of work and conditions of work in Invernesshire or Cornwall may be known by anyone, and these questions are discussed in thousands of households, and rates of payment are settled upon principle, and not upon the arguments or views of one party only. The rise in remuneration is too patent to everyone to need illustration. Again, the improvement in dwellings, the arrangements for supplying wholesome water to every house, for carrying away refuse, for maintaining the proper decorum of a family in the plan and sufficiency of the rooms, meet us on every side. Not long ago, "I saw some bothies in Scotland. Now, a bothy is a barrack, generally situated near the place of work, there being separate buildings for males and females. The floor is the bare earth, worn into ruts by constant wear. Here will be a stove, but no seats, though it is the living room of the barrack. Above are the dormitories. There was literally nothing for the hands to do but to work, to eat, and to sleep. When there was time to spend, it was spent rather in horse play than in rational amusement. Need I contrast with this happily exploded system the substantial, comfortable cottages built for operatives in the manufacturing districts, or compare any one of the hundreds of houses of Saltaire, which would be as Eastern palaces in their comforts to the inhabitants of the wretched bothies. Contrast, again, the prices of food and clothing of to-day with those which ruled thirty years ago. Contrast with them, at the same time, the relative power of increased remuneration to pay a higher price for necessaries, I will not say luxuries, formerly not dreamt of. The following figures will enable us to imagine the position we would have been in with an increased population, having greater powers of consumption, but for free trade. This is the sum of the food imported into this country in 1870 :—Animals, £4,155,463 ; corn, &c., £19,732,879 ; other provisions, £15,847,401. Corn has ruled much lower than it did thirty years since, but meat has risen considerably, princpally, I believe, from the enormous increase of meat consumers in the country. The high rate of remuneration has enabled families to consume meat constantly who formerly only consumed it occasionally, and many who never consumed any can now afford to eat it frequently. But if meat has risen in price, tea and sugar have fallen greatly, and chiefly through the application of the true principles of taxation. Taking tea, in the first place, we find that in 1841 the duty was 2s. 1d. per lb., that the consumption per head was 1 lb. 6 oz., and the annual contribution of each person to the revenue was 2s. 11d. Coming now to 1870, we find the duty 6d. per lb., the consumption per head 4 lb. 10 oz., and the contribution to the revenue of each person was just 2s. 4d. per annum—the revenue for the year being £2,940,000. Then, again, with respect to sugar. In 1841, the duty upon sugar was 24s. per cwt., the average consumption per head was 17 lb. 8 oz., and the contribution to the revenue per head was 3s. 10d., the revenue being £5,114,390. In 1870, the duty would average, according to quality, rather more than 5s. per cwt., the consumption per head was nearly 54 lbs., and the contribution per head to the revenue was about 2s. 6d.—the revenue, notwithstanding the reduction of the duty one-half over the last nine months of the year, was just £4,000,000.

"To anyone who has passed nearly 40 years of observation, nothing is more astonishing than the improvement in the articles of dress, as now worn by every class. Not long ago I saw in this county a coat which a friend had worn at his wedding—then five-and-thirty years ago. It cost a fabulous price, and I am certain I could dress myself from head to foot for a whole year for the cost of that marvellous blue coat. If fashion had been as enduring as the Yorkshire cloth of those days, that coat might have adorned the brilliant saloon for many a year. But when manufacturers saw that fashion changed almost as rapidly as the seasons, they made cloth to suit the public taste, and now we can buy excellent and serviceable clothes, which answer our purpose in reality better, at a mere tithe of the expense. We can have children's paletots excellently made and hemmed for 6s. 9d. a dozen, or 6¾d. each, wholesale price, and other articles in proportion."

We must look to all classes in considering the social condition of the people, and not only to those who live by labour. It is the aim of all classes to reach, at the least, the class immediately above them; and if we compare the taxes upon luxuries during the last thirty years, we shall see how far the middle-classes must have been augmented. For instance, it appears that in 1840, there were 318,251 horses charged with duty, exclusive of agricultural horses, which were exempt from duty. And notwithstanding the all but total extinction of stage-coaches and posting in 1870, there were in that year 744,906 horses charged with duty. In a similar manner, there is a comparison of the number of men servants and carriages kept, and of the consumption of wine—three elements of a well-to-do household. In 1841 there were assessed for duty 101,849 men-servants, and in 1870 the number was 267,671. In 1841 there were assessed for duty 28,334 four-wheeled carriages ; in 1870 the number was 132,331 In 1841 the number of two-wheeled carriages was 41,663, and in 1870 the number was 249,991 ; and the persons charged with keeping such carriages were, respectively, in 1841, 34,694 ; and in 1868, 59,190. Again, taking the consumption of wine, an element of luxury and health, we find that the average consumption per head, in 1841, was a little more than one-fifth of a gallon, while in 1870 it had risen to half a gallon per head. Again, if we take the game licenses, we find that there were in 1847, 39,373, and 2,694 keepers ; and in 1869, 54,203, and 4,921 keepers. But we may yet illustrate the increased wealth of the middle classes by an examination of amounts paid to legacy and property duty. In 1841 the capital subject to legacy duty was £41,476,521 ; and in 1869 this sum was more than doubled, for it amounted to £87,721,152. The amount of property and income charged with duty in 1843 was £204,868,035 ; while in 1869 it was £386,549,366. This is an enormous increase, even after allowing for the tax in Ireland, which did not come into operation until 1853. Another great advance has been the facilities for intercommunication by cheap postage and for the diffusion of intelligence by cheap newspapers. In 1839 the number of letters delivered was 99,014,156. In 30 years the number had increased to 831,914,000. In the latter year also a sum of upwards of £19,000,000 passed through the money-order office, and 2,727,763 letters of importance were registered. Since 1869 greater and very important facilities have been put into operation. The postage of letters, parcels, and newspapers have been re-arranged in favour of the public, and postal cards have been issued. That these arrangements have met a want will be credited by the fact that from the 1st October, 1870, to the 31st March, 1871, upwards of 58,000,000 post-cards have been issued, and upwards of 140,000,000 halfpenny labels and stamped wrappers. Cheap newspapers are of very recent introduction. For years the excise on paper, the stamp on newspapers, and the duty on advertisements, rendered a cheap newspaper impossible. But gradually each impost gave way before the more enlightened views of the statesman of modern days, and the press is unshackled; and what has been the result? In 1841 there were 134 newspapers in London, and in other parts of England and Wales there were 244, and in Scotland and Ireland 167—total 541. The number of stamps issued in the year was 59,936,897, which, as all newspapers were stamped, represents the number issued. At the present there are published in London 30 daily papers, upwards of 200 papers issued weekly, or at intervals within a week, and about 760 periodicals, partly of the nature of newspapers, partly of magazines, appearing at intervals from once a fortnight to once in three months. The number of provincial, Scotch, and Irish papers is 1,158, and the number of papers and periodicals registered for transmission as newspapers is upwards of 1,000.

Mr. Redgrave referred to the fine arts as bearing upon the social progress of the nation, and referred at some length to the arts in Greece, Rome, Florence, and other places, and to the great painters in our own country. He also spoke of the high-class style of the buildings at the present day, and said :—To particularise might seem invidious, but I cannot help pointing out the infirmary at Leeds, and the bank of Messrs. Beckett at Leeds, as being instances of the perfect adaptation of architecture to its purpose ; and the church at Halifax, built by Mr. Akroyd, as leaving nothing to the imagination to supply or to alter. And the building which has already raised its head in this town bids fair to rival, in appropriateness of design, in its elegant façade, the masterpieces of Brussels and Lorraine. But there is much more to be proud of. To look round this spot for a radius of only ten miles, we find that the Akroyds have erected churches, endowed schools, and built admirable dwellings for the workpeople. The Crossleys have given and adorned a beautiful park, have dedicated almshouses and orphanages for the poor, have endowed public charities. The Listers have enabled their fellow-townsmen to possess themselves of a second park. The Salts have erected a new town, perfect in its plan, have erected churches and schools, and set apart a park for the enjoyment of the people.

Upon the subject of education, Mr. Redgrave said:—In 1843, of the schools in Lancashire and Yorkshire attended by half-timers, only 19 per cent. were schools under any, even *quasi*, public management, and 45 per cent. were dame schools. In 1862, 70 per cent. of the schools were public schools, and there was not one dame school patronised by the factory population. Since that date, too, I learn that the per-centage of public schools has further increased. As another illustration, I found, by a very careful inquiry in 1867, that in Blackburn 74 per cent. of the whole of the children between 5 and 15 were attending day-schools. Again, in the same year, in Halifax, 70 per cent. of the children between 10 and 15 were attending day-schools. I doubt whether the best educated country in Europe can give a better account than that. From the year 1839 to the 31st of March, 1870, the Committee of Council on Education has made grants to the amount of £11,863,078, and in the last three years the committee had made grants to the extent of £680,000. During the same period grants have been made toward the erection of 5,016 new schools, and towards the enlargement of 2,319 existing schools, providing for 1,019,647 additional scholars. The sums granted by the committee for the above purposes were £1,556,819, in addition to the local subscriptions of £3,729,043. At the last date there were 15,253 schools in connection with the committee, of which 10,214 had been inspected in the year 1870. These had accommodation for 2,152,712 scholars, but the names on the registers amounted only to 1,949,026, of whom 1,353,911 were present on the days of examination. Before the Committee of Council commenced their operations, there was in existence, in connection with the Church of England, the National Society, founded in 1811. From that date till the end of 1870, the Society had granted £900,000 towards training colleges and schools, which sum had been a contribution to upwards of £4,000,000 raised by private and other subscriptions.

THE FORESTS OF INDIA.

(*Continued from page* 122.)

Before the attention of the government was given to the forests, the denudation had gone to such an extent, that there was not only a scarcity of timber and fuel, but the climate was seriously affected. There was reason to believe the rainfall had diminished very considerably, and the climate was becoming arid. The first teak plantaion of magnitude was commenced by the late Mr. Conolly, in Malabar. Subsequently, sandal-wood was planted in Bengal, red saunders and other trees in Madras, deodar in the intramontane valleys of the Himalaya. The success of the "Conolly" plantations makes the description given amongst the additional matter appended to the report of the India Committee useful for the imitation of forest cultivators. In 1844, several large blocks of land, covered with jungle, and estimated to embrace an area of 20,000 acres, were obtained by the Madras government, on perpetual lease. The first plantation was commenced in 1844, by Mr. Conolly, the collector of Malabar, who, in 1855, met his death at the hands of Moplah assassins, and in whose memory these plantations have been designated. The area annually planted was at first 100 acres, but they were reduced to about 50 acres, until, in 1863, it was again increased to the original extent. The plantations are situated on undulating ground along the banks of Beypoor River, near the village of Nellamboor, about ten miles from the foot of the Western Ghauts, and forty miles from Calicut on the coast. Towards the north and east, the Nellamboor district is sheltered by the Western Ghauts and Neilgherry-hills; and being open to the south, and so near the sea, the climate is particularly moist during the monsoon, while, owing to its sheltered position, the heat at all seasons of the year is excessive. It is, in short, a "forcing climate" as regards vegetation, and so much so, that Nellamboor is compared in that respect by some to a huge conservatory. The area planted up to date, with teak, is about 2,000 acres. The plantations extend, in narrow belts, a distance in all of six miles, and vary in width from a quarter of a mile to a mile, having a stream on one side, and either paddy-fields or low jungle on the other. The soil near the banks of the streams is a rich alluvial deposit of great depth, with, in some places, a large admixture of sand. In December, at the close of the north-east monsoon, the jungle on the site selected is felled and prepared for burning, which usually takes place at the very close of the dry season. In April, before the setting in of the rain, nurseries are formed in a part where water can conveniently be had. The seed, after being steeped forty-eight hours in cold water, is sown on raised beds of fine mould, which are then covered with straw, to prevent a too rapid evaporation, and are kept moist by constant watering, until the seed germinates and the young plants break the ground, which is generally within a lapse of from twelve to twenty days. As soon as the rains commence, the plants are put out in line six feet apart, and at six feet distances within the lines, the plants in every alternate row being opposite the vacancies in rows next to them. They are placed in pits a foot square and a foot deep, filled with good surface mould. A plantation is generally four years old before it is able to keep down grass and other jungle by its shade. To prevent fire, a broad belt several yards wide is cleared around the boundaries of the plantations, about the middle of the dry season, and peons, accompanied by coolies, are sent to examine this cleared track every second or third day, to see that no further accumulation of leaves and inflammable matter takes place. The reports of all officers who have visited the plantations agree that the selection of land was excellent, as regards climate, soil, and the facility for the export of timber, and other circumstances. At the first glance at the older plantation, from 12 to 24 years of age, they do not fail to be struck with the magnificent growth of the trees; the largest are from 4ft. 7in. to 5ft. in girth, with straight, cylindrical stems, 60 to 70 feet in height. These are found, more or less, in alluvial soil close to the streams; elsewhere, the growth of the trees, although in many parts excellent, has not been so rapid. The most remarkable feature, however, of these plantations is, that they have been established at a very small cost, and they appear at this time to be self-supporting.

An account of the descriptions of timber that may be grown with profit to the government was given by Mr. Cleghorn, a gentleman who possesses a thorough knowledge, from personal observation, of the forests in different parts of India. By far the most valuable of all Indian woods it appears is the teak, the chief supply coming from British Burmah, the forests of Malabar and Canara, and the Central Provinces, where the growth is comparatively small. The first-class, for ship-building, takes from seventy to eighty years to arrive at maturity, and for house building about twenty years. Previous to the formation of the forest service, the agent for the East India Company engaged in the purchase of timber, for the men of war at Bombay had been withdrawn in consequence of the destruction of the teak. At present, in addition to the Malabar plantations, operations to a large extent have been decided upon in British Burmah, above Rangoon, and elsewhere. Black wood stands next in importance, being of great value for ordnance purposes, house building, carved furniture, and for the use of cabinet makers; it is exported in considerable quantities. It is now planted in the same situation and often alongside the teak, and can be obtained in equal size. Ebony is a tree of great value; it is also sold by weight; the cultivation, which requires many years, could be much extended, although this has not been found necessary. The sâl wood is found in that large tract, the Terai of the Himalaya extending from Assam to the Kangra valley. This belt of sâl is broadest in the east, and becomes narrower as it proceeds north-west; the northern limit is between the Sutley and the Beas; the southern near Vizagapatam. It attains a very large size in the forests of Oude and of the Terai. It grows very close, and propogates itself in a manner different from other trees; the seeds fall viviparous into the ground, so there is comparatively little trouble in the management of the sâl forests. The wood is used for engineering purposes, ship-building, and very extensively for house-building in Upper India. It takes a long time to season, and is very peculiar in some respects; it becomes seasoned after a course of years, but if afterwards floated, it absorbs the water and gains weight more than any other wood, but it is especially liable to the attacks of the white ant. Sandal wood is confined in its growth to the plateau of Mysore and the adjoining country. The quantity is very large, yielding an annual revenue of between £10,000 to £15,000 to the Mysore state. It extends as far as Coorg, and north to North Canara. Plantations have been formed within the last few years, which are being extended annually. It is a small tree, which reaches maturity in twenty years. It is sold by weight, and the chips, fragments, and sawdust are used for the extraction of oil. The cinchona cultivation has been remarkably successful in the Neilgherry-hills, at Darjeeling, in Ceylon, and elsewhere. The growth is rapid, and the bark is valuable at an early age. The introduction was due to Mr. Markham's researches in the slopes of the Andes, and the cultivation is being extended by the forest officers. There is a scientific chemist, a quinologist, stationed at Ootacamund, engaged in extracting the alkaloid, and it is confidently expected that this will affect the value of quinine, although the affect has not been felt at present. There are seven or eight species of bamboo, which are used for scaling ladders, and various purposes of domestic economy; by the natives it is applied to an infinite variety of uses, and, next to the cocoa-nut, it is the most valuable wood in India. The rattans grow in great abundance in the forests of Malabar; it is a species of palm, the stem of which runs along the ground to the length of 80 to 100 feet. There is a very large trade in rattans, from the forests of Singapore, to China; it forms a valuble article of export. The larger description, called the *Calamus rotany*, is commonly used for walking sticks. The Malay chiefs derive a considerable revenue from granting the privilege of cutting rattans in their forests, which do not come under the Forest Department. *Cassia lignea* exists in abundance in the Malabar forests. It is an inferior variety of bark, resembling cinnamon in smell and appearance. Wild cinnamon is not much sold at present, but for all such articles there is an increasing demand. Cardamoms grow spontaneously in the jungles where coffee planters have settled. In Coorg and Wynaad there is a considerable cultivation, and revenue is derived from them. Pepper is a natural produce of the Malabar forests, and a great article of commerce; the cultivation has been under the civil authorities. Most of the pepper jungles in Malabar are private property. Caoutchouc and gums of similar properties are found largely in Assam. There are various gums, the gum gamboge, gum kino, and many other species. Kino is used for calico printing, and gamboge is a pigment and a medicine. There are several trees besides which produce vegetable colours the chay-root, for example, resembling logwood. Dammer is a product yielded from various species of the wood-oil family; it is much used as a substitute for pitch, and by the varnish makers. The pimento has been introduced, but only very sparingly, on the western coast, into Travancore and Cochin; it is only grown in gardens, and not sufficient for commerce. The bread fruit is cultivated and grows well on the western coast; this, with the cocoa-nut and betel-palm, belong also to the gardens. The cocoa-nut exists entirely on private lands. The palmyra tree is extremely useful for rafters of houses, for fishing stakes, and harbour staging, and other similar purposes as it resists the action of the sea for many years. The casuarina, or beef-wood, has been planted in the sandy shores north and south of Madras, and at various places on the opposite coast. It is of very rapid growth, and it possesses the property of durability under water; being very hard, it turns the edge of the axe. It has a peculiarity, which belongs to few fast-growing trees, of being extremely tough and durable. Satin wood attains fifteen inches in diameter; it is very useful for picture frames and fancy purposes, and resembles the American maple. The mahogany is not indigenous in India, but the seeds have been received in considerable quantities from the West Indian Islands within the last few years, and plantations have been commenced in Bengal and othet parts.

Besides these great varieties, all of which may be turned to future account, there are certain kinds of dog-wood and allied species, found to be useful for the manufacture of charcoal; several woods also that produce good bark for tanning. The native leather merchants remove, under permits from foreign officers in certain places, the bark of trees marked out for the purpose, chiefly the *Cassia auriculata* and the *Acacia catechu*. The great heat is not favourable to the process in the south, but at Meerut, in the north-west provinces, tanning is very sucessfully carried on. Amongst the etcetras of the forest produce, there is the honey and bees'-wax, in the collection of which the hill tribes have prescriptive rights that have never been interfered with.

PROCEEDINGS OF INSTITUTIONS.

Tonic Sol-fa College.—The annual congress of teachers and students of this method has just been held, under the presidency of Mr. Curwen. The proceedings, which lasted three days, included nineteen papers and lectures. Mr. Alexander J. Ellis, F.R.S., gave three lectures, on "Pronunciation in Singing," in which he showed the nature of vowel sounds and their relation to musical tones, the nature of diphthongs, and the proper mode of making the consonants distinct without being harsh. Other papers, by students from all parts of the country, were, on "The Human Voice," "The Duties of a Praise Leader," "The History of the Counter-Tenor Voice," "The Characteristics of Scotch National Music," "How to Meet the Minute on Music in Elementary Schools," and many other subjects.

CORRESPONDENCE.

DEAF AND DUMB INSTRUCTION.

Sir,—Referring to the correspondence on the subject of deaf and dumb instruction, I find that, as I expected, the teaching of these unfortunately-afflicted children how to articulate and understand speech by means of the eye, is only practised as an accomplishment in the deaf and dumb asylums of this country, and hence the system as used in Rotterdam has not received a fair trial, and its application as a primary means of communication is not understood by those who conduct these institutions. I cannot trace in the remarks elicited by my former letter, a single tangible reason why the system which is carried on with such success in other countries should not be tried here; and I hope the managers of our large asylums will not allow themselves to be blinded by the prejudice in favour of older-established plans, and the half-measures which have made the speaking and lip-reading system fail, or supposed to be impossible, as a means of educating the majority of deaf-mutes.

I trust that this question will shortly be again brought before the notice of the Society of Arts by abler advocates than myself, and that those gentlemen who differ from me in opinion upon it will attend and take part in any discussion that may arise. In the meantime—I am, &c.,

Lionel Van Oven.

34, York-terrace, Regent's Park,
21st December, 1872.

GENERAL NOTES.

South Kensington Museum.—His Royal Highness the Duke of Edinburgh has lent for public exhibition specimens of the collections of objects of science and art which he made in his cruise round the world in H.M. ship *Galatea*, in the years 1867, 1868, 1869, 1870, and 1871. They will be illustrated by paintings of the scenes of places touched at, by Mr. Oswald Brierly and Mr. Nicholas Chevalier. It is expected that they will be arranged for public inspection in the North Court of the Museum towards the end of January.

Coffee Roasting.—There is a considerable difference in the method of roasting the coffee berry in this country and on the Continent. In France, for instance, not only is the machinery used constructed with some amount of care for the purpose of securing the object desired, namely, the equal torrifying of the berries, but the persons employed in the operation have to possess a certain amount of technical skill, and a knowledge of the chemistry of the work they do. In France, a roaster has to acquire a knowledge of the various coffee berries, for each different sort requires to be roasted a longer or shorter period than the other; and when it is remembered that, on the authority of those who have studied the subject, a few seconds only will make all the difference in the quality of the coffee, it will seem that this knowledge is important. Roasters have to serve some years before they are declared thoroughly competent, and the operation of roasting is always under the superintendence, if not of the actual care, of a tried and experienced man. The machinery in use is generally as follows:—A hollow iron ball, turning on its axis, receives the unroasted berries. In it is a valve by which the escape of the gas arising during the process is regulated. This ball is turned over a fire and made to revolve somewhat rapidly. Its shape secures the equal contact of every berry with the hot metal. As soon as the berries are sufficiently roasted, the gas is let off, for if it was allowed to remain, the berries would absorb it, and the flavour be vitiated. The revolving motion is then continued until they are turned into the receptacle prepared to receive them. They are then kept in hermetically closed tins till ready for use. In England, the process is much more a rule of thumb affair, and, with rare exceptions, all coffees are roasted alike, in cylinders, which are not capable of roasting so equally as a ball, and but little attention is paid to the chemical effects of the roasting. Another bad feature prevails in England, and that is, the berries are ground by the wholesale dealers, and by the time the decoction reaches the breakfast table the best flavour of the coffee has been floated away in the air. In order to facilitate adulteration, coffee is usually ground very fine, which is another mistake. Mr. J. Picard of Planters' Hall, Farringdon-street, has introduced into this country coffee prepared and roasted an the above Continental principle, and some cafetiers, which seem to afford the facilities required for making good coffee. Mr. Picard proposes, after one of the usual evening meetings, to give members an opportunity of tasting coffee made by him.

Working Man's Recreation.—The following is extracted from the *Times* of Tuesday, December 26th, 1871:—"A time will come—is it not a sin to doubt?—a time will surely come when even the sons of toil and craft will have regular method and opportunity for enjoying, as becomes men, the days and the hours of rest and recreation. At present it must be said there is too much truth in the excuse that there is no provision made for the evening hours of the working man, except the public-house or the gin-shop. Philanthropists and moralists talk away, but do nothing. They are a very negative sort of advisers, like those who are ever beating their children and telling them not to do this or that, without finding them anything else to do. A penny admitted the ancient Romans to those magnificent and multifarious establishments called the baths; the ordinary English artisan or labourer has no place where, for a small entrance fee, he can have shelter, light, warmth, company, and some choice of recreations. As matters now stand, a man's work over, he is fairly driven into the place which he can only enter on one fatal condition. Will nobody descend from the clouds of declamation and philanthropy to do for the poor what they really are not allowed to do for themselves, by offering them the means of spending their evenings pleasantly and improvingly? In many country villages it is done, or at least attempted, although the village reading-room is an embryo institution as yet. The want is greater still in towns, because there the counter-attractions are greater. It is of no use to be always warning people against pleasant sins and dangerous indulgences; it is but advertising and recommending such tastes to them. What remains to be done is to offer something which shall compete in the open market with those seductive pleasures, and win men to our side by fair play.

MEETINGS FOR THE ENSUING WEEK.

Mon.....Victoria Institute, 8. Dr. Wheatley, "Chance Impossible."
Royal Geographical, 8½. 1. Capt. S. B. Miles, "On Bunder Murayah, Somali Land." 2. Lieut. De Crespigny, "Journey to the Murut Country in Northern Borneo." 3. Dr. A. Rattray, "Description of Fernando Noronha."
British Architects, 8.
Tues.....Royal Medical and Chirurgical, 8½.
Civil Engineers, 8. President's Inaugural Address.
Photographic, 8.
Royal Institution, 3. Prof. Tyndall, "Ice, Water, Vapour, and Air."
Wed.....Geological, 8. 1. Prof. T. Rupert Jones and Mr. W. K. Parker, "On the Foraminifera of the Family Rotalinæ (Carpenter) found in the Cretaceous Formations, with Notes on their Tertiary and Recent Representatives." 2. Mr. George Maw, "Notes on the Geology of the Plain of Marocco and the Great Atlas." 3. M. D. M. d'Orueba, "Further Notes on the Geology of the neighbourhood of Malaga." Communicated by the President.
Graphic, 8.
Royal Literary Fund, 3.
Royal Society of Literature, 4¼.
Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."
Thurs...London Institution, 4. Mr. J. C. Brough, "The Philosophy of Magic."
Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Fri.......Astronomical, 8.
Quekett Club 8.
Sat.......Royal Botanic, 3¾.
Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."

Journal of the Society of Arts.

No. 999. Vol. XX.

FRIDAY, JANUARY 12, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ANNUAL INTERNATIONAL EXHIBITIONS.

The following letters have been received from Her Majesty's Commissioners for the Exhibition of 1851:—

Upper Kensington-gore, London, W.,
20th December, 1871.

Sir,—I am instructed to inform you that, in consideration of the aid given by the Society of Arts to International Exhibitions, Her Majesty's Commissioners have decided upon permitting members of your Society to purchase, for each £2 2s. subscription paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public.

I am further to request that you will be so good as to make this known to the members of your Society, and that you will inform me, as early as possible, of the number of tickets you will be likely to require.

I have the honour to be, sir,
Your obedient servant,
Henry Y. D. Scott, Major-General,
Secretary.

P. Le Neve Foster, Esq., Secretary, Society of Arts,
John-street, Adelphi.

Members desirous of taking advantage of this privilege are requested to communicate with the Secretary of the Society of Arts.

Upper Kensington-gore, London, W.,
20th December, 1871.

Sir,—I am directed by Her Majesty's Commissioners for the Exhibition of 1851 to inform you that it is intended that one of the most prominent features of the International Exhibition of 1873 shall be the class of "substances used as food."

"(*a*) Agricultural products.

"(*b*) Drysaltery, grocery, preparations of food.

"(*c*) Wines, spirits, beer, and other drinks, and tobacco.

"(*d*) Implements for drinking, and the use of tobacco of all kinds."

Together with the raw materials used for all the above-mentioned objects, and the machinery belonging to each class.

Her Majesty's Commissioners desire to obtain the valuable co-operation of the Food Committee of the Society of Arts, in arranging for the complete representation of substances used as food, which will form a division of the London International Exhibition of 1873, and will be glad, therefore, if the Committee will make the subject known to the persons with whom they have been in communication in all parts of the world; and, in order to save postage to the Society, Her Majesty's Commissioners will have much pleasure in transmitting all letters on the subject through the Exhibition Registry.

I am to add that Her Majesty's Commissioners will be much obliged if the Society of Arts will assist in suggesting the preparatory measures to be undertaken for scientific experiments in cooking, and in the arts of preservation.

I have the honour to be, sir,
Your obedient servant,
Henry Y. D. Scott, Major-General,
Secretary.

P. Le Neve Foster, Esq., Secretary, Society of Arts,
John-street, Adelphi.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

January 17th.—"On the Oral Education of the Deaf and Dumb." By G. W. Dasent, Esq., D.C.L. On this evening, the chair will be taken by Sir Charles Trevelyan, K.C.B.

January 24th.—"On Improvements in the Process of Coining." By Ernest Seyd, Esq. On this evening, William Newmarch, Esq., F.R.S., will preside.

January 31st.—"On Individual Providence for Old Age as a National Question." By G. C. T. Bartley, Esq., Treasurer. On this evening, the Right Hon. the Earl of Derby will preside.

CANTOR LECTURES.

The Second Course of Cantor Lectures for the Session will be delivered by the Rev. Arthur Rigg, M.A., on "Mechanism." The first lecture will be given on Monday evening, February 5th, at Eight o'clock. Tickets for the course will be forwarded with the *Journal.*

Lecture I.—Monday, 5th February, 1872.

Structures, Machines, and Mechanism—Equilibrium and Motion—Force and Motion—Kinetics and Kinematics—Various motions required—Classification of Mechanism—Early contrivances.

Lecture II.—Monday, 12th February, 1872.

Motions produced by Rolling—Forms of Wheels—Circular, Elliptic, Logarithmic, and Lobe Wheels—Mangle Wheels—Star Wheels—Examples.

Lecture III.—Monday, 19th February, 1872.

Motions produced by Sliding—Forms of Teeth on Wheels—Teeth for Velocity—Teeth for Power—Cams—Screws—Worm Wheels—Examples.

Lecture IV.—Monday, 26th February, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies — Cam Pullies — Shafts not parallel — High Velocity Cords—Fusees—Illustrations.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links — Cranks — Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

THE LIBRARY.

The following books have been presented to the Library :—

Note sur les Recherches que l'on pourrait en Chine et au Japon, au point de vue de la Géologie et de la Paléontologie. Par G. E. Simon. Presented by Dr. Soubeiran, Société d'Acclimatation, Paris.

The Mining Magazine and Review. No. 1, vol. i.

The Annual of the Royal School of Naval Architecture and Marine Engineering for 1872. No. 2. Presented by the Editor, Adrian Vizetelly.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ON THE MANUFACTURE AND REFINING OF SUGAR.

By C. Haughton Gill, Esq.

Lecture III.—Delivered Monday, December 11th.

I shall enter to-night upon the consideration of a process of manufacturing sugar from beet-root. I say a process, because there is more than one employed, and I shall not have time to describe them all. I shall, therefore, describe the process which, up to a recent time, at any rate, has been most generally employed, and which is, on the whole, the most simplest to understand. I shall not enter into the nature and culture of the beet-root, for it has been very ably discussed before in this room, and I can add nothing whatever to what has been said on the subject. The roots, however, I may say, require tolerably deep soil, and, when grown under fair conditions, yield a crop of from 16 to 20 tons per acre. On the table are some specimens of roots grown in England, for which I am indebted to the kindness of one of the large London sugar refiners, Mr. James Duncan, of Lavenham. Some of these sugar-beets are rather larger than is considered good as a rule, for it is found that the larger beet-roots, generally speaking, contain juice much poorer in sugar than smaller ones. A root, to satisfy the requirements of a sugar-maker, should be of a regular shape, and free from rootlets. One of these I will cut in half, that you may get a general idea of the internal structure. You see that it is built up of a number of concentric rings, which, of course, are formed of a great number of small cells, each cell being filled with juice, that is to say, a watery solution of many bodies, including sugar. Of the non-saccharine constituents, I may mention the phosphates, oxalates, citrates, malates, and chlorides of potassium, sodium, and calcium, some bodies resembling albumen, if not identical with it, and other gum-like, but little known, substances belonging to the class of colloids. Besides these, there is a small quantity of a material which rapidly changes colour when exposed to the air, and becomes black, just as a similar body does which is contained in the juice of walnut rinds. The per-centage of sugar in these white beets varies greatly. I have analysed English grown roots with as much as sixteen per cent. of sugar, and others with not more than six. To what a degree of richness the roots may be brought is shown by the fact that some Austrian roots have been found to contain eighteen, or even nineteen per cent. of sugar in the juice. The object of the sugar maker when he has got the juice is, of course, to remove as many as possible of these impurities, and then to get out from the remaining liquid as much of the sugar as possible. I will point out, later, a reason why he is unable to extract the whole of the sugar from the juice that he wins.

The first operation performed in a beet-root manufactory is to wash the roots, which is done by a machine made for the purpose. This washing, which ought to be performed very carefully, being over, the roots are passed onwards, and are freed from the upper part, or crown, from which the leaves spring, and also from any worthless or decayed portions which may be noticed upon them. They then go to a machine, in which they are rasped up into a fine pulp. I have not a diagram showing the structure of this machine, but it practically consists of a drum, from 18 inches to 2 feet in diameter, and 2 feet long, the whole circumference of which is set with a number of saw blades, with teeth just sticking out of the circumference. This drum is caused to rotate with great rapidity, performing between 700 and 1,000 revolutions in one minute. Near to it is a straight steel edge, and as the roots are passed into the hopper of the machine they fall down, and are rasped against these rotating saw teeth, and, of course, as the teeth come round, they scrape out from the root a number of small strips, and gradually the roots are rasped up into a sort of pulp. Here is a specimen of the pulp, produced by an ordinary grater, which has somewhat changed colour, owing to the presence of the bodies which I just now mentioned. This pulp, which in practice is much wetter than this, because the manufacturer allows water to run into the machine while the roots are being torn up, is next folded up in a number of cloths made of coarse flannel; the pulp is put into the centre of the cloth, the edges of which are folded over, so that it is made into a kind of square cake. It is then put upon an iron plate, another plate upon the top, then another cake of pulp, and so on, till there are fifty, sixty, or seventy cakes piled one above the other. These packets are all put into a powerful hydraulic press, which is caused to exert a gradually increasing, but finally very great pressure on the mass. Of the 95 or 96 per cent. of juice which the roots contained 80 to 85 are obtained by this method. Where the process of diffusion is adopted 94 to 95 per cent. is the practical yield of juice. The juice, as it is pressed out, runs into a vessel prepared to receive it, in the same way as it does from this mass which I squeeze with my hand. It is then somewhat dark-coloured, as it contains all the impurities I mentioned before, and has now to be clarified. If we simply boil it, as I have boiled some similar juice here, we do get a partial clarification, for the albuminous constituents coagulate in the same way as the white of an egg sets when it is heated, and form a kind of scum on the surface. The coagulation is by no means very perfect. But it is found that, by the addition of some lime, the process of coagulation, and consequent running together of many of the other constituents is very much facilitated, owing to the formation of insoluble lime compounds. But this addition of lime prevents the coagulation of the albumen itself, which therefore remains in solution till it is partially destroyed by being boiled in the alkaline solution.

To illustrate this, I have put into a beaker a quantity of beet-root juice, and I will now add a a small quantity of milk of lime, that is to say, ordinary quick lime which has been slacked in water, and then stirred up to a thin cream. I will stir the two together, when the effect is, that the liquid immediately appears to grow whiter in colour, and there is now a quantity of small clots formed in the liquid. These will gradually collect together, and rise towards the surface, forming a kind of scum, and we find below a clear liquid of a moderate yellow colour. The juice will thus be clarified, or, as it is technically termed, defecated. This defecation is performed on a large scale in this way. The juice running from the presses is allowed to go into some large copper heaters, holding about 500 gallons each, and to each of these a quantity of lime is added which is equal to about one per cent. of the weight of the roots from which the juice has been obtained. Before the lime is added, however, the juice is heated to a temperature of about 180° Fahr. The lime being added, the coagulation commences, and then the heat is raised slowly by turning steam into the pocket of the pan. As the liquid approaches boiling point, a scum arises in the way I have described, and as you will see take place here in a few minutes. I can show you the effect more easily by exhibiting a sample which Mr. Duncan has sent me of the juice after it has been clarified. Here is some of the original juice, which comes from the sugar factory at Lavenham, not only the first, but the only beet-root sugar manufactory in England; and here is some which has been subjected to the treatment I have described. It has been heated, the lime has been added the scum been allowed to arise, and the clear liquid has been drawn off. You will observe the great difference in the apparent purity of the product. I should add, in fairness, that this purification is even greater in appearance than it is in reality, for the quantity of impurities removed by this process of defecation, is much smaller than the change in appearance would lead one to suppose. The next stage of the operation is this :— The juice defecated by the action of the lime contains still a considerable quantity of lime in solution, for though much of the lime which has been added has combined with the organic acids and other matters which were present in the juice, and has separated in the form of scum, still a great portion remains behind, and gives to the juice a distinct alkaline character, which, as I explained to you last time, is detectable by means of a turmeric or litmus test-paper. I have not explained exactly what I mean by alkaline character, but have only told you it is that character which lime, soda, and potash possess of neutralising acids and turning vegetable colours in the way I have shown. I pointed out, for instance, that an alkaline solution is capable of turning turmeric paper brown, and by applying this test to some of this defecated juice, you will see that it is distinctly alkaline in its character. That is due, at any rate for the most part, to the presence of an excess of lime dissolved in this weak solution of sugar. Before the manufacturer can advantageously treat the solution so as to obtain sugar crystals, he is compelled to remove a great part of this lime by some process or another; and that which on the whole is most economical and most usually applied is by causing the lime present in such a solution to unite with carbonic acid gas, which, as I showed you before, forms a compound which is insoluble, or very slightly soluble, in a sugar solution, and thus separates in the shape of a white powder.

I can show that, in this particular case, by passing some carbonic acid gas into this solution, which, however, should have been boiling hot, as the decomposition would have been much quicker. I daresay you can see, however, that the liquid has become cloudy, and this cloudiness is due to the fact that the carbonate of lime formed by the absorption of the carbonic acid by the lime held in solution, is insoluble in the solution of sugar, although the lime itself is exceedingly soluble. This solution, after it has been well saturated with carbonic acid and boiled, will have lost in a great measure its alkaline character, but not entirely so; for this alkaline character is due not alone to the presence of lime, but also to the presence of some bodies, such as soda, which have been liberated from combination by the lime previously added, and they, being soluble, do not fall to the bottom. When this operation is performed on a large scale, the workman continues to pass gas into the hot solution until he finds that the precipitate which forms clots together pretty readily, and sinks rapidly to the bottom of the vessel. He takes this as an indication that the operation is practically complete, the settling of the precipitate marking the termination of the action, and showing that nearly all the lime has become combined with carbonic acid, so as to become insoluble. I will filter some of this solution—when you see it is pretty bright, and of a somewhat paler colour than it was before. This diminution of colour, which really takes place when the operation is performed carefully, is greater in proportion to the quantity of lime that was present before carbonation, and is due to the fact that the carbonate of lime, as it is formed and precipitates, combines in a loose sort of way with a certain quantity of the colouring matter present, and carries it down into the sediment. It fact, the carbonate of lime forms with the colouring matter a kind of "lake," in the same way as alumina forms the ordinary lakes used in painting, when it is precipitated in a solution containing a vegetable colouring matter. On proving this filtered solution with the turmeric paper, you see that the colour produced is much lighter, and by the continued saturation of the liquid with carbonic acid, this change would have been more marked. I must now show you another experiment. In this glass I will put merely a solution of lime in water, adding some more distilled water to make it weaker. I will now pass carbonic acid gas into that. You immediately see the action takes place, the lime combines with the carbonic acid, and forms carbonate of lime, in the same way as it does in the solution of sugar. But what I want you to observe in this experiment is this, that on continuing to pass carbonic acid into the lime-water, until it is present there in excess, the carbonate of lime which was first precipitated will be dissolved, that is to say, the excess of carbonic acid re-dissolves the carbonate of lime first formed. It is very important to establish this point, but you must remember that this only takes place permanently in a cold liquid. Thus, if we heat the solution so obtained to the boiling point, the carbonate of lime, which has been dissolved owing to the excess of carbonic acid, will be re-precipitated again. It is necessary to remember this, in order to understand why, when in a sugar factory they pass carbonic acid gas in to precipitate the lime held in solution by the gas, and, when the action is apparently complete, they are obliged to boil the liquid pretty vigorously for some time, for if they did not do so a quantity of the carbonate of lime which had been first precipitated would remain in solution, being re-dissolved by the excess of carbonic acid, and, what is worse, at the time the carbonate of lime is dissolved there is also dissolved the organic matter which that carbonate of lime previously carried down with it. You see, no doubt, this solution is already becoming clear again, the carbonate of lime being dissolved by the excess of carbonic acid; but, upon boiling the clear liquid, you again see, as it gets hot, the excess of carbonic acid present is given off in bubbles, and in a few minutes the carbonate of lime dissolved will be re-precipitated, though not quite in the same way as before, but in a much more crystalline form, and it will adhere much more to the side of the glass, and, therefore, be less visible.

Supposing that this operation has actually been performed in the factory, that the juice has been first defecated, then saturated or carbonated with carbonic acid, that the excess of lime in the juice has been removed by carbonation, we get such a product as is contained in this bottle, which also comes from Mr. Duncan's factory. The juice has now in a great measure lost its alkaline character, having been deprived of a greater part of the dissolved lime by means of carbonic acid. There is, however, still some lime to be removed from the juice, and there are also contained a considerable number of those gummy and albuminous bodies which I before mentioned. These are partially removed, and at the same time a considerable portion of the colouring matter which gives this brown tint to the liquid, by passing the juice through animal charcoal. This is done by taking the juice coming from the carbonating pan into an iron cistern, and there heating it nearly to boiling point, and from there passing it into the top of tall vessels 15 or 16 feet in height, and 2½ to 3 feet in diameter, and filled with granulated animal charcoal. The juice finds its way through this charcoal gradually to the bottom, and runs out while a fresh supply is poured in at the top. As I showed you last week, the animal charcoal has a considerable power of absorbing bodies, such as dextrine, and if you give it a longer time and the liquid be hot, as in the case under consideration, the action is considerably increased, and the liquid undergoes a very material purification. I have here some juice which has been defecated, carbonated, and also passed through the animal charcoal; and you will observe that the result is very much less coloured, the juice now being a very pale yellow tint, and a great portion of what small quantity of lime had been left in it by the carbonating process has been now removed, together with a material portion of the gummy matters. The carbonated juice might be sent up to the cisterns, in which it is held before it comes down to the animal charcoal, by means of common pumps, but it is not found advisable to do this in a beet-root sugar manufactory, because the inside of a pump is not very readily cleaned; and when beet-root juice is allowed to hang about, for even a comparatively short time, it begins to undergo a kind of fermentation; and when the juice contains, even for a very short time, any fermenting body, a considerable portion is converted into non-crystallisable sugar. Here is some beet-root juice which has been standing for some time in a bottle, and, whereas in its natural state it flows freely, you see now it has become slimy and thick. Beet-root juice very readily passes into this state of fermentation, and, as it is difficult to use a pump without leaving behind in different parts of the apparatus a small quantity of the juice or of the pulp which is carried with it, and which soon gets into this sticky, slimy state, the operation of raising the juice to the iron cisterns is performed by an apparatus called a juice-lifter, of which I have here sketched a rough diagram. It consists of a wrought-iron cylinder, from the bottom of which proceeds a pipe leading to the cistern at the top of the building, whilst a branch from the same pipe communicates with the reservoir of juice to be lifted. The top of the cylinder has two openings, one communicating with the external air, and the other with a steam boiler. On opening the cock communicating with the air, and also the one communicating with the juice to be lifted, the iron cylinder is soon filled with the juice. These two cocks are then shut off, communication is made with the cistern to which it has to be lifted, and, at the same time, steam is allowed to enter from the steam boiler, and the pressure of the steam soon forces the whole of the juice in the cylinder into the cistern above. This apparatus, therefore, has the double advantage that none of the juice is left behind, and at each operation the vessel is thoroughly cleansed and scalded out by the action of the steam.

The juice, therefore, has now been defecated, carbonated, sent up-stairs, heated to boiling, so as to decompose any remaining bicarbonate of lime in the solution, and to raise its temperature, so that the charcoal may have a greater action upon it, and it has then been allowed to run down through a column of animal charcoal, 15 or 18 feet deep. The thin juice, as it is now called, issuing from the bottom of the charcoal, has become decolourised, somewhat freed from the lime and from the gummy and albuminous bodies which the lime had failed to remove. The next process is to concentrate it, or to remove from this thin juice—and as a rule it is very thin—a great portion of the water which it contains. This is effected in the ordinary way by boiling. In the older processes this was done by simply putting the juice into open pans, and putting a fire under them, in the same way as cane sugar is treated, but this method is no longer adopted. It is now done in an apparatus, which I may call a double effect apparatus, because the heat is used twice over, for the purpose of evaporating the liquid. The juice is put into a vessel somewhat resembling a locomotive boiler, being heated by steam, which passes into a number of pipes which run through the boiler, while a very partial vacuum is created above. When the steam is hot enough to make the liquid in the vessel to boil rapidly it goes off in steam, but instead of sending it out into the air, and wasting the heat contained in this vapour from the boiling juice, it is made to pass by a tube into the tubes of the second vessel similar to the first, and though the temperature of the vapour thus obtained from the first pan is not high enough to make the liquid in the second vessel boil with any degree of rapidity at the ordinary atmospheric pressure, by connecting the top of No. 2 vessel with an air-pump, and a condensing apparatus, so that the contents of the second vessel boil much below the usual temperature, this slight difficulty is entirely got over, and thus nearly the whole of the heat given off by the steam is utilised. If the steam coming from the original boiler were capable of evaporating, say, 10 lbs. of water out of the first vessel, theoretically, if there were no loss of heat, the vapour from the juice in that vessel should, on passing into the second vessel, be also capable of evaporating another 10 lbs. there but, practically, it does not do anything like so much work; but still there is a considerable saving of fuel by employing two vessels connected in this way. In some factories three such evaporating vessels are connected together, but I believe the saving effected by using a third is very small, because the practical loss of heat is very considerable.

In this double effect apparatus the juice is brought to what is technically termed 25° Beaumé, which I may explain thus. I will put into this jar some water, and I then put into it a little apparatus called Beaumé's ærometer, which, when immersed in water, sinks down until the top of the graduated scale is just on a level with the water in the jar. Now I will mix with the water some sugar, and we shall find that the liquid has become heavier, bulk for bulk, than the water, and in consequence the float will not have to sink so far into it in order to displace a quantity of the liquid equal to its own weight, but will float higher out, and higher in proportion as there is more sugar in the liquid. This is the kind of instrument which is constantly used in sugar factories to roughly determine the strength of the various solutions of sugar. When the juice is so far concentrated that this little float only sinks in it so far as the mark 25, it contains about 45 per cent. of its weight of total solids, including sugar, in solution. From this preliminary concentration, the juice, now technically "thick juice," goes to a cistern in which it is heated to boiling, and is then again filtered through fresh animal charcoal, to remove more of the colouring matters still present, and some of the albuminous bodies which are more readily absorbable from dense than from thin liquids. After this second charcoaling, the juice is almost colourless, and very brilliant and transparent, but is still not a pure or by any means a saturated solution of sugar, and accordingly, before the maker can obtain any sugar from it in the solid form, he is obliged to reduce the quantity of water still further. This he does by the use of the vacuum pan, the name of which, I have no doubt, suggests the nature of its construction. It is simply a pan, into which the liquid can be introduced and heated, while a comparatively perfect vacuum is formed above the surface, and in which, consequently, the liquid is capable of boiling at a very low temperature. [The lecturer then described, by means of a large diagram, the construction of the vacuum pan.] The liquid introduced into this vacuum pan of course loses water and shrinks, and from time to time more is added, until the pan is filled to a convenient height with the new and more concentrated liquor. At this point the admission of liquid is stopped for a short time, and the boiling is continued, until a sample, taken out by means of what is called a proof stick, is found to be of a certain degree of stickiness. At this time the liquid contained in the pan is a supersaturated solution of sugar, that is, a solution containing more sugar than the water present really ought to contain at that temperature. The problem which the man has to solve is, how to disturb that liquid in such a way as to bring about crystallisation. I showed you, by some experiments at our first meeting, that all super-saturated liquids cannot be disturbed in the same way. A solution of sulphate of soda might be disturbed in such a way as to promote crystallisation by merely shaking it, but one of hyposulphite of soda might be shaken vigorously without starting crystallisation. The problem, therefore, is how to start crystallisation in this super-saturated solution of sugar, at this comparatively high temperature, for, although it has boiled at a comparatively low temperature, it is still much hotter than an unaccustomed hand could bear. The right kind of disturbance in this case is, as a rule, to admit by little jerks small quantities of the liquor from which the boiled mass was made. The man therefore opens the cock, and lets in a small quantity of the thickened juice into the pan, and after a little time—the duration of which appears to me very uncertain, depending very much on the purity of the juice operated upon—the boiler, when he takes out the proof and examines it between his eye and the light, sees small grains of sugar beginning to appear. At this point he knows that crystallisation has begun, and when it has once started it proceeds very rapidly, and in a few minutes after they have once made their appearance, the whole mass of liquid in that pan is filled with a mass of very minute crystals of sugar floating in a syrup, which is a normal saturated solution for the temperature at which the crystallisation takes place. The excess of sugar forming the supersaturated solution is deposited, and we have now crystals floating in a solution only properly saturated for the temperature at which we have been operating. After the crystals have once formed, and we have this mass of crystals in the pan, little by little, more of the original solution is admitted, and so it is continually added, and the water is evaporated until the pan becomes nearly full. The effect of doing it is this. As we admit a fresh portion of liquid into the pan, and evaporate off the water, the sugar crystallises out at once; it no longer forms a supersaturated solution, for we have present a great number of crystals on which it can deposit. The crystals which are first formed now continue to grow by a continuous addition of sugar to their surfaces, and if this operation of adding to the solution of sugar, and evaporating off the water, be allowed to take place a sufficient number of times, and in a sufficiently gentle manner, the crystals will become a very considerable size. I have here some samples of sugar made by this process, some of which are very fine specimens. Here is some of very nearly the first quality beet-root sugar, which is made in France in the way I have described. It has been boiled for twelve hours in this way. After they once get "grain," as it is technically termed, in the pan, they add fresh liquor in very small quantities, and evaporate off the water, so that there is a slow deposit of sugar on the grains already formed, so slow, that it deposits in a comparatively regular manner, and when that occurs we get large-sized crystals. Here are some still finer, for which I am indebted to Mr. Duncan; indeed, it is the finest I have ever seen, though it is called raw beet sugar. It is made in England, from English-grown roots.

We understand now what has occurred in the vacuum pan. We have a mass of sugar crystals floating in a syrupy material, which consists of some water, a good deal of sugar, and all the impurities which the juice originally taken into the pan contained, because when crystallisation takes place, the crystals formed consist of only one kind of matter; therefore, as a rule, the crystals formed in this case are practically pure sugar, and therefore, what is left behind when the crystals are separated out must contain all the impurities originally present, plus so much of the sugar as has not been crystallised on account of the water still present. The mass in that state, when the boiling is finished, is let out by opening a plug, or slide valve, in the bottom of the apparatus. I cannot show you a mass actually so formed from beet-root, because there is no beet-root factory in England in which they work exactly in the way I have described, and where they make these crystals from beet-root; and even if I could show you some of the mass as it comes from the pan, it would present a different appearance when exhibited to you from what it does when first drawn off, because it is then hot; and when it is cold, as it would be here, some of the sugar which the syrup contained when hot would be deposited, and would cement the crystals of sugar together, so that the mass would be somewhat hard. I have, however, prepared here what is not a bad representation of a mass as it comes from the pan, only I have rather too large a proportion of syrup. It is prepared by mixing some of the beet-root sugar crystals in an impure syrup. It is a hard, sticky mass, which does not look a very promising material from which to extract pure, white sugar. The sugar now has to be recovered from this. The old method was to put the mass into moulds of some kind, at the bottom of which holes could be opened, so that the syrup could gradually drain away, and leave the crystals above, but that is a very slow process, and the syrup which actually adheres to the crystals is much more sticky than that which I have here. It therefore drains away very slowly, takes a long time in operation, and is, after all, very imperfect. It is necessary, therefore, for the rapid success of the operation, that we should employ some force to aid the draining of the syrup, and the mode usually adopted is to make use of a so-called centrifugal machine. You know that when anything is set rotating very violently on its axis, the outer particles of it at any portion of their course tend to continue their motion in the direction of a tangent to the circle at that point, and if you make the motion very rapid, the force which makes them tend to fly off becomes very considerable. I have here, owing to the kindness of Messrs. Wainwright, a model of a centrifugal machine, such as is actually employed. It consists of an outer casing of iron, inside which there is a drum strongly made, the sides of which consists of finely-perforated copper, or in some cases of woven wire, but at any rate it is a pervious coating. Liquids are capable of passing through that coating, but solids are retained in the meshes. I will now pour in some of the mixture of syrup and beet crystals to the drum; and, while it remains at rest, very little, if any, will pass off. There is an opening in the outer casing through which the liquid which passes into it may drain away conveniently. On setting the drum in motion, you will find that the mass which was lying at the bottom becomes separated by the centrifugal motion, and spreads itself up the sides of the drum, and as the motion is continued the liquor passes through the meshes, and the sugar is becoming quite white. The syrup is now running out very rapidly, and on increasing the speed of the drum, the sugar is spread evenly round the sides. When it is going at its highest speed I will dash on it a little water, which will be forced out through it and will slightly wash it, and thus help to carry away the last particle of syrup which might otherwise be left behind. On stopping the action, I can now scrape with my hand enough of the sugar to show you the nature of the operation that has taken place while the syrupy portion has drained away beneath.

In this way, and in this first operation, about three-fourths of all the sugar that can be obtained, is obtained, if the process is conducted successfully. The syrup that has drained away is obviously worth keeping. It is a saturated solution of sugar, and for every pound of water we have there, we have at least two pounds of sugar, for one pound of water will dissolve that quantity of sugar. It is obviously necessary to recover as great a quantity of that sugar as possible; the syrup is therefore treated in the following way. The principle is very simple, although the details of the process are somewhat complicated. The solution is concentrated to a convenient point, and allowed to stand for a considerable time. It is concentrated in a vacuum pan, similar to that I have described; but it is found on the second concentration that you are no longer able to get grain formed in the pan. If the original solution or liquor is very impure, it is much more difficult to disturb that state of supersaturation than if it is comparatively a pure solution of sugar. Now this syrup that has been drained away is far more impure than the original thickened juice which we evaporated, and accordingly it is not possible to get crystals of sugar formed in the pan during this second concentration. But the liquid having been thickened to the degree which experience has found necessary, is run into large iron tanks, where it is allowed to stand for a fortnight or three weeks, and kept at a moderately high temperature. Crystallisation then slowly takes place, and the mass is then stirred up with some fresh syrup, and put through the centrifugal machine again. This constitutes the second product of factories, of which I have two samples here. The result is, of course, less pure, both in appearance and in reality, than the first product, owing to the crystals retaining on their surfaces a large proportion of the still more sticky mother liquid than the first did, and not only a larger proportion of that, but but this mother liquid itself is more impure, consequently the whole mass contains a much greater proportion of impurities than the first crop. The syrup from this second product is again concentrated, but by this time it is so impure that before crystallisation can be brought about after it is concentrated, it has to be kept for six months in tanks at a comparatively high temperature. At the end of that time, a comparatively small quantity of sugar has deposited out. Some of such sugar I have here, but I am bound to say it is the worst I ever examined. It looks very nice, but if there are present any persons practically acquainted with sugar, they will be surprised to hear that it contains over 9 per cent. of salts, although it is an apparently bright, and what is technically termed "free" sugar. This leads me to mention very briefly the fact that, if in a concentrated solution of sugar you have various other matters, if you only give it time enough, it will crystallise out in actual chemical combination with some of these salts, and consequently this third product, which stands a long time, and which is formed from the mother liquid containing a large proportion of impurities, is not merely pure sugar coated with impure syrup, but is actually an impure product, itself also coated with syrup, and is consequently often very much contaminated with salts.

The syrup which drains away from the third product has no longer any value to the sugar-maker, but is sold for the purpose of making spirits from. It is diluted, fermented, distilled, and thus is obtained a crude beetroot spirit, which is afterwards rectified, duly flavoured, and sold as French brandy.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, R.E., secretary.

Australian Wool.—The Agricultural Society of New South Wales has forwarded to Mr. Sedgwick S. Cowper, secretary of the Sydney Commissioners, a series of questions with respect to various samples of wool sent to that gentleman, with a view to elicit information as to the description most in demand and likely to bring the best prices in London, &c. The 34 questions proposed are embraced under the following headings:—1. Samples in the Exhibition and their suitability. 2. Combing and clothing. 3. Greasy wool. 4. Washing, chemicals, yolk, &c. 5. Scouring. 6. Classing, sorting, skirting, and packing. 7. Dumping. Through the exertions of Mr. Cowper, much valuable information has been obtained. The specimens are deposited at 26, Suffolk-street, Pall-mall.

Jewellery.—Some cases of jewellery for exhibition have been received from Hong Kong and Morocco, and some Maltese jewellery has also arrived. It is contemplated to have a department of this branch of the Exhibition where the family jewels of private persons, lent specially for the purpose, may be exhibited, the owners having the right to withdraw such jewels from the Exhibition, for the purpose of wearing them on any court or other occasion.

Musical Instruments.—The following notice has been sent to exhibitors of musical instruments:—Her Majesty's Commissioners reserve to themselves the right of giving recitals in public on the musical instruments selected for the Exhibition of 1872, if such recitals be deemed expedient in the interest of the public. Such recitals will, when convenient, take place in the Royal Albert Hall, and the names of manufacturers of instruments will be announced in the programmes, and exhibited upon the orchestra. Instruments which may not be used in the recitals given in the hall may be tried without removal from their Exhibition allotments, subject to the approval of her Majesty's Commissioners, and at the exhibitors' expense. Any additional trials which exhibitors may desire to have carried out will be matters of arrangement, both as to their nature and cost, between her Majesty's Commissioners and the exhibitors interested. The recitals will include performances upon instruments accompanied and unaccompanied by other instruments.

Uniform Pitch.—A notice has been sent to the makers of musical instruments, inviting them to a meeting, to be held in the arena of the Royal Albert-hall, on the 20th January, at 12 o'clock noon, when the question of one uniform musical pitch for instruments exhibited in this year's Exhibition will be considered.

Campanology.—It is contemplated to introduce good change-ringing on a peal of eight bells specially hung for the purpose. The Ancient Society of College Youths, and other well-known bell-ringing associations, may be expected to perform occasionally, and illustrate this essentially English branch of music.

Royal Albert Hall Concerts, 1872.—With the sanction of Her Majesty's Commissioners for the Exhibition of 1851, President, H. R. H. the Prince of Wales, K.G., and under the direction of the Executive Committee of the Royal Albert Hall, Chairman H. R. H. the Duke of Edinburgh, K.G., the Executive Committee of the Royal Albert Hall will give a series of eighteen musical performances of the highest class during the time the exhibition is open, in the months of May, June, and July next, for which a subscription list is now opened. These concerts will embrace four classes of music, viz.:—Oratorios, given by the Sacred Harmonic Society, under the direction of Sir Michael Costa. Operatic and Miscellaneous Concerts, given by Mr. Mapleson, who will have the services of the whole of his opera company. Popular concerts, given by Mr. Arthur Chappell, the manager of the Monday Popular Concerts at St. James's Hall. Grand Choral Concerts, given by her Majesty's Commissioners, under the direction of Mr. Chas. Gounod, with the aid of "The Royal Albert Hall Choral Society," consisting of above 1,000 voices. The prices of admission to the public, for any seats not subscribed for, for each concert, will be as follows:—Single admission, balcony front seats, 5s. each seat; arena seats, 7s. 6d. each seat; amphitheatre stalls, 10s. 6d. each seat. The subscriptions for seats for the entire series of eighteen concerts will be as follows:—Balcony front seats, each seat three guineas; arena seats, each seat six guineas; amphitheatre stalls, each seat seven guineas. The seats will be transferable. The Executive Committee reserve the power of raising these prices after a date which will be announced. The concerts will take place in the afternoons and evenings; the dates will be duly announced. The subscribers to these concerts will have the privilege of obtaining season tickets for the Exhibition of 1872 at one guinea each.

EXHIBITIONS.

The Exhibition at Milan.—In the notice of this exhibition in the *Journal* of November 17th, reference was made to the models of kilns, similar to the well-known Hoffman continuous kilns, shown at the Milan exhibition by M.M. Novi-Goebeler and Chinaglia. A correspondent says that "as regards the Novi-Goebeler kiln, which is an imitation of the Buerher and Hamel kiln, two judicial trials in Italy, the first carried out on the 5th September, 1869, and the second on the 27th September, 1870, have determined that the so-called Novi-Goebeler kiln is a *contrefaçon* of the Hoffmann continuous kiln. The experts present at the examinations were the engineers Odozio, Ruemmelle, Buehrer, and Colombo. As regards the Chinaglia kiln, two similar examinations (*expertises*), held respectively in March, 1870, and November, 1871, have had the same results. They were carried out by the engineers Borella, Elia, and Cursioni, at Turin. The last *expertise* or technical examination, also ended in a formal declaration of the novelty and originality of the Hoffmann contínous kiln. The beauty of the scientific principles involved in this mode of heating, and the great economy in its results, have clearly led to plagiarisms in Italy as well as in England. It embodies the first plan ever carried out in practice for burning fuel in small pieces. Small fuel is dropped amongst the bricks, which are first dried, then gradually more and more heated by the fire gases led from the bricks nearly burnt. The bricks themselves are thus most ingeniously made to serve (1) as a firegrate; (2) a Siemens regenerator; (3) and, yet further on in the course of the air to the chimney, as a drying apparatus for carrying off the moisture. Hundreds of these kilns are now in use in England, France, Prussia, Austria, Italy, America, and even in India and Australia."

THE INDUSTRIAL CLASSES ABROAD.

(*Continued from page* 856, *vol.* ix.)

NORWAY.

Owing to the physical nature of the country, the extent of sea coast, the relatively small proportion of land appropriated to agriculture, the dissimilarity of climate between the sea-board districts and the eastern boundaries, together with the supposed influence of the Gulf Stream, a variety of pursuits have arisen, depending as much on natural causes as on industrial labour, and thereby causing a fluctuation in the earnings which makes it difficult to generalise them. The direct extent of sea-board includes no less than 13½ degrees of latitude, and about 42 of longitude. If to this extent be added the length of coast formed by the numerous deep fiords intersecting the country, from its eastern boundary to the entrance of the White Sea, it will be more than doubled. In consequence of these geographical characteristics, Mr. Consul-General Crowe observes that an attempt to equalise the condition of the labouring classes would prove extremely difficult. According to the last census, taken on the 31st December, 1865, the population was 1,701,756; of these, 269,042 inhabited the towns, and 1,432,714 the rural districts. With regard to means of living and employment, they may be divided into three distinct classes, viz., the seafaring peasantry, occupying the islands off Nordland and Finmark, and the coast side of the fiords, extending in some instances as far as 100 miles inland from the ocean, along which small farms may be seen wherever there is sufficient soil to maintain one or two cows and a few sheep or goats, where potatoes may be grown, and, under favourable circumstances, a little corn. Their subsistence, however, depends mainly on the fisheries. The "bonde," or real peasant, is generally the owner of the land he farms. This class may be considered the kernel of the nation. The property of the "bonde" is not sufficiently large to exempt him from work, but large enough to afford him and his household establishment ample support. He farms, in the majority of cases, not so much to raise produce for sale as to grow provisions, and everything necessary for spinning wearing apparel. If situated in the vicinity of a town, he finds easy communication and a ready market for any superfluous produce. This class usually build their own houses, and make their own implements, harness, &c. The third-class comprises the so-called "field bonde" (mountain peasants). These are small proprietors, living on the verge of mountain tracts, or in the upper valleys, above the level of the corn-growing districts. They live chiefly by rearing cattle, by felling and floating timber down to the saw-mills, and by sale of game, which, during the winter months, they bring to market in a frozen state.

Endeavours have been made to improve the material as well as the intellectual condition of the working classes. Savings banks have been established, tenements built for workmen and their families, soup kitchens opened, co-operative societies formed, and washing and bathing establishments introduced, which have, generally speaking, prospered and borne satisfactory results. The deposits in the savings banks and co-operative societies form a striking proof of the prosperity of these establishments. There are no less than 250 such, of which some are penny banks. The deposits, in 1862, amounted to £3,201,740, and in 1868 to £4,757,649, showing at the same time a steady increase of deposits, made principally by the industrial classes, such as small traders, operatives, servants and labourers. The lowest deposit taken is 12 skillings (6d.), except in penny savings banks, 4 per cent. interest being allowed, which is either paid out or carried to the principal at the end of the year. The banks utilise the deposits by discounting exchange obligations; by lending on mortgage, state obligations, shares, &c.; the rate of interest or discount varies from 5 to 6 per cent., according to the stringency of the money market. A certain portion of the surplus revenue, after deducting the expense of management &c., goes to form a fundamental capital, and whenever this amounts to one-fifteenth of the deposits, the surplus thence accruing is appropriated for benevolent objects and public improvements of various kinds. A certain number out of the depositors being elected trustees, everything connected with these establishments is submitted to them, the accounts being regularly published and widely circulated. The introduction of co-operative societies is comparatively of recent origin. The system has, however, been successfully carried out, and it is spreading throughout the country. The returns of five of these societies have now been obtainable, showing profits of 9½ per cent., with an expenditure for management of 5½ per cent., leaving a surplus of 4 per cent. A portion of this has been returned to the members in the shape of dividend, and the remainder has been carried to a reserve fund, the respective members having had the benefit of being supplied with unadulterated wares at moderate prices. Strikes are as yet scarcely known, even by name. No instance is on record of any combination having occurred to coerce masters with the view to obtain higher wages, The friendly societies are strictly intended to insure assistance in case of sickness, and decent burial in case of death; to promote education, and thereby raise the social position of the working-man; and, in certain eventualities, to afford him pecuniary aid. Unconnected with such societies, there is a law which compels mining works to support their own poor, and to maintain schools for the education of the workmen's children. Towards these objects a monthly deduction of 2 or 3 per cent. is generally made from the earnings of the men. Large manufactories and industrial establishments have, as a rule, their own special communities, to which the workpeople, by mutual agreement, contribute, receiving in return aid in case of sickness. The means by which education and social intercourse between the respective members of these unions are promoted are, by periodical lectures followed by discussions, and by free access to books, periodicals, and literature suitable to their position. Libraries are being gradually formed, partly by contributions from the members, but hitherto mainly by free gifts. The facility of access to these books, together with the occasional meetings afforded to the working man by means of these unions, tend much improve his condition, and raise him morally from any contamination which often his vocation may expose him to. Independent of these unions, there are, in every seaport town and district in Norway, charitable institutions, established exclusively for the benefit of seamen, their widows and children. These are maintained chiefly by voluntary contributions, collected by the registrar of seamen, whose functions are similar to those of the shipping masters in England.

From its geographical position and extent of seaboard Norway is eminently more maritime and commercial than agricultural or manufacturing. It has developed its resources, particularly those connected with shipping, more prominently in proportion to its population than any other country. All male inhabitants of towns or districts along the sea support themselves by piloting, serving in ships, yachts, and boats, as well as those employed in floating timber; ship-builders and those engaged in the fisheries are compelled to enrol themselves on the seamen's register, and are liable to be called out for naval service when needed. Only registered seamen can be employed for piloting, for foreign going voyages, or for sea fisheries. Before engaging himself on board a foreign-going vessel, a seaman must obtain a ticket from the registrar, which is granted without a fee. This ticket, on joining a ship, must be handed over to the captain. It only requires to refer to official returns to show how rapidly the mercantile marine has developed itself, and how important a position it has assumed. It has been a prevailing opinion that Norwegian sailors were badly paid and badly fed; but neither of these assumptions are borne out by the rates of seamen's wages, or the lists of stores issued both for short and long voyages. The vessels are generally better manned than the English; where the latter employ twelve men, the former have fifteen men. More harmony is also said to exist between a Norwegian master and his crew than is found on board an English vessel of the same class. The registrar of seamen in Norway has to superintend the engagement of seamen for foreign-going vessels, the same as a superintendent in England. No vessel can be cleared out at the custom-house without articles having been previously signed in presence of a registrar. The *pro rata* contribution from every seaman is agreed upon, which, on completion of the voyage, is paid by the master to the registrar, and by him to the cashier of the institution to which the seaman belongs. Formerly, there existed but one sailors' institution for the whole country, but now there may be found one in every registering district. These tend much to attach seamen to their respective homes.

With respect to the distribution of the population, there exist but few inland towns. An occasional cluster of small farm-houses and buildings to the nearest approach to what may be termed a village. Farmers, being proprietors of the land, with their housemen, and servants, and foresters, seem to form the whole of the inland population. Skilled mechanics or handicraftsmen are few, and those not the best of their kind. They generally travel from farm to farm, in order to do some special work to which the skill of the houseman or labourer is found to be inadequate. They reside and live with their casual employers during the term of their temporary service. Farmers weave their own linen and cloth, and tan their own leather. Railways have in many parts of the country materially assisted the farmer in getting a better market for the produce of his land; but, as a rule, either a market does not exist, or it is inconveniently distant. The food, both of the master and labourer, is of an inferior description, consisting of coarse rye or barley-bread, porridge of barley or oats, potatoes, or salt-fish. Fresh meat is seldom seen on the table of the small farmer, and to the labourer it is a rare luxury. Coffee alone is much consumed, both morning and afternoon, in the poorest cottage. The Norwegian labourer is, nevertheles, not a very discontented being. His wants are few, so that his position, after all, may bear comparison with that of wealthier countries. All is stint and parsimony, but the eye of the observer is not often shocked by scenes of distressing poverty. It may be remarked of the rural population of Norway, that if not remarkable for intelligence, there always exists a certain amount of rough-and-ready handiness. This, in the opinion of Mr. Crowe, is caused by the great want of skilled workmen. The common peasant can generally repair his own implements, vehicles, and harness, and in many instances shoe his horses; and, owing to the system of compulsory education, can always read and write. These qualities render the Norwegian an excellent and generally successful emigrant; and he is recognised as such in America and elsewhere.

Owing to the nature of the climate, work on the land is confined to some five, or at most six, months in the year; forests yield means to the Norwegian to fill up the remainder. This branch of industry is carried on according to the following description:—A person, whose position and duties are highly responsible and confidential, is selected by the timber-merchant to mark and purchase timber. Ordinarily the seller, through the agent, obtains a sum in advance, to enable him to pay for the labour; for this advance the agent is responsible immediately to his principal, but as soon as possible secures himself by marking, with a special mark, the felled logs; such a mark fully establishing legal right therein. Labour in the forest is chiefly done by contract. Felling and stripping the bark is the first process. Small trees are sometimes felled for 6d. or 8d. per dozen. Timber which is intended for sawing will cost from 1s. to 3s., according to the dimensions; for large timber, however, more would be paid. After having been felled, horses are used to draw the logs into convenient heaps, to await the snow-fall for further drawing. When sledges can be used, and the logs can be dragged along the ice-roads, they are transported to the frozen water-courses. Drawing, like felling, is generally carried on by piece-work, and a dozen logs may, of course, demand very different prices, but the owner of a horse is generally ready to agree for a price which will give him 3s. to 6s. for labour for horse and man per day. Floating is undertaken by a company called the "Timber Direction," and much of this work is done by contract; the day-labourers' wages range from 1s. 4d. to 1s. 8d. At saw-mills, where most of the timber is taken, wages vary very considerably, according to situation, skill, and power applied.

To the fishing community, who depend for support on the produce of the sea, which likewise forms one of the chief sources of wealth to this country, about one-fourth of the whole population belongs. It not only affords a cheap article of consumption to the community in general, but also the means of providing themselves with small luxuries which are denied to many of the farmers, and also form one of the staple exports of the country. There are four main fisheries in the year; the winter and summer cod-fishery, and the spring and autumn herring fishery. When not engaged in these fisheries, a portion proceed to the bank and Arctic fisheries, while others remain at home to repair their fishing gear, and to convey the cured fish to market. They generally fish in gangs or companies, of which a part man the yachts or coasting vessels employed for carrying the fish to market and bringing back their own provisions. No exact rate of earnings can be given, as they so much depend on the state of the weather at the fishing season, but want or penury is seldom met with in that class of the community. Until of late years, many trades were shackled by restrictions imposed by guilds, which have been finally suppressed, and a salutary competition is now the result.

In drawing a comparison between the earnings of the industrial classes in Norway and those of the United Kingdom, the comparison must be confined to those located in, or in the neighbourhood of, towns, and it will be found that the skilled artisan, as well as the common labourer, is more favourably situated in England. Besides the higher cost of fuel and clothing, another drawback consists in the military system, which compels every man to serve either in the army or the navy. For the former, the agricultural and other classes are selected, who have to serve annually one month; for the latter, the coast and fishing population.

(To be continued.)

PRIVATE GAS MANUFACTURE.

One of the latest inventions for the purpose of enabling small consumers to manufacture their own gas is that of Mr. Symes, who specially claims for his apparatus that it affords an opportunity for almost everybody to make their own gas. He claims, where the consumption is that of twenty-five lights, that his Patent Portable Gas Apparatus gives the consumer the power of making his own gas at a cheap rate. The first cost of the apparatus, from twenty-five up to thirty lights, is said to range between twenty and twenty-five shillings per light, the rate decreasing with every increase of light. Made from "slack," the cost of the gas is reckoned at a shilling per 1,000 cubic feet. Made from coal at 18s. per ton, with 10 per cent. of cannel, the cost is given at 2s. 2d. per 1,000 feet. The illuminating power is reported as equal to 18 candles or more, while the purity of the gas is stated to be perfect. At a recent trial, the gas was produced in a small iron retort fitted into what resembled an ordinary stove, the fire which heated the retort being also available for ordinary domestic purposes. A boy shovelled in about three pounds' weight of rather indifferent coal, and the door of the retort was then closed, fitting gas-tight into its place without any ceremony of "luting," that is to say, without any plastering up of the door of the retort to prevent the escape of gas. Within a few seconds from the closing of the retort, the gas began to flow out of the burners, and burned brilliantly, the number of the flames being increased as the coal underwent distillation. It is not absolutely necessary to use coal, or coal alone, bones, wood, or peat being available. Peat, however, gives a weak gas. On its way from the retort to the burner, the gas passes, first of all, through water, which deprives it of certain impurities, after which it enters a condenser where the tar accumulates, and from whence this material can be readily drawn by means of outlet pipes. At the foot of the condenser is the purifier, and thence the gas proceeds into the gasholder. The space occupied by the apparatus is very moderate, the bulk depending mainly on the size which is thought desirable for the gasholder. The erection of the affair is within the compass of an experienced gasfitter. The process of manufacture is so automatic that a domestic servant once instructed could manage it with quite as much facility as the machinery of a kitchen range. All the solid refuse of the house which happens to be of a combustible character may be turned to account. The design of the invention is to provide individuals with a supply of gas where the smallness of demand precludes the operation of a regular gas company. Mr. Symes is also prepared with a modification of his apparatus for use on board ship. The following is a technical description from the specification of the patent, the purpose of which is the supply of cheap and pure gas to churches, hospitals, private houses, shops, offices, warehouses, factories, and other buildings, as well as to steamboats, railway carriages, signal ships, lighthouses, &c. As to the generation of gas, it is preferable to do it from wood, but coal, paper, peat, resin, "dead oil," and, in fact, almost any material may be used. It should be distinctly understood that no part of the invention relates to the use of any particular substance or compound for producing the gas or for burning wood, &c. The apparatus is provided with a circular box or retort of iron, or other suitable material, which may be placed in a kitchen range, or in any ordinary stove. The form of this box or retort allows it to be surrounded by the fire, and quick and economical production of gas is thereby obtained. The box is perfectly closed by a cover, fitted with a face like a valve, instead of being made tight by means of lime or cement, as in ordinary gas retorts. The retort is connected by a pipe or tube to a hydraulic main, which may be placed in the chimney, or arranged and supported in any convenient position in or near the house or structure. This vessel is partially filled with water, and the pipe or tube which connects the retort with the hydraulic main has one opening above the water, and another below the surface. The hydraulic main is provided with a safety valve, and when the pressure in the retort rises above a certain degree, the safety valve is forced open, and the gas escapes into the chimney, or into a pipe or passage leading thereto. Except when the safety valve is open, the gas leaves the pipe through the opening below the water level, and the apparatus will thereby work with a pressure considerably less than if the gas entered the main above the water. The exit pipe for the gas is at the top of the hydraulic main, and the tar pipe is at the end or side thereof, level with the surface of the water. The main is provided with a covered aperture for pouring in the water, and with a tap for permitting it to escape. By this means the level of the water in the main can be so regulated as to ensure the continual proper working of the apparatus. The gaseous products of combustion received from the retort into the hydraulic main are by the latter separated, so that the gas passes away through the exit pipe, while the tar and other impurities, except the sulphur, are carried off by the tar pipe, which terminates in a larger tube or cylindrical vessel, arranged below the main. The hydraulic main is connected by the gas exit pipe to a condenser, which is a vessel having within it a series of vertical partition plates, so arranged that the gas passes alternately over and under the other until it leaves the condenser. The latter is connected to a purifying vessel, which is divided vertically into two chambers, in one of which there is a series of sieves containing lime, and in the other similar sieves, with sawdust, sand, or other suitable material. The gas, as it enters the purifiers, passes up through the lime, and enters the second chamber, and descends through the sawdust, thence passing, free from sulphur, away through the pipe to the gasholder. This gasholder is preferably a cylindrical vessel, which may be made of sheet iron, zinc, &c., and is partially filled with water. It may be made of any required capacity. Inside the gasholder is an inverted chamber, which opens into the water, and which rises and falls in proportion to the quantity of gas in the holder. At the top this interior vessel is provided with a small tube, which passes through a guide at the top of the holder; it has also a burner attached, whereby the quality of the gas in the holder can be tested at any time. Instead of using a cylindrical metal gasholder, an air-tight bag, made of india-rubber, gutta-percha, leather, or other flexible material, may be used. In cases where it is desirable to increase the brilliancy of the light, a small carburetting vessel may be provided, this being partially filled with undistilled naphtha, or other carbonaceous liquid; the gas passes from the gasholder in the vessel, where it absorbs carbon, and consequently increases the power and brilliancy of the light.

ECOLE PRATIQUE DES HAUTES ETUDES, PARIS.

This high school, formed by the Minister of Public Instruction, M. Duruy, and installed at the old Sorbonne, has been continued by the present government, and promises to take an important position amongst educational establishments. Its plan, being somewhat new, deserves special notice; it is historical, philological, and scientific, but not technical, that is to say, it is not a special school for pupils intended for any of the professions, but a college intended to foster studies of the highest character, to raise the general level of literary and scientific knowledge, to form *savants* capable of occupying the highest professorial duties, or to undertake scientific missions, or, as it has been said, to raise France to her proper intellectual rank in Europe, and prepare the way for the establishment of true universities in the fullest sense of the word, which, it is maintained, France does not possess at present. The word practical in the title demands explanation. It is not used in the ordinary sense, but signifies that, whereas the Sorbonne and the College de France offer lectures on the various branches of literature and science, the Ecole Pratique des Hautes Etudes brings its students into more intimate relations with its professors, and teaches literature and science in the manner of the medical and other schools, by the practical means of study, reanimation, and experiment, in short, by a collegiate system of the most complete kind, the only difference being that its courses of study commence where those of the colleges leave off, and create *savants* out of well-instructed scholars. The pupils of this school must therefore have passed through all the preliminary courses of superior education. The programme of the historical and philological section for the current half-year is now before us, and its heads, with the names of the professors, will give an idea of the importance of the new school. They are as follows:—

1. *Egyptian Philology and Antiquities.*—Professors, the Vicomte de Rougé, member of the Institute, and M. Maspero. Subjects.—Study of picratic writing; papyrus anastasi, 2 and 4; comparative study of hieroglyphic and Coptic grammar.

2. *Greek Philology and Antiquities.*—Professors, M. W. H. Waddington, of the Institute, M. Tournier, and M. Robiou. Subjects.—Paleographic exercises; examination of the latest works concerning the text of Sophocles; study of the constitutions of the republics of Greece, through authors and inscriptions.

3. *Roman Inscriptions and Antiquities.*—Professors, M. M. Léon Renier and Ch. Morel. Subjects.—Origin and development of municipal institutions in the Roman empire.

4. *Latin Philology.*—Professor, M. Thurot, of the Institute. Subjects.—Grammar and critiques of texts.

5. *History.*—Professors, M. Alfred Maury, of the Institute, MM. Monod, and Thevenin. Subjects.—Critical history of the Latin sources of French history; critical study of the epoch of Charles the Simple; juridical studies of the two first races.

6. *The Semitic Languages.—A. Hebrew, Syriac, and Chaldiac.*—Professors, M. de Fremery, of the Institute, and M. Carrière. Subjects.—Grammatical interpretation of the history of Joseph and the history of Samson; interpretation of selections from the first forty chapters of the book of Isaiah.

6. *Arab and Persian Languages.*—Professor Guyard. Subjects.—Explanation of the "Christomathic Arabe" of M. S. de Sacy. Explanation of the "Gubistan" of Sadi.

7. *The Sanscrit Language.*—Professors, MM. Houvette, Besnault and Bergaigne. Subjects.—Explanations of selections from the "Episodes of Mahabharata," and of the "Seventh Mandala" of Rig Véda.

8. *The Roman Tongues.*—Professors, MM. Gaston, Paris, and Brachet. Subjects.—Critical exercises, philosophical and literary, and grammar.

9. *Comparative Grammar.*—Professors, M. Michel Bréal, of the College of France; and M. Bergaigne. Subjects.—Exercises in comparative grammar, and course of Indo-European phonetics.

10. *The German Language.*—"Practical Courses," by M. Hermann.

The rooms set apart for study are open every day to the students of the section.

The scientific sections have chemical and philosophical laboratories, well stocked with instruments and materials, at the Sorbonne; and that of natural history at the Jardin des Plantes. The first professors in France are appointed to these sections also, and superintend the laboratories.

It is impossible to overrate the value of a school erected upon such a high and broad basis as that which is here sketched out, and its success is almost as important to other countries as to France, for whatever raises the standard of education in that country must have a tendency to elevate it throughout the civilised world.

PARIS SALON, 1872.

The annual exhibition of works by living artists, foreign as well as French, is announced to take place, as usual, on the first day of May. The extent of the exhibition, and the regulations concerning it, differ from those of former years. The limitation of space arises principally, if not entirely, from the fact of some portions of the Palais de l'Industrie being occupied by the offices of the Minister of Finance, whose establishment was burnt down on the fall of the Commune. The alterations in the regulations are the result of the opinions of the Minister and the Director of the Beaux Arts. The main changes are as follows:—In the first place, the limitation of each artist to two works in any one or more sections is done away with, and each painter, sculptor, architect, or engraver may send in as many examples as he may think fit, the jury being at liberty to accept or reject without any other limit than that enforced upon it by the space at its command, which will be about half the usual amount; the pictures and drawings will thus necessarily be reduced by about one-half, or 1,500 in place of 3,000; the sculpture will not necessarily be reduced in amount, as the garden is capable of accommodating a large number of works. In the next place, the possession of medals or other honours will not exempt the works of any artist from examination by the jury—all will have to pass the ordeal. M. Charles Blanc, the director, demands a severe jury, laying it down as a rule that a State exhibition should be composed of monumental art only, works executed to order, or decorative works of a high standard of excellence; he protests against such an exhibition being regarded in the light of a mere opportunity for the exhibition of cabinet pictures, domestic subjects, &c., and calls upon the artists, in their own interest, to establish exhibitions of their own, like those of the various artistic societies of London, and promises them the aid of the State in supplying a gallery until the societies are able to build for themselves. With the view of obtaining a high-class jury, the election of the greater part of the members of that body is not left to all exhibiting artists, but to those only who have previously obtained first-class medals, or their equivalent, arguing that young artists who have not obtained such rewards do not yet form a portion of the artistic body, and are moreover likely to vote, not for the best jurors, but for those who are likely to be most lenient; the smaller remaining portion of the jury to be nominated, as heretofore, by the Minister of the Beaux-Arts. A change is also made in the arrangement of the medals. Formerly, there were first, second, and third class medals; these were set aside a few years since for a first-class medal only, three of which placed an artist in the first rank, and generally led to the cross of the Legion of Honour; now there are to be first and second class medals, but only to be given once to any artist; the great medal of honour for any one work of remarkable merit is retained. The report proposes a great innovation with respect to the admission of the public to the salon, which, it is argued, should be entirely gratuitous; but, considering the state of the finances at the present moment, that plan will not be fully carried out at present, the only change to take place next year being the establishment of two free days a week instead of one, namely, Sunday and Thursday, in place of only the former. The question of making the admission to the salon always gratuitous has raised considerable opposition. It is argued that, by throwing open the doors to the public, the rooms will be unduly thronged, as they used to be on Sundays, the pictures covered with dust, and the interests of artists damaged, from the fact that connoisseurs will have but little opportunity of carefully examining the works exhibited. There is force in these objections, but, at the same time, it may be said that if every day were free, the crowding, except on Sunday, would not be great; but even on the pay days the salon was often too full for comfort and the proper study of the pictures.

CORRESPONDENCE.

ANGLO-INDIAN ROUTES.

Sir,—In the Mediterranean, imperial interests are comparatively secure, sea-borne on England's native element; and a like dictum is true respecting the maritime conditions of our Indian Empire in the Persian Gulf.

Now, a geographical line from Acre to Mohamra constitutes the shortest interval between the two seas, and this seems the most suitable railway route, taking all circumstances into consideration, both termini occupying strong strategic positions, and Acre only requiring a sea wall to render the harbourage as secure as Mohamra. See my letter in your *Journal* of April 1, 1870.

The time of the present overland route would be shortened from three to four days, and the salubrity of the sea transit increased, by making a branch railway from some point of the Cairo and Khartoom line (now in course of construction) to Suakin, a port every way preferable to Suez. The prevailing winds in the Red Sea are N.W. and S.E., continuous for eight months and four months respectively, and either wind would be more or less on the ship's beam in the passage from Suakin to Aden, as also on the return. Thus fully 800 miles of the upper and middle sea, with its contrary winds and currents, would be avoided, and in calms those terrible furnace heats, which paralyse the strongest energies, and are so prolific of disease and loss of life.—I am, &c., Indicator.

Dublin, 29th Dec., 1871.

Sir,—With reference to the observations of Messrs. Rawlinson and Cheetham, printed in your *Journal* of the 24th Nov. (page 29), I recollect that, at the reading of a paper by Mr. Horace Greeley, at New York, in December, 1859, in favour of a railway from New York to San Francisco, it was objected that the Indian tribes would interfere and prejudice the scheme. But the railway has been made, and I believe no obstruction has occurred, although the line transits the Indian territory described in Mr. W. H. Dixon's "New America," where the cruelties formerly practised by these savages are mentioned. Towns and villages are increasing near the line, while advancing civilisation has stamped out the Mormon nuisance, and must eventually clear out the savages. So it would be near the line from Scutari to Baroda, *viâ* Bagdad, shown in the map *ante* page 25, which well illustrates Mr. H. Clarke's scheme, and which I hope may be successful.—I am, &c., Chr. Cooke.

London, 29th December, 1871.

TRAINING OF BOYS.

Sir,—I feel very much gratified with the practical facts furnished by Captain Pocock as to the results of his experience in the *Wellesley* training-ship, as to the practicability of making the roughest boys "law-loving and law-abiding." He is practically "training up the children in the way they should go," and no doubt when they are old a very large number "will not depart from it." The fact that he finds the boy judges inclined to severity is a clear proof that there is no fear of the laws falling into desuetude or contempt. Nothing but unjust decisions can make such a system fail; the relations of master and slave cease, and with them all the hateful results, when the smallest boy can walk about conscious that he is equal to the strongest before the law. But were a system of favouritism to grow up, making judges of inefficient or corrupt boys, the reverence for the moral laws would disappear, and all would fall as before, under the practice of the law of prey, the sole rule of right amongst the lower animals.

I have heard it remarked that the plan may be successful in a training-ship, where all the boys are under a specific controlling power, but that such a system would be impracticable in ordinary schools, where the master has no control save in school-hours. But ordinary, and even some of our extraordinary schools, are simple despotisms, and if the despot has not time or skill to appoint efficient officers, there is no security of justice being done; and it is the sense of justice—of equal justice only—that can make either boys or men self-controlling and abstinent from injustice. Trial by jury was a necessary growth of a rude state of society, not always necessary in a condition of higher civilisation; but boyhood, and especially uncultivated boyhood, is and must be a rude or embryo state of society. I shall be very glad to hear that Captain Pocock's letter of facts has commended itself to school rulers generally, and become largely imitated. Boys will desist from bullying when the result is a loss of marks and status, reducing them to a lower grade.—I am, &c., Cosmos.

ABOUT COLOUR.

Sir,—Allow me to make a few remarks, in reply to your late correspondents on this subject. Mr. Hunt (*Journal* of Nov. 24) has rather misapprehended my meaning about the terms "blue" and "violet." The term "blue," in common language, is applied not only to the pure blue, but also to a great variety of colours, some dark, some light, some containing a considerable mixture of green, and others a considerable mixture of red.* The term "violet" ought to be strictly confined to the latter, and ought not to be applied to a colour like that of the deep, pure blue of the spectrum, called "indigo" by Newton—a colour complementary to the best yellow, and well represented amongst flowers by the blue salvia, and amongst pigments by the best French blue; notwithstanding that when such objects are viewed by gas-light, which contains a great excess of the red-producing rays, and very little of the blue, the superficial reflection gives them the distinct reddish tinge remarked by Mr. Hunt. When we speak of the colours of objects we mean, of course, their colours by the best light of day.

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* My quotation from Milton "There on beds of violets blue," was misprinted in my last letter.

Mr. Hunt has been experimenting on his own account, and is going through the perplexing investigation which many, myself amongst the rest, have undertaken before him. He wouldsave himself much troubleif he would first ascertain (that is, not only read, but understand) what others have already done. He would then no longer say:—"It is not yet by any means decided how many colour-sensations there are respecting which the term primary, or some term corresponding thereto, may be applied, nor what precise colour-sensations should be called simple or primary." These are the very points which have been most accurately determined, both by Mr. Maxwell, in England, and by Helmholtz and J. J. Müller, in Germany.

Mr. Cave Thomas (*Journal* of November 24) says, "the denial of the old notion of primary and secondary colours is a legitimate consequence of accepting the wave theory." Why so? May not three different colour-sensations be excited in different degrees by waves of innumerable different periods, as well as by atoms of different sizes, or of different velocities, according to the old abandoned theories? Is it not possible that the waves of longer periods may excite the sensation of red most strongly, the waves of mean periods the sensation of green, and the waves of shortest periods the sensation of blue? This is the very thing that has been proved again and again, by masters of the undulatory theory of light; but it is easier to contradict than to learn the reason why. But the whole letter shows that the writer had not fully comprehended either the theory of light or the theory of colour.

In his next letter (*Journal* of December 8), it is a pleasure to find so strongly asserted the fact that colours are sensations; but is it not rather hypercritical when this fact is clearly understood and maintained (as it is in all I have written on the subject), to quarrel with the use of the word "colours" to denote coloured surfaces? The objection I have to make against Mr. Thomas is much more substantial, relating to his meaning, not his language. It is to his repeated assertion, for which he neither gives nor can give any reason, that sensations cannot be combined—cannot be mixed; "every sensation is at any one moment an indivisible prime." I would ask Mr. Thomas whether there can be presented to the eye such a thing as a continuous gradation of colours, as, for example, from red to blue? If so, what constitutes such a gradation? Does not each of the innumerable different colours, which we perceive as the eye advances from the red to the blue, suggest to the mind a gradual diminution of red, and increase of blue? Does not the cerise, the crimson, the mauve, the violet, suggest less and less of red, and more and more of blue? If this is practically true, what is the use of a doctrine which means, if it means anything, that there is no resemblance, no affinity in colours, but every colour is absolutely free from mixture of any other? Allow me once more to entreat Mr. Thomas to look into the whole matter again with an unbiassed mind, and then I believe that, instead of depreciating the value of the science of colour, and deterring and confusing those who are ignorant of it, he will, as a true lover of art, labour to make it more widely known. There is not a branch of natural science more beautiful in itself, or more refining in its effect; and many years will not elapse before it will be regarded as essential to the education of an artist.—I am, &c.,

W. Benson.

DEAD LEAVES AS FUEL.

Sir,—With reference to the recent paper and discussion on "Fuel for Locomotives in India," a few years ago I made some experiments with the dead leaves of trees, the result of which was, that if leaves are compressed they make excellent fuel. The quantity of leaves which fall every year from trees is of no small weight. Old forests, however, contain a considerable depth of dead leaves, the accumulation of many years.—I am, &c.,

B.

OBITUARY.

Delabere Roberton Blaine died on the 13th day of December, 1871, after a severe illness. He was a barrister-at-law, and was well known for his skill and learning in all matters connected with the law of copyright. When the Society took up the question of artistic copyright, with a view to the amendment of the law, he joined the Society's Committee, and worked ably and energetically upon it. The first Bill was drawn by him, and this, ultimately, after several years of continued work, was taken up by the government. Under the able guidance, in the House of Commons, of Sir Roundell Palmer, then Attorney-General, and of Lord Westbury, then Lord Chancellor, in the House of Lords, the Bill became law in 1862, and under it copyright was secured for the first time for pictures, photographs, and drawings, which, up to that time, had no legal copyright whatever. Mr. Blaine was subsequently made a county court judge, and had just been transferred from Lincoln to Marylebone when he was attacked by a severe illness, from which he never recovered. Mr. Blaine became a member of the Society of Arts in 1857.

Sir Francis Crossley, Bart., M.P., died on Friday, January 5th, at his seat Belle Vue, Halifax. Sir Francis, the son of Mr. John Crossley, an enterprising carpet manufacturer of Halifax, was born in 1817, and at an early age entered his father's business, of which he became joint-partner with his brothers, Messrs. John and Joseph Crossley. These gentlemen have been great benefactors in the town of Halifax, where they employ above 5,000 workpeople, and have recently erected and partially endowed an orphanage for the maintenance and education of 400 children, besides contributing munificently to other benevolent undertakings. Sir Francis Crossley presented to his native town, in 1857, a handsome park and pleasure-ground, and he built a row of almshouses for aged people, whose support is provided for by endowment. He represented Halifax, as an advanced Liberal, from 1852 to the general election of 1859, when he was returned for the West Riding of Yorkshire, and in January, 1868, was made a baronet. On the division of the West Riding in July, 1865, he was elected for the northern portion. He became a life member of the Society of Arts in 1856.

Mr. C. H. Fielder died on the 6th of January, at the age of 36, from a bronchial affection. He was Secretary of the Port Philip Gold Company and of the Upper Assam Tea Company. In the latter capacity he took an active part in the endeavours now in progress, with the promise of success, to place our Indian tea enterprises on a sound basis. With this purpose, he became a member of the Society, and co-operated with its Indian Committee, reading a paper on "Tea Culture" at one of the Conferences, and a another before the Statistical Society. Mr. Fielder's paper and its discussion were re-published from our *Journal* in the Indian papers, and became the means of attracting great attention and securing practical results. The views of the most experienced men were elicited, a medal was offered by the

Society for a manual of tea culture, and a prize by the Agri-Horticultural Society of Bengal. Illness overtook Mr. Fielder while promoting an Indian Tea Association, in connection with which he had proposed a "Tea Journal" By his assistance the Society of Arts was able to exercise a very useful influence on an important branch of industry, and it is much to be desired that Mr. Fielder's example may find an imitator among those connected with tea-interests.

GENERAL NOTES.

Hours of Labour.—While the artizans of England are intent on obtaining a reduction of the hours of labour from ten to nine per day, the workmen of Rouen are petitioning for a reduction of their working hours from twelve to eleven.

A Merovingian Cemetery.—Highly interesting excavations have been made of late in the commune of Nesle Hadeng, in the Seine Inferieure, in a field called the Champ de Paradis, and an extensive Merovingian necropolis brought to light. Ten ranges of graves or vaults, each containing from fifteen to twenty-two coffins, were opened, and it was found that they had been previously searched for treasure. The quantity of objects found in the vaults is large, and includes two glass and thirty-six earthenware vases, masses of coloured glass beads, forming one bracelet and four necklaces, one sabre, eight hatchets, fourteen lances, a drill, hoops, buckles in iron, many many articles in bronze, including one vase, triangular girdle ornaments, a ring, still on the finger-bone, a number of fibulæ, some cruciform, some in the form of birds, and some Roman coins. The articles in gold are numerous and comprise a ring decorated with a cross, seven pearls, belonging to a necklace, a hair-pin, with a lapis-lazuli head, and two magnificent fibulas, the metal of which is valued at twenty pounds sterling, decorated with stones and filagree work. The most interesting of all the discoveries, however, is that of silver coin of Theodebert I., King of Austrasie (534-548) unique of its kind, it is said. It is in the form of the imperial money, and is supposed to have been struck at Arles, the head of the Merovingian prince being substituted for the Cæsar.

Geography and Topography in France.—It is said that the French government, impressed by the want of thorough geographical instruction, has under consideration a plan for a Geographical Institute, on a scale which has never before been attempted. The proposed institute is to include all the means and accessories of geographical education in its widest acceptation—books, maps, charts, globes, instruments, collections of natural objects, &c., and to include a staff of professors and teachers of the highest grades. The naval depôt of charts and plans will form one of the departments of the new institute, which promises to be of eminent service, not only to France but to the whole of Europe, for should it be established on the scale proposed, there is little doubt that it will give an impulse to geographical study throughout the civilised world. In connection with this subject may be mentioned the reconstruction by the Minister of War of the corps of Geographic Engineers. This corps will be employed, in conjunction with the Etat-Major, in topographical works, and as guides in time of war. Orders have been given for the complete revision of the *cadastre*, which has not been corrected since 1810, and during sixty years the changes that have taken place in the face of the country are of course considerable. The work is to be begun on the 15th of the present month of January.

The Canal Cavour.—A Milan paper gives the following as the revenue derived from the Canal Cavour during the last five years:—

	Francs.
1866	438,000
1867	494,000
1868	729,500
1869	733,000
1870	885,000

This does not include the revenue derived by the company from the State canals purchased from the government. It may safely be anticipated that, after the completion of the important branch canals now in construction, that the revenue of the company will increase considerably, and render it a most profitable undertaking.

Macnair's Invert Permanent Way.—A trial of this way has recently been made upon the North London Railway. It has had a trial of 18 months on the North British Railway, and a sample has been in wear on the North London line for three months. The North London line is laid with double-headed steel rails of 80 lb. weight to the yard, their depth being 5½ inches. The locomotives traversing the line weigh 45 tons, with 14 tons weight upon each pair of driving-wheels. A part of Mr. Macnair's invert way carries flat-bottomed steel rails of 70 lb. to the yard and 4½ inches deep; these are expected to stand the traffic as long as the company's heavier ones. Another part consists of iron rails of similar patern 66 lbs. to the yard and 4½ inches deep. The principle of the "invert" is, as the name indicates, a supporting of the rails upon a series of inverted arches, formed by wrought iron plates, about 3 feet long, 12 inches wide, and ¼ inch thick. These are put in loose, and their extremities abut against small butt plates, riveted to the under side of the rail. The rails forming the roadway are connected together by tie-bars, made of common angle iron, placed at suitable intervals, and fastened by the same rivets. In this manner a roadway of very uniform elasticity is produced. The peculiar motion of the substructure calls into exercise the transverse strength of the rail itself, which, as borne upon the points of the inverts acts always like a beam in carrying the load rolling over it, the points of support themselves yielding to the weight as it comes over them, so that even the supporting points take their due places in the common elasticity of the whole. The form of the inverts has suggested to many the idea of springs—a purpose they are in no wise intended or fitted to fulfil; their proper object is correctly expressed in their name, and their action under a train is thus:—When the weight comes on the anterior end of the first invert that end is depressed; the invert then slides slightly forward along the curve of the ballast on which it rests until the posterior end is elevated in front of the weight, and is thus kept up to its duty of supporting the rail as the load approaches. As the weight travels on, the posterior end of that invert, as well as the anterior end of the next invert, are then depressed, the posterior end of the second invert rising up similarly to the support of the rail in front of the load, and as the posterior end of the first invert descends its former sliding action is reversed until its anterior end is brought up again under the rail behind the load, so that at this stage the rail which forms the beam is supported between the anterior end of the first invert and the posterior end of the second invert, whilst the load itself is over the intermediate ends of them both. When the load is intermediate between the two ends of an invert they both contribute to the support of the shorter length of rail which then carries the load; and so on along the whole length of the railway, the points of support for the rails, whilst acting as beams, being alternately the two ends of the same invert on the opposite ends of two contiguous inverts. The general conditions of the system as shown, appear to indicate that there will be a saving in the cost of maintenance, and more durability of the materials than in any sleeper roadway. In respect to cost, in a general way, it seems to be proved that the invert road will not cost more than an ordinary sleeper road in this country, but abroad, where the expense of transport becomes an important item, the advantage of the invert over the sleeper will be considerable; the weight of the invert road being 190 tons per mile, as against 230 tons per mile for the sleeper road, both carrying the like weight of rails.

Railways in Asia Minor.—The Turkish Minister of Public Works publishes the following official note on the subject of this enterprise:—"The railway in course of construction between Scutari and Ismidt, is one of the numerous public benefits which do honour to the spirit of initiative of His Imperial Majesty the Sultan. His Majesty, gratified with the progress made with this line, and acting upon the regenerating ideas with which he is ever animated, has further ordered the Minister of Public Works, through the Grand Vizier, to establish a network of railways throughout the whole of Asia Minor, by means of branches, communicating with the Scutari and Ismidt line. In conformity with the Sultan's order, engineers have been sent to Ismidt to examine Mount Seugud, and to make all necessary surveys, with a view to the extension of the line to Eski-Sheir, as a first instalment of His Majesty's splendid scheme. As the works on the Scutari to Ismidt line are comparatively far advanced, considering the time employed upon them, there is reason to believe that this section will be completed by next September, that the extension to Eski-Sheir will be in readiness during the following spring, and that both lines can then be joined. The important subject of the branch-line is now under earnest consideration at the Ministry of Public Works.

Musical Cultivation in 1658.—The following extract is made from a rare book written in 1658, entitled "Institutions; or advice to his Grandson," by William Higford, Esq., part iii., pp. 84—87 :— . . . . "But now, from the rude noise of arms, I shall call you to the harmonious sounds of music, worthily placed among the liberal arts. All creatures have an inclination thereunto—the birds chanting in the woods; the laborious husbandman and artificer in their several vocations alleviate their toilsome labours by their rude accents making melody to themselves; and in all ages music hath been esteemed a quality becoming a noble personage. Themistocles, the Athenian (as Tully saith), *Quia non poterat fidibus canere, habitus est indoctior.* Music is either vocal or instrumental. Vocal is best, because made by God himself, adding thereunto the liveliness of the musician, singing some excellent composed poem well fitted to the music; and in this kind these latter times have been most exquisite. But you will be most complete when you join the vocal and instrumental both together. Great is the power of music. In the kingdom of Naples, there is a small thing called the tarantula; any one bitten with it falleth into a phrenzy, and the proper cure for him is music, whereby he is recovered. Music did allay the evil spirit of Saul. Music prepared the prophet Elisha to receive his inspiration. Music advanced God's honour and service in the Temple, and the happiness in Heaven is described and set forth unto us by music and singing. Memorable is that which St. Austin relateth of his conversion (in the book of his Confessions):—*Cum reminiscor lacrymas meas quas fudi ad cantus ecclesiæ tuæ in primordiis recuperatæ fidei meæ, magnam instituti hujus utilitatem agnosco.* They say in our English colonies—in Virginia and New England, and the Summer Islands—the pagans give wonderful attention to the singing of psalms, and thereby are so taken and delighted, that it is a special means of their conversion to the Christian faith. I have sent you a book of the psalms composed in four parts, an excellent composure, whereby you may be invited to proceed further in this divine faculty. When you are oppressed with serious and weighty business, to take your viol and sing to it will be a singular ease and refreshment."

The Ecole des Beaux Arts, Paris.—The new Ministry of the Fine Arts announces some radical changes in connection with the examinations for the Grand Prize of Rome, and the regulations respecting the French schools at Rome and Athens. During the late Empire, the direction of the School of Fine Arts, and of the annual exhibitions of works of living artists, were taken from the Academy, and the management of the former was placed under the Superior Council of Education. The Republican government restores to the Academy a portion of its ancient influence. According to the new decree, the age of pupils competing for the Grand Prize de Rome is extended from twenty-five to thirty years. The programme, both of the preliminary and final examinations is to be drawn up by the Academy. The results are also to be judged by the Academy in its several sections, in conjunction with jurors selected from amongst artists not members of the Academy, whose numbers are to be half those of the sections of the Academy, namely, seven painters, four sculptors, four architects, two engravers, and three musical composers. The decisions of each section are to be submitted to a general assembly of all the sections; if the sectional judgment be confirmed, only a majority of votes is required, but to annul a judgment of a section requires two-thirds of the votes of the members present in the general assembly. Young painters and sculptors winning the great prize, are to reside at the school at Rome for four years, instead of two as at present; architects, three years at Rome and one year at Athens; and musicians, only one year at Rome. Lastly, the director of the school at Rome is to be appointed by the Minister from a list of three names, selected by the Academy of the Beaux Arts, and his term of office is fixed at six years, instead of five as at present.

MEETINGS FOR THE ENSUING WEEK.

Mon. ....Royal United Service Institution, 8½. Capt. Colomb, "On the Attack and Defence of Fleets."
Institute of Surveyors, 8. Adjourned Discussion on Mr. Clutton's Paper, "The Cost of Conversion of Forest and Wood Land into Cultivated Land," and Mr. Grantham's Paper, "Agricultural Pipe Drainage in connection with Arterial Drainage and Outfalls."
London Institution, 4. Professor Odling, "Elementary Chemistry."
Medical, 8.
Social Science Association, 8. Mr. H. N. Mozley, "On the Theory of the Appellate Jurisdiction."
Asiatic, 3.
Anthropological, 8.

Tues.....Civil Engineers, 8. Discussion, "Stresses of Rigid Arches."
Statistical, 7¾. Professor Levi, "On the Limits of Legislative Interference with the Sale of Alcoholic Drinks."
Pathological, 8.
Zoological, 9
Royal Institution, 3. Dr. Rutherford, "On the Nervous and Circulatory Systems."

Wed.....SOCIETY OF ARTS, 8. Dr. Dasent, "On the Oral Education of the Deaf and Dumb."
Meteorological, 7.
Science and Art Department (South Kensington Museum), 2½. Professor Guthrie, "Elementary Physics and Chemistry."

Thurs...Royal, 8½.
Antiquaries, 8½.
Chemical, 8.
Numismatic, 7.
Royal Society Club, 6.
Linnæan, 8. Prof. Owen, "On the Anatomy of the American King-crab" (continuation.)
Royal Institution, 3. Prof. Odling, "Chemistry of Alkalies and Alkali Manufacture."

Fri...... Philological, 8¼.
Royal Institution, 9. Prof. Odling, "On the New Metal—Indium."

Sat.......Royal Institution, 3. Mr. Donne, "On the Theatre in Shakespeare's Time."
Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."

Journal of the Society of Arts.

No. 1,000. Vol. XX.

FRIDAY, JANUARY 19, 1872.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SIXTH ORDINARY MEETING.

Wednesday, January 17th, 1872; Sir Charles Trevelyan, K.C.B., in the chair.

The following candidates were proposed for election as members of the Society:—

Ashby, Frederick William, Staines.
Caine, William S., 16, Alexandra-drive, Liverpool.
Campbell, Frederick, 82, Hereford-road, Westbourne-grove, W.
Cape, Lawron, M.D., 28, Curzon-street, W.
Cawley, Charles E., M.P., National Club, S.W.
Chaplin, Henry, M.P., Blankney-hall, Sleaford.
Dietrichson, Lauritz, 127, Lancaster-road, Notting-hill, W.
Dougall, James Dalziel, 51, Bedford-gardens, Kensington, W.
Dunn, John Messenger, 30, Claverton-street, St. George's-square, S.W.
Edmondson, Joseph, Balmoral-place, Halifax, and Brunswick-mills, Halifax
Espinasse, Francis, 4, Stafford-place, Buckingham-gate, W.
Finnie, William, M.P., Newfield, Kilmarnock.
Goldsmid, Sir Francis Henry, Bart. Q.C., M.P., Rendcomb-park, Cirencester.
Guthrie, Professor, F.R.S., Royal School of Mines, Jermyn-street, S.W.
Hart, Mrs. Ellen, 10, Carlton-terrace, Harrow-road, N.W.
Haworth, Jesse, Pall-mall, and Strutt-street, Manchester.
Holden, Angus, Woodlands, Bradford.
Jones, Charles, Windsor-road, Ealing, W.
Jones, Rev. John, Hawthorn-villa, Anfield-road, Liverpool.
Jones, John, Middlesborough.
Lee, Henry, J.P., Sedgley-park, Manchester.
Nunn, Richard Joseph, M.D., Savannah, Georgia, U.S. America.
Park, James, 52, Gracechurch-street, E.C.
Saywell, George, 1, Percy-circus, Pentonville, N.
Smithson, Joseph, Balmoral-place, Halifax, and Brunswick Mills, Halifax.
Taylor, Thomas, J.P., Aston Rowant, Tetsworth, Oxfordshire.
Warren, Joseph, 146, New Bond-street, W.
Weichert, William, 19, Bute-dock, Cardiff.
Whittall, Alfred, 3, Clarendon-terrace, Harrow.

AND AS HONORARY CORRESPONDING MEMBER.

Roche, Martin, M.D., President of the Polytechnic, corner of Chesnut and Eighth-street, Philadelphia.

The paper read was:—

ON THE ORAL EDUCATION OF THE DEAF AND DUMB.

By G. W. Dasent, Esq., D.C.L.

I suppose there is no one here present who will deny the necessity of education for the individual, as a means of making him fit to be a worthy member of the State. A people without education is like a fertile country without cultivation, over the face of which spring up and spread rank weeds and scrub in the place of corn and fruits. And so universally is this admitted, that it has become almost a platitude to speak of the duty of the State to educate the young. All children have now one right at least in the body politic—the right to be educated—and the neglect to fulfil this duty, and acknowledge this right in its widest sense, will assuredly bring down on the nation which fails in these points that woe predicted of old against him that offends these little ones. But it is not for the instruction of a nation at large, so much as to the best method of educating a class of persons—and that a most afflicted one—that I propose to call your attention, and enlist your sympathy to-night. If you were told suddenly that there was a considerable number of foreigners or savages settled among us, perfectly able to speak, but ignorant of our mother tongue, and driven to express their wants and wishes to the rest of the community by an elaborate system of signs and gestures, all of you would say—or if not all, those that were gentle and tender-hearted would say—"These poor foreigners and savages, how we pity them; let us have a mission, and teach them to speak English, and raise them at once from the degraded position of a sign-making to that of an articulate-talking portion of the commonwealth.

But let us carry our suppositions a little further, and suppose that those foreigners had been all smitten, when infants, with the loss of hearing, and so, besides being unable to communicate with us Englishmen, had, at the same time, been deprived of the power to hear what was said to them by those of their own race. The loss of that one sense in those aliens would most assuredly strengthen your sympathy, and you would say, "These poor aliens have, by a dispensation of Providence, lost one of their five senses, but they can still see, and taste, and touch, and smell; let us see if we cannot contrive some system of education by which the loss of the missing sense may be compensated, and so restore them, either fully or in part, to their true position in the State. You would say, in so many words, "God has made this unfortunate race deaf, but let not man keep them dumb. They possess the power of articulate speech; let us teach them, if it be possible, both to understand the speech of others, and to speak themselves."

This is what you would all say with regard to these imaginary aliens. You would alleviate their affliction by every means in your power; you would not abandon them to instruction by signs, however clever and cunning. Still less would you build a church for them, in which the service would be performed on the fingers, and in what is called dumb show. As you knew that this afflicted race possessed the power of articulate speech, you would see if you could not excite, and cultivate, and develope their vocal organs till you had taught them to express their wants and wishes, not in gestures and imitations of apes and monkeys, but in the intelligent and intelligible utterance of civilised men. Then only would your philanthropic desires be satisfied. Then only would your conscience suffer you to sit down and say, "We have done everything in our power to educate these aliens, and we have been blessed in the result." No doubt, even in the case of such foreign outcasts, you would be quite right; you would have your reward in the feeling that you have done your duty in the common cause of humanity. Your fathers, perhaps, and certainly your forefathers, would not have been so philanthropic. If they saw a black savage they looked on him as lawful prize—as a chattel, not a soul—and they would have sold him without a pang, as Robinson Crusoe sold his faithful black boy, Xury, the only salve to his conscience being the obligation on the part of the Brazil slave-owner to set him free in ten years if he turned Christian. But you would be more philanthropic and charitable. Well, then, reflect a little, and see whether the old adage be not true in this case, which tells us that "Charity should begin at home." Among you exist just such an afflicted, outcast race, only they are not imaginary aliens, but your own flesh and blood, and the name by which they are known to all of you is "the Deaf and Dumb."

It is the proud and the just boast of this age that it is more philanthropic than any that have preceded it. In this respect it may be called the age of awakened conscience of man in his dealings towards his fellow-men. For time out of mind the divine seed of philanthropy had lain dormant in the hearts of men. Like mummy wheat, it was to germinate, but not till century after century had passed away. The progress of civilisation had made religion from a particular into a universal. It had declared the equality of all men in the eyes of God. Every man, of whatever race, or of whatever position, was to every other man a brother—because he was a man. That was the theory, even in the earliest ages, but the practice of the world was far otherwise. It has been said that those ages were cruel with the innocent cruelty of children who kill flies as ignorant mobs kill men, and know no better. But, in reality, they were more cruel than children, and their dealings towards their own flesh and blood can only be compared to the instincts of brutes, which persecute to the death the sick and weakly of their own kind. There was a blind and ignorant superstition connected with the deaf and dumb, both in heathen and mediæval times, which illustrates this inhuman feeling. By their dumbness the Deity was supposed to have set a mark upon them, which at once separated them from man, and reduced them to the state of brutes. To the Greeks they were worse than barbarians, for even barbarians could twitter something like swallows, and so that profound thinker, Aristotle, declared the deaf and dumb to be utterly brutal, and incapable of instruction; and in early Christian times the great Augustine, whose "Confessions" are full of the widest sympathy with the rest of mankind, pronounced the deaf and dumb to be incapable of conversion to Christianity, because they could not learn to repeat the creeds and other formularies of the Church. If those hard-hearted doctrines were maintained by the most enlightened, and at the same time the most methodical and practical reasoner among the Greek philosophers, and by the most sympathetic of all the saints and doctors of the Christian Church, it is not wonderful that, in that decay of civilisation and twilight of education called the "dark ages," deaf and dumb children should have been supposed as specially marked out by Providence as something monstrous and unnatural, and exposed to destruction as objects unworthy of humanity. Thus, in France, we are told, all children who had attained the age of three or four years without acquiring articulate speech were put out of the way as unfit for existence, a thing not so hard to believe, if we remember that in the earliest ages of society it depended on the will of the father whether any child, whether male or female, were it ever so healthy, was allowed to live. There is a noble passage bearing on this in Macaulay's History, where he contrasts the fate which would have attended William III. and his great adversary Luxembourg in the middle ages with their proud position in 1693, as leaders of their vast hosts at Landen. He says:—"Never perhaps was the change which the progress of civilisation has produced more strikingly illustrated than on that day. Ajax beating down the Trojan leader with a stone which two ordinary men could scarcely lift; Horatius defending the bridge against an army; Richard the lion-hearted spurring along the whole Saracen line without finding an enemy to stand his assault; Robert Bruce crushing with one blow the helmet and head of Sir Henry de Bohun, in sight of the whole array of England and Scotland. Such are the heroes of a dark age. In such an age, bodily vigour is the most indispensable qualification of a warrior. At Landen, two poor, sickly beings who in a rude state of society would have been regarded as too puny to bear any part in contests, were the souls of two great armies. In some heathen countries, they would have been exposed while infants. In Christendom, they would, six hundred years earlier, have been sent to some cloister. But their lot had fallen in a time when men had discovered that the strength of the muscles is far inferior in value to the strength of the mind. It is probable that among the 120,000 soldiers who were marshalled round Neerwinden under all the standards of Western Europe, the two feeblest in body were the hunch-backed dwarf, who urged forward the fiery onset of France, and the asthmatic skeleton who covered the slow retreat of England."*

But to return to the deaf and dumb. We pass over willingly the dark period of their persecution during the middle ages. How in France they were confounded with those remnants of old races which lingered on in the southern provinces, whose story has been well told by Francisque Michel, in his history of what were called the accursed races in that country. Even to speak a foreign language in a Christian country was then a mark of degradation, and so it came that "Cagot," a corruption of *Canis Gothicus*, "dog of a Goth," was applied to the descendants of the warriors of the great Alaric, who once had filled all southern Europe with the clash of arms, and had been the first to plunder imperial Rome. But if it made a man accursed not to speak the common tongue, how much more accursed, according to the false logic of the time, must be one who was unable to utter any words at all. In most cases it has been the hard fate of the deaf and dumb to have been confounded and classed with idiots, and to be pronounced inaccessible to reason, because the want of hearing had prevented their instruction in speech. But, as I have said, passing willingly over those dark ages, we recognise the first sympathy with this afflicted class at the end of the 16th century. Earlier, indeed, in that century, Rabelais, of whom all of you have no doubt heard, though few of you have probably read, makes the first mention that I know of "lip reading," of which I shall have something to say further on, and tells of a young Italian, one Nello de Gabrielis, who, though deaf, understood all that was said by merely watching the lips of speakers. But it was in Spain, the land of noble exceptions, that the first systematic attempt to consider the deaf and dumb as rational beings, and to show that they were capable of articulate speech, was made by Pedro de Ponce, a Spanish monk, at Sahagun, and confessor to the king. This benevolent ecclesiastic, in 1570, instructed four deaf and dumb pupils in speech. He had worthy followers, both in his own country, where Ramirez de Carrion followed his example, and also abroad. In England, it was William Holder, and especially Wallis, Professor of Mathematics, at the end of the 17th century, in the University of Oxford, who distinguished themselves by these acts of philanthropy. In Holland, the oral instruction of the deaf and dumb found an advocate in the physician Amman. In Germany, Kruse, of Liegnitz, in Silesia, and Schulze, in Dresden. But these were but individual efforts of isolated philanthropists, though they are remarkable as agreeing in one thing, and that was the possibility of instructing this afflicted class of persons in articulate speech.

And now let us consider a little more closely what is really meant by a deaf and dumb person. He may be defined as a human being who, either on account of total or partial deafness, cannot learn to speak without special instruction. Even in the worst case, he is not altogether "dumb," in the sense of inability to utter a sound. In this sense even brutes cannot be called "dumb," though that is the fashion so to speak of them, for they can utter sounds of their own, which are plainly understood by those of the same family. Of these, and the deaf and dumb, it may be said that they have voices, but no speech. It is only artificial speech which is wanting to the deaf, and therefore dumb, human being; for articulate speech is only a modification and modulation of the natural voice which has sprung up and been recognised by all the members of the same race. But this arbitrary arrangement of natural sounds which we call this or that language can only be acquired by a painful process of imitation in every child of man, and of that process the deaf and dumb are deprived by the loss of hearing. A child born deaf and dumb, in fact, stands still so far as speech is concerned, while other children of his own age, with infinite pains, are gradually being taught, or rather teaching themselves, to speak. The result is that he is stunted morally and mentally, as well as linguistically. Speech is the first and most important element of all instruction, and so the intellect and intelligence of the deaf and dumb remain uncultivated and undeveloped. His mind is, as it were, shut up in a prison which has windows indeed—his eyes—but in which, though he can see what is passing around him, he can hear nothing. Thrown upon himself, even under the most favourable conditions, his mind becomes morbid and suspicious. For him life is a mere spectacle in dumb show, at best a pantomime; and so he grows up in the midst of civilisation as though he were a savage just brought from the desert, with eyes indeed to see, but without the wit to understand the wonders of existence. As to time, he is restricted to the present, to what, as the phrase is, is passing before his eyes. For him there is no past, and little expectation of a future. To this condition has the loss of that one sense, which more than all the rest is needful to enlighten the human mind, reduced the unfortunate class which we are now considering.

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* Vol. vii. 32, post 8vo., Ed. 1860.

It was soon detected, very soon in fact after the recognition of the deaf and dumb as rational beings, that the degraded position in which they stood, compared with others of the community, arose not only from their loss of one sense, but also from the isolation of the senses from one another which was the result of their sad infirmity. In this respect our ears may be called the masters of the ceremonies of life. They introduce the several senses to one another, and enable the seeing, smelling, tasting, and touching child to know what sight, and taste, and touch really mean, and how they stand in mutual relations, and combined helpfulness to one another. The senses stand five sisters in a row, ready to move in graceful harmony. Of these, the eldest and most directing is Hearing, and if she be missing the action of the rest is gone, and their motions confused and imperfect. It is now, I believe, almost universally recognised that what we call dumbness in the human being is caused, in a vast majority of cases, solely by the loss of hearing; but it was not so in earlier times. Hardly had the deaf and dumb attained their natural right, reason, which the earlier ages had denied them, than the theory arose that their dumbness was caused by an imperfection in the organs of speech. That, you will say, was soon set right. Not at all. It was ultimately set right, but not so soon. We are so apt to summarise long centuries of human suffering, and to dismiss in a sentence whole histories of painful experience. In the period between 1570 and 1770, many and painful were the surgical operations undergone by the ill-fated deaf and dumb in different countries, all aimed at the tongue or other organs of speech, in the hope of alleviating their infirmity. But even in 1570, Valles, the body surgeon of Philip the Second of Spain, had declared that in the organs of hearing, and hearing alone, the seat of the evil really lay. But still the surgeons went on hacking and hewing at the tongues, and tonsils, and throats of their unhappy patients, and it was only at the beginning of the present century that this false practice was finally abandoned. Now I believe, as I have already said, it is universally admitted, that the cause of dumbness in the human being is either congenital deafness, or deafness, more or less total, caused by eruptive diseases, the chief of these being scarlet fever. I believe, also, that it has been observed as a fact that the being totally or partially deaf makes little difference in children of tender years, so far as dumbness is concerned. Of course, a boy or a girl who had lost their hearing from disease, having already heard, and so received some previous education, would be in a far better position than a child congenitally deaf. The remarks I have made only applies to children who have lost their sense of hearing from disease at an age too tender to receive instruction through the sense of hearing. With one other observation I will trouble you, and that rather of a psychological than a physiological character. It has been found very difficult to get parents to confess that their children are congenitally deaf. They are always ready to declare, very often with the smallest ground for the assertion, that their children were brought into the world perfect, and in the full enjoyment of their senses, only an unhappy accident had marred one of these senses. It would be curious to calculate the chances of such accidents having repeatedly occurred in those unfortunate families in which we find several deaf and dumb children. But it is a law of humanity that, by a kind of natural conceit, we are unwilling to deprive either ourselves or our offspring of the advantage of having been, once in our lives, perfect beings, without flaw or blemish, however crippled, or dwarfed, or stunted, or crooked, or hunchbacked, we may have become afterwards.

I may here remark, in order further to narrow the subject, that a certain, but not a large, proportion of the deaf and dumb are idiots; but as the idiotcy of these unfortunates is only accessory to and in no wise caused by their defect of hearing, just as there are idiots who are lame or blind, such cases must be eliminated from our inquiry, and referred to the category of mental and moral afflictions, just as, in the asylums and institutions for the education and relief of the deaf and dumb, only those children who are not idiots are received as objects of instruction and charity. If any one desires to know what proportion the deaf and dumb bear to the rest of the community, statistics tell us that on an average, there are 700 deaf and dumb persons in every million of the inhabitants of the earth, so that there would be 200,000 of these unfortunates in Europe alone; and here it must be remembered that observation has shown that in mountainous countries—such as Switzerland and Savoy—the deaf and dumb stand in a much greater proportion to the rest of the people. In the canton of Berne, for instance, it is stated that in every 195 persons there is one deaf and dumb, which would raise the total in the million to 5,128. Roughly speaking, we may say that there are probably about 700,000 deaf and dumb on the surface of the earth, so that that those suffering from this affliction approximate to an aggregate which, in earlier times, would have been dignified with the name of a nation, and in the present would be called a flourishing colony, so far as mere number is concerned.

If we come home to Great Britain, we find the rule still holding good as to the frequency of the deaf and dumb in hilly and pastoral districts. The northern counties of Scotland, and especially the Highlands, present the highest average, where the number rises to the enormous proportion of 1 in 196 of the population. The average proportion of the deaf and dumb to the rest of the population all over Great Britain is 1 in 1,670; in Ireland, it is 1 in 1,380 persons. At the census for 1851, 12,553 persons, 6,884 males and 5,669 females, were returned as deaf and dumb in Great Britain; and in the 20 years which have since elapsed the number of those unfortunates has proportionately increased. It is curious to remark that all over the world, so far as statistics afford us any information, the number of males born deaf and dumb is considerably above that of females similarly afflicted. In Great Britain, there are 121 male deaf mutes to 100 females. There still remains a fact which it is more important to note than any other connected with these unfortunates, that throughout the country a very small number of the whole amount of the deaf and dumb were returned as inmates at asylums or schools in 1851, when we have seen that the total number was 12,553, only 1,100 were returned as receiving special education. Nor is there any reason to suppose that this amount of pupils is much exceeded at the present day, though the total number of the deaf and dumb in this country has probably increased to upwards of 20,000.

We are now approaching what may be called the era of institutions for the deaf and dumb, which might rather be called institutions for relieving the parents of deaf and dumb children of the claims of natural affection. One would almost think, when one sees the alacrity with which deaf and dumb children are huddled away and kept out of sight, that it was still considered that they were born under a curse. It seems hard to say so, but I firmly believe it to be the truth that, under the cloak of the most charitable intentions, there often exists a refinement of inhumanity. I detect this in all those institutions for the deaf and dumb, which, while relieving the parents of deaf and dumb children of the care of their support and instruction, separate a human being from domestic and public life, and throw him, designed by Providence to live in the family and the State, into a separate world of his own, where he lives an isolated and imperfect existence with others alike afflicted as himself. It is an aggravation of this inhumanity to educate one so afflicted by signs, and then, after years of instruction on the level of that which might be bestowed on apes if they were only a little more rational, to turn him back into this great world to make his way as best he can by gestures—to work with his hands, but to talk with his fingers, if he is so fortunate as to find persons able to converse with him in that most imperfect fashion. It has been well said, that the living spirit of one age haunts after-generations as its ghost; and so it is with the education of the deaf and dumb at present. Of course, we are too enlightened to consider them as utter brutes, like the great Aristotle, or to deny them the blessings and privileges of Christianity, like the sympathetic Augustine. Far too civilised to suffer parents to put them out of the way, laws to proscribe them, and whole populations to mock at them as irrational idiots, yet for all that, we are in our way, and according to our light, quite as inhuman as our forefathers; for we take a being fit for family life, and able to fulfil all the duties of a citizen, from the family, and society, and the State, and immure in an institution where, except his teachers, he will see none but fellow-sufferers; and then restore him, or better, thrust him out into the world, after years of education, only able to speak on his fingers, when, if we had done our duty by him, and taken care that his parents had done theirs, he would have grown up in his own family, with all its ties and all its tenderness, and at last entered the world able to speak, not so harmoniously perhaps as the rest of his fellow-men—though the speech of some of us is, after all, not so very harmonious—but able to communicate freely by speech with his fellow-men. When I know from the experience of my senses that a very large proportion of those for whom I plead this night are capable of being restored to society, both understanding what is spoken, and speaking audibly and intelligibly themselves; I am amazed to read a passage in the last report of a society designed for their education, which appeals for the sympathy of the opulent and benevolent classes of society "on behalf of those to whom Providence has denied the power of pleading for themselves," and I assert with all the energy of my nature that, though Providence has sent those poor creatures into the world deaf, it is man, and such institutions as man has made, which has kept and keeps them dumb.

But there are other evils accompanied with deaf and dumb institutions which must be considered. The greatest of these is the fact that where the young of both sexes are educated together, it is impossible, even by the greatest care, to prevent that approximation between the male and female pupils, towards the end of their life in the institution, which naturally leads to acquaintance, liking, love, and marriage. Without going so far as to lay it down as an infallible rule, it may safely be asserted that there is a likelihood that the infirmity of the parents may be inherited by their children, and if this be so, these very institutions, which are directly intended to alleviate a great infirmity, become indirectly the means of perpetuating it among the community. But while saying this, I should be the last to say that institutions for the support and maintenance of deaf and dumb children have not done good in their day. They were an advance on the isolated efforts of individual philanthropists; and the benevolent individuals who established them were no doubt actuated by the best motives. But in this, as in so much else, what has been the good of one age is the evil of the next, and thus we may see institutions all round us which, refusing to progress with the enlightenment of the age, become retrograde instead of progressive, and fall back into the rear of civilisation, instead of standing, as of old, in the vanguard and front of the battle. A little further on, I will endeavour to explain the system of the school for the deaf and dumb which is best suited both to the spirit of the age, and the wants of the deaf and dumb community.

With regard to the instruction of the deaf and dumb themselves, whether in public or private establishments, there can be no doubt that the system of signs and gestures, or what is called the French system, should be at once abandoned, and, so far as it is possible, abolished. As soon as it is admitted—and, as the proofs are overwhelming, it must be admitted—that the deaf and dumb can be taught to speak, not pleasantly perhaps, but articulately, the whole system of education by signs collapses and falls to the ground. Why educate by signs and gestures those whose organs of speech are perfect, and who can use them for all the purposes of life if they are only properly taught to do so. *Solvitur loquendo;* and when, as we know, the deaf and dumb in Holland and Germany are taught to speak on what is called the German system, why should our English deaf and dumb continue to be instructed by signs, which, the cleverer and more refined they may be, are all the more difficult—in fact, impossible—to be understood by the rest of the community?

But it may be said that our existing institutions for the education of the deaf and dumb already teach them to speak, and some one will quote, in support of this view, the very last report of the Asylum for the Education of the Indigent Deaf and Dumb, in the Old Kent-road, which has one passage which says, "these children are, in many cases, taught to speak." But, unfortunately, there are one or two reasons which preclude absolute belief in this consolatory statement. One is suggested by the very next paragraph of the same report which informs us that "the condition of the deaf and dumb, though calculated to awaken our compassion and sympathy, is, nevertheless, too frequently overlooked and forgotten. They do not differ in appearance from those who possess perfect functions, while their inability to express themselves in language precludes any complaint of their position, which might arrest attention and excite the feeling of the benevolent towards them." Another objection is drawn from the scheme of instruction, also contained in the report, in which, unfortunately for those who assert that these children are taught to speak, oral instruction is entirely omitted. The report says—"The ordinary courses of instruction are, reading, writing, arithmetic, and the outlines of British history and geography; and the pupils who discover a taste for the art are taught drawing. Their knowledge of language is daily exercised." And here, one would have thought, some words such as these would have followed, if many were actually taught to speak, "by lip reading and articulate speech." Instead of this, we find that it is only exercised "by writing their thoughts upon any subject they may choose, or upon one selected for them. The errors and necessary corrections of these little compositions are explained by the teachers, and by this means the pupils acquire a practical knowledge of grammar, and the normal use and arrangement of words and sentences. In addition to this essential practice, they have dictations made to them in the language of signs, which they are required to translate into written language. The pupils take great delight in this exercise, and it is gratifying to see how anxiously they emulate each other in trying to find the proper word or expression for the sign or combination of signs used." From all which it would seem that, though many have been taught to speak, no provision for speaking is provided in the ordinary instruction of the pupils in the institution in question. But quite apart from these admissions of the report, there is one great reason why the pupils in such an institution as we are describing cannot be taught to speak, and that is, because the bulk of the instruction which it affords is conveyed by signs. It has been found by experience absolutely impossible to work the two systems together, since it has always been found that deaf and dumb children will content themselves with the less perfect system, that of signs, as easier, and will always resort to it in preference to articulate speech, if the choice is left to them. They are unaware, so long as they remain in the society of those similarly afflicted to themselves in an institution, that the language of signs is not that of the world at large, and they are incapable of conceiving or understanding the superiority of articulate speech until they are thrown bodily into daily life, only to find, however perfectly they may talk on their fingers, or by imaginary alphabets in the air, that the rest of the world shake their heads and go their way. Then these unfortunates awake to the bitter truth that they have been educated on a false system, and that for all the purposes of communication with the great mass of their fellow citizens, their years of instruction have been as good as thrown away. But though these poor children are ignorant of the advantages to be derived from articulate speech, and therefore may be excused for betaking themselves by preference to signs and gestures, those who have undertaken their education, and drawn large subscriptions from the public for that purpose, are responsible to the opinion of the community if they persist in teaching by signs those who are capable of articulate speech, and instead of boasting of their enlightened philanthropy, they ought, if convicted of adhering to a system which will no longer satisfy the wants of the age, rather to confess that after all they have been unprofitable servants.

And now let me speak a little of the so-called French system, and its originator. This system, as originally professed, is based upon the use of a peculiar medium of communication between the teacher and his pupils. It is entirely independent of ordinary language, and is formed out of a set of artificial signs for the expression of ideas, consisting, not of words, but of certain conventional gestures. These signs, as has been well remarked, might be considered as being virtually words, since they play to the deaf and dumb all the parts of words, and, in theory, every word in the language is represented by its peculiar gesture. In instructing the deaf and dumb on this system, care is taken that in learning the meaning of any written word, the particular gesticulation appropriated to it should be learned at the same time. This system was invented by the Abbé de l'Epée, and developed by his pupil and successor, the Abbé Sicard, and this is the account which the former ingenious writer gives of the circumstances which induced him to adopt it. It so happened that two sisters, both deaf and dumb, lived in Paris, opposite to the society called Les Péres de la Chrètienne, and one of the priests, Father Fanin, had tried to instruct these ladies. A sudden illness, however, carried him off before his good work had been rewarded with any great success, and the two sisters, as well as their mother, were inconsolable for the loss of their instructor, when the Abbé de l'Epée had occasion to call at their house. The mother was out, and, while he was waiting for her return, he put some question to the young ladies, but, to his surprise, they returned no answer, and their eyes remained fixed on their needlework. He repeated his questions with the same ill-success, and, not suspecting that they were deaf and dumb, he was lost in conjecture as to the reason of their silence, when the mystery was solved by the return of the mother. This visit made so strong an impression on his mind, that he devoted all his thoughts to devising a means of supplying to those young women the faculties of speech and the means of intellectual intercourse. After meditating long on the subject, it occurred to him that every language is but a collection of signs, in the same way as a series of drawings is an assembly of figures, so gestures were also signs, and that things might be figured by gestures, just as anything can be painted by colours or expressed in words. Why, then, should there not be a language of gestures? The attempt was heroic, but of enormous difficulty, for it was in fact an effort to write Chinese picture-writing in the air. Since the gesture vanished as soon as it was made, this Chinese system required a still more prodigious effort of memory than is demanded by the Chinese language of those who attempt to acquire it. Full of this idea, he again visited the deaf and dumb ladies, eager to try his new mental undertaking. To their great delight, he declared himself ready to become their instructor. He drew to them, he gesticulated, and he wrote down the corresponding words, but he found, as all teachers of the deaf and dumb have found, that it is hard to teach minds wholly uncultivated. It was in vain that, after infinite trouble, he taught them letters and words, and invented, so far as was possible, gesticulations answering, as he declared, to every word in the French language. The act of imitation had been originally mechanical, and mechanical it remained. He had began by the wrong way, from the outside rather than from within, and though his pupils possessed a vast vocabulary of gesticulation, and a perfect Chinese dictionary of visible signs, they still had no conception of the relations in which the objects which they denoted in the air stood to one another, so that, in one word, these ladies had words but no ideas. It has been well said that, in thus leading his pupils to write words as signs, he was endeavouring to lead them to something which they did not know, by setting out from what was equally unknown. He succeeded in enabling them to transcribe whole pages of the most abstract disquisitions by the means of gestures, that is to say, while he gesticulated and grimaced they wrote down every word; but it never seems to have occurred to this amiable enthusiast that he it was that supplied the mind, while his pupils were the merest machines, for they were no more thinking beings while the process of gesticulation and interpretation was going on than a musical snuff-box is capable of understanding the melodies which it utters, under an arrangement of a most complex system of springs. The Abbé de l'Epée made his pupils into writing machines, but for the purposes of reflection and combined thought they knew no more than Newton's pen, with which he composed "the Principia," or that with which Bacon wrote the "Novum Organum," of the wonders of science which they were mechanically assisting to describe.

But, notwithstanding these radical and incurable defects of De l'Epée's system, the success which he obtained was of that ostentatious and demonstrative kind, which we must not be so illiberal as to call peculiarly French, but which was just calculated to excite wonder and amazement in a host of superficial spectators. When, in such public displays, a credulous crowd saw the master gesticulating, and the pupils transcribing page after page of terms, which the spectators, though not deaf and dumb, could not comprehend with the use of all their senses, they very naturally forgot, especially as the peculiar gesticulations of the one were beyond their comprehension, while the words written down were supposed to be within their capacity, how much was due to the ingenious master, and how little beyond mere memory to the unfortunate pupil, and they went away declaring that there never was such a system for instructing the deaf and dumb. The religious zeal, too, and the noble charity of the man contributed to his reputation. "His fame," as has been well said by a writer in the "Encyclopædia Britannica," to whom I am indebted for this interesting narrative, spread itself all over Europe, and his lectures and exhibitions attracted everywhere crowds of enthusiastic admirers. There was not wanting, however, persons who saw through the delusion. His system was introduced at Vienna by the Abbé Storck, and there it was put to a very simple test by the famous Nicolai, an academician of Berlin, who, at a public exhibition, proposed to the Abbé to require one of his pupils to describe in writing the action he was about to perform. The challenge being accepted, M. Nicolai struck his breast with his hand, upon which the deaf and dumb boy immediately wrote the isolated words "hand," "breast." The academician at once withdrew, satisfied with this proof of total failure; for it was evident that, notwithstanding all this parade of learning and of the quickness of the pupils in writing down any question, together with the answer, both had been equally dictated by the master in the same language of gesture, but without any corresponding ideas, or the exertion of any intellectual faculty except that of memory. They were utterly incapable of composing a single sentence, and it was found accordingly that their spontaneous answers to the questions asked them were limited to the monosyllables "Yes," and "No," of which it is even doubtful whether they fully understood the real meaning. "It is more easy," says the writer in the "Encyclopædia Britannica," "to conceive than to describe the disappointment which the parents must have felt at the discovery of the real ignorance of their children, after so many years of instruction, and after the brilliant manner in which they acquitted themselves in their public probations. The secret is indeed betrayed in some letters of the Abbé de l'Epée, published by Sicard, in which he avows that his views of education were limited to the mechanical qualifications necessary to enable his pupils to perform their parts in a public exhibition, namely, that of writing words, after certain gestures had been made to them, without the least intelligence of their import, and, of course, without the power of employing those words either as instruments of thought or as vehicles of meaning."

The Abbé Sicard, the successor of De l'Epeé, while he retained the system of artificial signs, soon discovered that the intellectual, and not the mechanical, education of his pupils was the main object to be aimed at. He found a favourable opportunity for developing his plan on his appointment as teacher to a school at Bordeaux, where, among the first pupils presented for admission, were a boy and his sister, both deaf and dumb, belonging to a poor family, five of which were afflicted with that infirmity. They lived in a small cottage in a wild part of the country, and the sole occupation of John Massieu, the name of the boy, had been to tend his father's sheep amid heaths and woods, in which occupation he had contracted almost savage habits. He was sullen and suspicious, and shrunk from all intercourse. It was scarcely possible to imagine a being less capable of education; but, under the judicious management of M. Sicard, his faculties were developed, his intellectual powers gradually exerted and exercised, his capacity for instruction expanded, and he made rapid strides in the acquirement of knowledge. But, though all this was done by the Abbé Sicard, and though there can be no doubt that he succeeded where De l'Eppé had failed, in using his system of signs for the intellectual development of his pupils, the great vice and error of the French system still remained. After years of education, the deaf and dumb taught on that system were unfitted to enter upon the duties of life, and to communicate freely with their fellows. If all the world were an institution for educating the deaf and dumb, one might be satisfied with such a result; but as it is not, we must necessarily pronounce any system which contents itself with educating its pupils for life in the institution, and in the institution alone, self-condemned.

Of course, there are certain signs, which may be called "natural," which all children make use of in infancy to express their wants. In children whose senses are sound, and who possess all the organs proper for articulate speech, the process of education is to wean those little ones, so to speak, from such necessary signs and tokens; and when a nurse says to a baby which is pointing and gesticulating for something that it wants, "Ask for it, baby; speak prettily for it," she is engaged in annihilating the brute, and cherishing the human element which exist in all of us. But for the first education of the deaf and dumb, in that isolation of the senses which is their peculiar affliction, these natural signs must be necessarily longer retained. So long as a deaf and dumb child remains entirely under the care of its parents, these natural signs are often the only means of developing the faculties. A teacher, too, must necessarily understand them when he first receives such a child from its natural guardians for the purpose of instruction. He must begin with that, since he has nothing else to start from; but he must not persist in it a day longer than is absolutely necessary. What shall we say, then, of a master or of a system which degrades himself or itself to the level of the ignorant being whom he has undertaken to teach, who forgets his own language, and not only contents himself with these brutish natural signs, but further develops and expands them into a system, and calls it the language of signs. Against such a system it is remarkable that Dr. Watson, who was, I believe, the founder, or at any rate one of the founders, of the Deaf and Dumb Asylum in the Old Kent-road, over which, too, he presided as principal for many years, was entirely against the system of signs as the ultimate end and object of instruction for the deaf and dumb. His remarks on this point are so excellent that I cannot help quoting them. After describing the importance to the teacher of understanding what he calls "natural" as opposed to artificial signs, he proceeds:—

"But never let anything so chimerical be thought of as an attempt to turn master to the deaf and dumb in the art of forming signs. What should we think of a European who should undertake to teach his own regular, copious, and polished language to a South Sea Islander who was henceforth to live among Europeans, and whose scanty vocabulary extended only to a very few words, barely sufficient to enable him to express in a rude manner what was required by the uniformity of his condition and the paucity of his thoughts? Should we suspect that the teacher would set about new-modelling, methodising, and enlarging the rude and imperfect language as the readiest way of making the islander acquainted with the European tongue, especially when this new-modelled language, after all the pains bestowed in forming and teaching it, could be of no manner of use but to assist the intercourse of these two persons? If this supposition seems ridiculous, how much more fanciful and useless is an attempt to methodise signs for the instruction of the deaf and dumb! Would it not be a more natural and rational mode of procedure for the teacher to begin by watching the objects and occasions to which the scholar applied the words of his barbarous speech, that by knowing them he might gradually substitute the words of the language to be taught, using the former only as an introduction to the latter? It should never be lost sight of that deaf and dumb people are not educated to live always among persons in their own unfortunate situation; were this the case, indeed, an artificial language of methodised signs might be of important use; but as they are intended to mix with their fellow-beings in social habits and necessary avocations, we have to open a channel to this intercourse, and this cannot be done so effectually by any other means as by teaching them the language of the country where they reside."

To which most judicious observations the writer in the "Encyclopædia Britannica" adds the remark, that our object in educating the deaf and dumb is not so much to make them acute grammarians and subtle metaphysicians as to render them useful members of society. Experience has shown that more simple and ordinary modes of instruction will effect this in less time or with better success than the complex and elaborate system of the Abbé Sicard and his followers.

We have now disposed of the French system of signs, which depended alone upon a single sense—that of the eye; and we have seen the isolation, in a moral point of view, which follows on the use of one sense alone. It was the remark of the Latin poet:—

> "Segnius irritant animos demissa per aures,
> Quam quæ sunt oculis subjecta fidelibus,"

lines which the late Professor Conington rendered:—

> "A thing when heard, remember, strikes less keen
> On the spectators' mind, than when 'tis seen."

but this remark is only true if by *animus* we understand what we call the "senses," that is, mind in its relation to matter. For all moral and intellectual purposes, the ears are far more faithful—much better friends to us than our eyes, and, as we have already seen, it is to the loss of hearing alone that all the injuries which the deaf and dumb suffered in former years from the ignorance and inhumanity of their fellow-men are mainly to be attributed. We have seen how De l'Epée took the eye as his means of exciting the attention of his pupils. He gave them words by his gesticulations, but no ideas. Sicard kept his gesticulation and signs, and gave his pupils ideas. To the pupils of the founder of the system words had no meaning, but when Sicard's pupils wrote down sentences they understood them. They were thinking beings, but they did not comprehend words in their ordinary sense, and for all purposes of speech their mouths were dumb. We have, however, seen that, from the 16th century at least, it had been always asserted, and more or less successfully proved, that the deaf and dumb could speak if properly taught. This school of teachers, which may be called the Dutch or the German school, is that to which I now desire more particularly to call your attention. It uses the eye just as the French school uses it, for the purposes of drawing and writing, which must necessarily form so large a portion of the education of the deaf and dumb; but it goes beyond this, and uses the eye to supply the place of the ears by an ingenious system of teaching, to the results of which, and not to the process itself, I must confine myself to-night. In a question of such wide extent, where so much ground has to be covered, I must be permitted, in this part of my subject, to be *doctrinaire*, and to beg you to believe that, by a process perfectly natural, and not in the least attended with cruelty, as some ignorant people have asserted, on the part of the teacher, deaf and dumb children have for a long series of years been taught in other countries, not only to understand spoken words, but also to speak articulately. This system, some of the results of which will be shown to you at the conclusion of the lecture, absolutely forbids artificial signs, such as gesticulations and talking on the fingers, to its pupils, and while it uses the eye to teach them to read and write and draw, it also uses it to supply the want of hearing. Articulate speech is, of course, the crowning triumph of the system, but not less wonderful is what is called in the German system "lip reading," by which the deaf and dumb use their eyes to understand what is spoken. It seems a strange thing, but it is no less true, that deaf and dumb children, especially if taken into tuition at an early age, may be taught to understand with amazing quickness of perception whatever is spoken within eyeshot. Any one who has had the good fortune—as I have had—to visit the Jewish school, of which Mr. Van Praagh is the worthy conductor, in the Euston-road, or who has been permitted to see some of the children taught by him, cannot fail to be deeply interested in the philanthropic patience and industry of that gentleman and in the success of his teaching. So successful, in fact, is this part of the teaching under the German or Dutch system, that it is necessary, if you are saying anything which it is not desirable that the children should understand, to cover the mouth; for so far as their eyes reach so far do they understand what is said. So perfectly too has this process of education been carried out in individual cases, that persons thus educated are able to carry away with them a sermon or a speech by only observing the motion of the lips and the play of the countenance of the speaker or preacher, and in one case of which I have heard, the preacher, ignorant of the infirmity under which a regular attendant at his church suffered, sent to beg that So-and-so would not stare at him so hard, as it put him out in his sermon. Far different from such practical results are the Chinese writing in the air of the Abbé de l'Epée, or the refined, metaphysical system of Sicard. Very different, too, are the results attained by the system pursued at the Deaf and Dumb Asylum, with its machinery of signs. Here are the deaf and dumb restored, by the intelligent use of their eyesight, to that lost sense of hearing, and ready, on leaving school, to enter the world understanding the language of man.

But, after all, the crowning triumph of the German system is the undoubted fact that, in a majority of instances, deaf and dumb children, if properly taught, if the system of signs be prohibited, and they are instructed, as by patience and perseverance they can be, in articulate speech, may be restored to the world not only able to understand, but able to converse with their fellow-men. I have already noticed the objection, that this part of the Dutch or German system is attended with cruelty. All education was cruel in the good old days, when the ferule, and taws, and rod of the master eked out savagely his modicum of patience and intelligence; and even in more modern times, the mantle of Busby fell, not lightly, on the shoulders of Keate and Goodenough. But the instruction of the deaf and dumb in articulate speech is no more cruel than any other method of enlightened education. It is chiefly based on teaching the pupil the difference between sounds and articulations by calling in aid the sense of touch, and so supplying the loss of one sense by another. It was Amman, a physician, born in Switzerland, though he practised in Holland, who first introduced what may be called indifferently the Dutch or the German system. He taught his pupils to watch closely with their eyes the changes which came over his face and lips as he uttered words, and then to imitate those changes before a mirror. When he uttered a sound he made the pupil place his hand on his master's throat, that he might perceive, by the sense of touch, the quivering vibratory motion which arose in it when the sound was uttered. Going one step further, he made the pupil, when he imitated that particular sound, lay his own hand on his own throat, and thus he arrived at last to the utterance of articulate sounds by the pupil, a feat which could never have been accomplished had the pupil been left to the sense of sight alone to imitate sounds from the mere observation of the changes which passed over the face and lips. This system of Amman was brought to perfection by the famous Heinicke, born in 1729, and died in 1790, who is considered in Germany and Austria as the founder of the German system. He was perfecting his method in Hamburg and Leipsic 1760 and 1770, just about the time that De l'Epée was hard at work with his system of gesticulation in France. While the Abbé established, in 1760, a school for the deaf and dumb in Paris, with the success which we have already seen, and which was raised to the dignity of a State institution at the epoch of the Revolution in 1791, Heinicke, in 1778, removed his private establishment from Hamburg to Leipsic, where it became a public institution, under the protection of the Elector Frederick Augustus of Saxony. Very soon after, similar institutions were established at Vienna, at Prague, at Berlin, and many other parts of Germany and Austria. These were all on the principle of lip-reading and speaking, and not of gesticulation or signs; and at this moment it is stated that there are a hundred such institutions in Germany alone, and yet it is calculated that instruction is only afforded in these schools for one twenty-fifth part of the deaf and dumb children, between the ages of six and fifteen years, who are capable of instruction. So that it appears that both at home and abroad there is ample room for the exercise of benevolence in the education of a most afflicted class. It is no objection to this part of the system to say that it is not successful, because the utterance of the deaf and dumb so taught is inharmonious. Probably, except in some very few cases, the speech of all such persons will have something harsh and monotonous in its delivery; but I can safely say that it is perfectly intelligible. And even if it be discordant and inharmonious, I would willingly put it to any one of you, if he were deaf and dumb himself, or had a child so afflicted, whether he would not prefer that he and his child should speak inharmoniously and yet be placed into articulate communication with their fellow-creatures, than that he should possess the most refined system of signs or finger-language, and still be deprived of articulate speech.

I have now sufficiently exhausted your patience, but I could not do justice to the subject, however imperfectly, at less length; my object has been, first, to show the degraded position in which the deaf and dumb had been kept for ages, by the inhumanity and ignorance of his fellow-men. To the Greek he was an idiot, because he could not speak. In the earliest ages of Christianity, no doubt, the being deaf and dumb was supposed to be a mark of God's anger on the afflicted being and his family. Exposed by his parents, put out of the way by the authorities, confounded by the ignorant population with accursed races, every where mocked and scouted as an idiot, so he remained till the 16th century, when at last the fact was recognised that, after all, he too was a thinking being. Then, tortured for more than two centuries by surgeons, who mistook the seat of his infirmity, while the isolated efforts of individual philanthropists were directed towards restoring him to articulate speech. After that, in France, the victims of a system of gesticulation and grimace, which has found its defenders, and still finds them, in this country. Lastly, the prospect of a better state of things opens for this afflicted class in Holland and Germany, where a better system educates them, with a view, not to life in an institution, but to intercourse with the world, and the rights and duties of a citizen. One step still remains to be taken, and that is to restore the deaf and dumb to family life. This can only be done by discountenancing the institutions in which, as I have shown, the afflicted classes are separated altogether from family life, as if to be born deaf and dumb were still to be branded with a mark of God's wrath. I have already pointed out the social inconveniences of such a system of isolation, by the tendency to perpetuate the evils which it is designed to remedy; and will only add that the system of day schools, as in Holland, which, while it relieves indigent parents of the education of their children, restores them at night to the charities of domestic life, is, together with an education by lip-reading and articulate speech, the system which tends more than any other to alleviate the affliction of the deaf and dumb. A visit last summer to the school taught by Mr. Van Praagh in the Euston-road, and supported by the boundless charity of the Jewish community—a charity boundless not only to members of their own faith, and which puts our Christian charity to shame; a charity secular, undenominational, and infinite—a visit, I say, to this school, made me feel that I had, so far as my small influence went, treated a most suffering class all my life long with great injustice and neglect, and I have since striven to repair it, I am thankful to say, with the support and sympathy of many more influential persons. Believing, as we do, that the education of the deaf and dumb in institutions and by the French system of signs to be false in principle and pernicious in practice, we have resolved to form ourselves into an association for founding a normal day school on the Dutch or German system, in which, by a full staff of teachers—and such a school will require many teachers—we may prove to the community at large the benefits of a method of education for the deaf and dumb, which has been talked of, indeed, but never properly tried in this country. If we fail in our benevolent intentions, we shall, at least, fail with the conviction in our hearts that we have deserved success. But, in conclusion, let me tell you that we do not intend to fail, for with your sympathy, and when the German system becomes better known, we trust that the day will come when lip-reading and articulate speech will be the rule rather than the exception in the education of the deaf and dumb, and when the French system of gesticulation, grimace, and signs will be thrown aside as a thing of the past, and no longer be considered worthy to be dignified with the name of education for the class in question.

DISCUSSION.

The Rev. J. Watson said the children in the Old Kent-road institution were, in many cases, taught to speak, and such had been the case under the management of his grandfather, his father, and himself. All were taught to speak who were capable of learning—in fact this was part of the regular system of education, but at the same time other methods were carried on, so that no time should be lost. If the report only said that the children were "in many cases" taught to speak, it was only from modesty, and because some of the children were not really capable of being taught to speak, and this, he feared, would be the case under the German system. At any rate, whatever the German system could do, that, practically speaking, was done at the Old Kent-road. If Dr. Dasent had paid them a visit, he would have seen that this was the case. Like his grandfather, he discouraged signs as much as possible, and he only looked upon them as a means to an end, like the ladder used to get to the top of a house, and then to be discarded. He might give an illustration of the use of signs until children attained the free use of speech—which, he maintained, was not possible with all—from the case of a little girl who, had recently died, after being a year in the institution, who thoroughly understood the meaning of folding her hands in prayer, and the idea of dependence on a superior Being, but who could not have learned so much from lip-reading alone. However philanthropic they might be, and however they might be desirous of doing what was best, they should not cast away what they had until they were sure of something better. If this system of articulate teaching were not mentioned in the scheme of instruction, it was nevertheless the fact that every child that entered the institution was taught to speak first of all. Any one, by reading his grandfather's book, which had been quoted in the paper, and following out the instructions, would be able to teach a deaf mute to speak, and he believed there was a young lady present who had been taught there, who was as expert as any one, and he was rather surprised that Mr. Becker, in his papers on this subject in the *School Board Chronicle*, had omitted any reference to this case, though he had introduced that gentleman to the young lady referred to. He discouraged signs as much as possible, and should be glad if he could see his way to substitute articulate speech for them entirely.

Dr. Dasent thought this could be done by forbidding the use of signs.

The Rev. J. Watson said if he could only see his way to the education of the deaf and dumb in that way entirely, he shoud say "Thank God!" for he looked upon signs as the greatest curse to deaf mutes in after-life, inasmuch as they got to depend upon them, and lost the use of speech. All children, therefore, who left the institution, were instructed to use signs as little as possible, but in the case of the poorer classes it was impossible to prevent it.

The Rev. Wm. Steiner said he was a missionary to the deaf and dumb, and he had to use signs, in the same way as missionaries from England to Africa and other foreign countries, had to learn the language of those with whom they came in contact, although English was much superior as a language in every respect. He believed every English teacher admitted the desirability of abolishing the use of signs, if possible. The German system was that which he had taught for 30 years, having begun his career under the late Rev. James Watson, and continued it under the last speaker, and having had every advantage in the way of trying experiments. He had with him a pupil, whom he had taught for four years and four months, who before that time could not speak one syllable, but he could now read from any book so as to be understood. He was born deaf, but not totally so, and, therefore, was more readily taught; and he was, moreover, a lad of extraordinary intelligence. He thought it a mistake to set up a sort of rivalry between the German and English systems, and that it would be much better to see on what common ground they could all agree, which was, he believed, that they desired to teach their unfortunate pupils the use of language, so as to be able to read an ordinary book with intelligence. Whether this was effected by means of sounds or by reading aloud was a secondary point. It must be remembered, however, that there were different classes of the deaf and dumb to be dealt with, and they must be dealt with differently. There was no one system applicable to all any more than in the case of ordinary children. For instance, the poorer classes required to be taught that which would be most useful to them, which was colloquial language, not an extensive knowledge of books, so as to be able to enjoy Shakespear. He was sorry to say that there was no English book published consisting of colloquial phrases suitable for such persons, and the pupil he had referred to had been in the habit of using French and German phrase-books for this purpose. Of those in a higher station more was expected, and they ought to be able to read any ordinary book with intelligence. He did not bring forward his pupil as representing deaf-mutes as a class, and it was a great mistake, when you saw a boy or a girl exhibiting certain powers on a public platform, to suppose they were all the same. He knew the deaf and dumb well, having laboured amongst them and taught both systems from childhood. He entirely agreed with the idea of day-schools, but not that signs must be entirely abolished, or that that it was foolish to build a church for the deaf and dumb.

Dr. Dasent said he did not find fault with the idea of building a church for the deaf and dumb, but with conducting the service by signs.

The Rev. W. Steiner said it was out of the question to suppose that one-half of a congregation could follow a sermon, so as to understand, by lip-reading. He had been in Germany, and had investigated the results of the teaching, and was sorry to say that, in his opinion, they did not come up to the statements in the reports. It was impossible for a deaf person to sit at a distance and follow a speech or sermon. If it were not so, he was certainly greatly mistaken. He was not quite certain whether the greatest credit in the matter of teaching the deaf to speak was due to Germany or England; but certainly Dr. Watson was a most earnest teacher of articulation, and the results of his labours were now to be found in all parts of London. He was in fact a most indefatigable teacher.

Dr. Dasent suggested that perhaps his system had degenerated.

The Rev. W. Steiner said there was no doubt this had to be borne in mind, that whereas Dr. Watson was like the father of a family amongst his pupils, the institution he had founded had so grown that there was a deficiency of teaching power, for it was impossible for any one man to teach many pupils at once.

Mr. Heal expressed himself very much disappointed with the paper read that evening. He took a great interest in the subject, having a child deaf and dumb, and he had come in the hope of getting some information as to the system followed in Germany in teaching the deaf and dumb, and learning how much it was possible to teach. If Dr. Dasent had brought one of the pupils taught upon the German system, and if after his speech that young man, woman, or boy, had got up and explained any portion of it, he should have gone away quite satisfied. He did not dispute that a great deal had been done under the German system; but he did not think the lecturer had done justice to the present deaf and dumb institutions. So far from the system of education conducted in them hindering the family ties and the possibility of a child, after it left the institution, entering into society, he might say that his son, who was deaf and dumb, was one of the happiest of a very large family. He enjoyed the society of his friends, had a ready means of communication with them, mainly by signs and by the means of writing, and he could go away for a month's holiday, and write home very intelligible letters describing the various places that he visited. He should have liked to have heard more of the advantages of the German system, and less about the shortcomings of other existing institutions.

Mr. Becker explained that he had not referred to a young lady mentioned by Mr. Watson, in his articles in the *School Board Chronicle*, because he found that gentleman's account somewhat clashed with the official report, which he held in his hand, of one of the most eminent authorities in Europe, and because he was precluded from giving certain details of Mr. Watson's system. It was, he believed, a mistake to call the system advocated by Dr. Dasent the Dutch system; for although he was a Dutchman, he believed his countrymen could not lay claim to the credit of the discovery, although, when its practical value had been shown by Dr. Hersch, it was soon adopted, first in combination with, and afterwards in substitution for the other. There was one point in favour of the German system which had not been mentioned, namely, that those who had been taught it did not cease their education on leaving the school, but being fitted to take their place amongst the other members of the community, not forming a small clique by themselves, were constantly adding to their stock of knowledge and improving themselves, which was not the case on the French system.

Mr. Van Praagh said his time and knowledge, since he had been in England, were always at the service of those who were interested in the question of the education of the deaf and dumb, and there not being time to state what were the principles on which he taught, he could only invite anyone who felt disposed, to call upon him, and investigate the system for themselves. It was a mistake, however, to suppose the German system simply consisted in teaching the deaf and dumb to speak; its essence consisted in the way in which this was done, and his experience had shown him that, by this system, all deaf mutes could be taught to speak; and not only so, but to use their eyes as substitutes for ears, and understand what other persons said. The degree of perfection to which this could be brought of course depended on the amount of practice; and if the fingers were allowed to be used, no mute would ever be able to hear with his eyes, as he might term it. He defied anyone to produce a deaf mute, accustomed to talk with his fingers, who was a good lip-reader. He had brought with him two or three children from Burton-crescent, where the system had been introduced four and a-half years, who would show the progress that could be made in a short time; and a son of Professor Pilano, of Leyden, was also present, who was totally deaf congenitally, but who was able to converse in German or Dutch with the greatest facility. His sister, who was similarly afflicted, was even more expert. Many children described as deaf were still sensitive to sound in some degree, and in those cases of course there were greater facilities in the way of teaching correct articulation. Mr. Pilano was an exception to the general rule, inasmuch as he suffered from a slight defect in the organs of speech, which was very rarely the case; indeed, in his own experience, both in England and on the Continent, he had only met with one case of cleft palate, which being cured, the child was able to speak well. He should be quite ready to give a course of lectures explaining the German system, but could not do it justice in the short time he had his disposal then, but he might say that while by the French system a pupil was taught to speak certain words, and those only, on the German system they were taught to use language like any ordinary person, to speak intelligibly, and to think and reason, so that they could take their place in the world. Day schools were preferable to others, because the children, by mixing at home with those who were not afflicted, were constantly gaining new ideas, and were not strangers to the world at large when they left school. He must express his decided opinion adversely to the mixed system; he using both, neither was carried to perfection. He had found great difficulty himself in teaching mutes to speak who had been accustomed to signs; it was much better to drop the signs altogether, and teach speaking perfectly.

Some pupils taught upon the German system were brought before the meeting by Mr. Van Praagh, to illustrate the proficiency, both in speaking and understanding ordinary speech, obtained by this method. Mr. Pilano also conversed in German with a gentleman present, and in Dutch with Mr. Becker, understanding every question put to him.

Mr. Watson proposed that Mr. Steiner's pupil should also show his powers.

Mr. Becker objected that the lad referred to, not being totally deaf, was not a fair object of experiment.

Mr. Watson said he believed, in the general course, this affliction arose from physical degeneracy, allied to tuberculosis, and it was only in extraordinary cases that very rapid process could be made. He would invite anyone present to pay a visit to the Old Kent-road Asylum, and see what was accomplished there.

The Chairman proposed a vote of thanks to Dr. Dasent, and said the paper was quite what he should have expected from the cultivated mind and literary abilities of that gentleman. The subject was one of the most difficult in existence. It was a difficulty that even touched, in the popular apprehension, on the prerogative of Divine power, and it reminded one of the time when the people were amazed, and beyond measure astonished, and said, "He hath done all things well; He hath made the deaf to hear, and the dumb to speak." When examined, however, it would be found that there was nothing of irreverence in the matter. The subjects of instruction were the deaf and dumb; they were deaf before they were dumb, and dumb because they were deaf; wisdom at one entrance was quite shut out, but the Divine benevolence had left other entrances, which, with the aid of their fellow creatures, would suffice for the admission of knowledge after all. The eye, which, in some respects, was the most efficient of all organs, was left intact, and by its help they might be taught to speak. An instance occurred to him, which was on the tongue of everybody in the West of England, when he was a boy. There was a lady of one noble family entirely deaf, who married into another noble family, and, by the help of her friends and relations, by the kindness of those about her, and by great good temper, industry, and quickness, she acquired the habit of expressing herself freely, and properly filling her place in society, thus illustrating what Dr. Dasent had said about the importance of not isolating the deaf and dumb in separate institutions. What had been done in a single instance, in an unsystematic manner, and without any scientific help, he thought might be done generally with the present improved appliances. He was happy to say that an institution was being established at Norwood, for the purpose of teaching blind pupils music, which would give them a useful and honourable employment. This was another example of using the senses which are left to supply the deficiency of those which are wanting. Other systems had been in use heretofore, but it must not be understood that what was at present proposed was meant in any way in rivalry; on the contrary, it was intended to be an equal help to all. He observed, with great satisfaction, that it was admitted by all the gentlemen who had worked so meritoriously hitherto, that to teach articulate and intelligent speech was the great object to be aimed at, and that considerable numbers might be so taught. What was wanted was, to concentrate all their efforts on teaching articulate speech, and on the success of that everything would depend. If the success of the oral system were established, it would be for the benefit of the deaf and dumb all over the world, not merely of the 2,000 in London. He had, for some time, been connected with a society whose object was to check the abuse of charity, which was very great, and it was refreshing now to have to do with a beneficient enterprise which was hardly capable of abuse, and must, therefore, exercise a salutary influence over the whole field of charitable exertion. The whole world was under everlasting obligations to the Hebrew race, and they it was who had initiated this movement. Hebrews spoke Continental languages to a degree which Englishmen did not, and it was to their cosmopolitan, benevolent character, to their great liberality, and, happily, to their ample means, that this great experiment was to be made in England, the success of which would be an additional benefit conferred upon mankind by the Hebrews.

The Rev. W. Watson seconded the vote of thanks, which was carried unanimously.

Dr. Dasent briefly acknowledged the compliment, and said he was not sorry for having provoked the discussion, because he thought it was for the good of the object he had in view. He was not aware that lip-reading and speaking was carried out to such an extent as had been mentioned, and should gladly avail himself of an opportunity of going and inspecting Mr. Watson's institution.

CANTOR LECTURES.

ON THE MANUFACTURE AND REFINING OF SUGAR.

By C. Haughton Gill, Esq.

Lecture IV.—Delivered Monday, December 18th.

Ladies and Gentlemen,—I come this evening to the last branch of my subject. Having treated of the preparation of the raw material from its two main sources, viz., the sugar cane and the sugar beet, I now have to describe, but in outline only, one of the processes employed in the refining of that sugar, so as to render it fit for consumption. Many of these samples of raw sugar that I have laid before you are really quite uneatable; indeed, I was told this evening that one sample I had left here had been used for making a pudding, which had to be thrown away. It was a specimen of low, raw West Indian sugar, containing some two or three per cent. of sand, and naturally, therefore, the pudding made with it was somewhat gritty.

The sugar refiner has to deal with this raw sugar, and his business is simply to cleanse it,—in fact the sugar refiner has to take dirty sugar and make it clean; and I propose this evening to tell you one process by which he does it, for there are variations in the methods employed, and perhaps no two sugar refiners work in precisely the same manner. I can only, therefore, tell you an outline of what takes place in one set of refineries, and I propose to choose those which turn out their main product in the form of loaves, such as I have placed on the table.

In the first place, I must tell you that the sugar which the refiner has to deal with is, of course, of two sorts, cane sugar and beet sugar, as the case may be, but it makes no difference to him which he employs. Refined sugar, from whatever source it is made, has identically the same properties, and, in fact, cannot be distinguished by any means I am acquainted with. Before entering on the details of the work performed in a refinery, I must mention again what I have previously implied, with regard to the nature of raw sugar. In both cases, if you recollect, the more or less purified juice of the cane or the beet respectively has been evaporated with greater or less precaution, to avoid the destructive action of heat and acids, until the solution became a hot saturated solution, and that then the sugar has been caused to crystallise in one way or another. In any case, the sugar crystallised in the concentrated solution somewhat quickly, and, as you saw by the samples I produced, the crystals were small and confused. Now consider the conditions under which they have been formed. They have grown in a solution which contained not only sugar and water, but also a good many impurities, including saline combinations and albuminous bodies, and, at any rate in the case of cane-sugar, very often a considerable amount of actual solid impurities, feculencies of one fluid or another, the *debris* of plant-cells which had remained in the liquid, never having been separated from it, and which therefore remain ultimately hanging to the small crystals of sugar formed in the syrup, which consists of sugar, water, and various gummy and other bodies, of which the nature is practically not known.

The syrup surrounding these crystals is of a very sticky nature, and when the mass, consisting of grain sugar and syrup, is allowed to drain slowly by itself, or when it is put into a centrifugal machine, such as I showed you last week, still the syrup is not perfectly separated from the grains of sugar. Each individual grain of sugar remains wet with the syrup, which syrup is obviously not a pure solution of sugar, and therefore the material which is won in this way is not pure sugar. Even if the crystals themselves were quite pure, their remaining wetted with a solution which is not that of pure sugar causes the material itself to be contaminated with various foreign bodies, which it is the refiner's duty to remove.

Now, the impurities adhering to the crystals of sugar are of two kinds—solid ones, which, if washed and dried, would be described in ordinary language as mere fluffiness; and also soluble bodies, which were not removed in the processes to which the juice was subjected. The refiner gets the sugar containing these impurities, and his first operation is to dissolve that sugar in water. This is generally performed in large, circular cast-iron pans, containing four or five tons of sugar, with a proportion of water sufficient to dissolve it, which is about half the weight of the sugar. I have so dissolved a quantity of raw sugar here, and it is by no means a bad specimen, still you see the solution is quite cloudy, indicating that there are solid bodies present which interfere with the free transmission of the rays of light. If the solution were simply coloured, but were free from solid bodies, it might look dark in colour, but still it would be transparent and bright. The refiner, then, has first to get rid of this solid matter, and the obvious plan is, to pass it through a filter, in the same way as I clarified a solution the other day, by passing it through a folded filter paper. But all these fluffinesses tend very rapidly to choke up the pores on any filter on which you can pour the solution, and accordingly it becomes very difficult to clarify the liquid simply by filtering. The difficulty is very often got over by a method which you have all heard of, and I dare say thought very nasty, I mean by the use of blood. Blood consists of two parts. When it is first drawn from the animal, if it is allowed to stand quietly by itself, it soon sets into a sort of clot; that arises from the passing of one constituent of the blood into a solid form; the fibrin, as it is called, becomes solid, and binds the whole mass into a clot—that is if the blood is allowed to stand still. If fresh drawn blood be stirred, the fibrin collects in a sort of thread, whence its name, and this can be all withdrawn from the mass, leaving behind a solution, somewhat coloured, of the other constituents of the blood, among which albumen, that is the same body as the white of egg, is the most important. I am going to show you the effect of putting this defibrinated blood into a solution of sugar. I might have used white of egg in the same way, but blood being more generally used (except in Russia), I thought I had better use it on this occasion, when you will see its effect in clarifying the solution. The solution ought to be at a temperature of about 120° or 140°. You can anticipate what will occur, if we mix a solution containing solid particles either with white of egg stirred up with water or with this albumenous portion of the blood, and then heat the liquid to near the boiling point. You know that white of egg sets when it is heated. If I mix, therefore, albumen of the blood with this solution of sugar, and then heat it up to the point at which the albumen will coagulate, there will be a sort of network of solid albumen formed, and that will entangle every particle of foreign matter in the solution, and, at the same time, there will be bubbles of air enclosed in it, and the mass will float up to the surface, forming a sort of scum. As it comes to the top it will carry with it the solid impurities contained in the sugar. I am now using a larger quantity than is used practically in sugar refining, for only two or three buckets full are used for several tons weight of sugar. After heating the solution to the temperature at which the albumen will coagulate, I will strain off the liquid, and I think we shall find that it will be, though still coloured, clear and transparent. When this has been performed in the "blow up" pans, as they are called, and the liquid has been blown up and clarified in this way, the scum has to be separated from the liquid. This cannot be done on a large scale by allowing the mass to stand, and straining the liquid off through a pipe, but another and more perfect mode has to be adopted. That is done by pressing the whole contents of these "blow up" pans through a series of bags made of twilled cotton cloth, each of which is placed inside another case of very coarse hemp material, which simply serves to hold the bag together, and being much smaller than the inside bag, causes the surface of the latter to lie in folds, which present a large filtering surface. On the table there is a specimen of one of these bags with its case; one end is attached to a pipe, through which the liquid runs down and fills the bag below, and passing through the folds of the bag, it runs out clear, leaving all solid matter behind. The liquid that passes through these bags is of course highly coloured, if it is a solution of anything like ordinary raw sugar. There is a specimen on the table of the result.

The liquid now passes into a series of iron cisterns, where it remains until it is wanted. When almost boiling hot, it is run into the top of an iron cistern, like a large steam boiler turned on end—a vessel made of cast-iron, perhaps 20 feet high by 7 feet in diameter, and capable of holding from 15 to 20 tons of animal charcoal. The liquor runs into the top of this cistern, which is nearly filled with animal charcoal, and gradually percolates downwards through it.

Now, I have shown you already one action of animal charcoal. You recollect that when a solution of dextrine passes through a column of animal charcoal, it loses its dextrine, and the solution of sugar in passing through the animal charcoal loses in like manner portions of the albuminous and gummy matters contained in it. But now I wish to show you another action which is very remarkable, and far more striking at first sight than the one I have mentioned. I refer to the power which animal charcoal has of absorbing from a solution many vegetable colouring matters. For the purpose of exhibiting this power, I will choose a solution of indigo, and show you its effect. The sugar, in passing through this column of animal charcoal, loses in great part the colouring matters which it originally had, and, at the same time, as I told you, some of the less visible but somewhat more important bodies of a gummy nature. Here are two solutions, one before going through animal charcoal, and one after, and you see the difference, though I have taken a not very favourable specimen, because the liquor had been running through for some time, and therefore the decolourising power of the charcoal had become to some extent exhausted. It is a very important matter to the refiner to get the solution of a good colour, and therefore great care is taken in this process. Now, to show you the effect of the charcoal on the solution of indigo:—I might have chosen carmel, which is practically burnt sugar, or many other colouring matters, such as cochineal, and it would have shown the same result. On putting into this solution of indigo some powdered animal charcoal, and boiling the two together for some minutes, and then filtering the liquid, you see that the charcoal has removed the colouring matter to a very considerable extent; and the same effect is produced on the sugar liquid on passing it through these large charcoal filters.

From these charcoal filters, the liquor, which is now almost colourless, passes to a vacuum pan, the mode of action of which I have already described. The solution is concentrated there until it becomes a super-saturated solution. It is then caused to crystallise, and the crystals are made to grow in size by the admission of fresh portions of the liquor into the pan from time to time, and the evaporation of the water belonging to that liquor, until the pan is nearly filled with a mixture of grains of sugar floating in a hot saturated solution of sugar, *plus* the impurities which still remain. When the "boiler" judges that the mass in the pan is of sufficient strength, he stops the process of evaporation by simply shutting the valve which communicates with the air-pump, and causes the boiling to cease. He then allows the temperature of the mass to rise some 20 or 30 degrees. Now, what is the effect of raising the temperature? As I have stated, and shown to you by experiments, water has a point of saturation for every soluble solid at each degree of temperature, and, as a rule—at any rate it is the case with sugar—the higher the temperature, the more of the solid matter will dissolve. Now, we had here a mass of crystals floating in a syrup, saturated at a temperature, say 150 degrees Fahr. Now, on raising the temperature of this mass, the water present in the syrup becomes capable of dissolving an increased proportion of sugar, and accordingly some small portion of these grains, or small crystals, passes again into solution; the syrup becomes more concentrated at the same time that it becomes hotter. This heated magma of crystals and syrup is now filled out as rapidly as may be into a series of moulds, which vary in size in different refineries. I have here a specimen of one of the smaller size, the shape of which will be familiar to you; they have an opening at the bottom, which can be readily closed or opened. In these moulds the mass is allowed to stand for a couple of days or so; first it stands for twenty-four hours, when it becomes entirely set into a hard cake.

How is it caused to set? We had a quantity of crystals of sugar floating in a very hot, saturated solution. The mass becomes cold, and what happens? The hot saturated solution deposits some of the body, which it held in virtue of its heat, and this sugar, deposited from the hot solution, forms round the crystals, and sticks them all together. It cements this quantity of crystals, and binds them into a firm mass. This loaf of sugar has been treated in this way. It was then sent up to the working floors; a pricker was put in to clear the opening, and the mass was allowed to drain for about two days. In the course of that time a considerable quantity of syrup has drained away from it, but, as you will notice, the sugar is by no means white. It consists of a porous mass of sugar crystals, penetrated all through by syrup. When it has drained away, it leaves an apparently dry mass of sugar, but stil soft and crumbling, although sufficiently hard to bear handling. This is not pure sugar yet, there are still crystals of sugar wetted with the syrup; although it is true this syrup is purer than that surrounding the crystals of raw sugar, still it is not a solution of pure sugar. Here is a specimen of the syrup that has drained away, though it may not be a fair specimen of that syrup from this mould, as it may have come from sugar of lower quality. Still the syrup is somewhat dark-coloured, and the darkness of the colour arises from the fact that when this apparently slightly coloured liquid, which I showed you before, is concentrated, a good deal of the water is removed, and a large portion of the sugar forms itself into essentially white crystals, so that all the remaining colouring matter, together with all the other impurities, has become accumulated in this portion which subsequently drained away. The syrup having drained away as much as possible, the loaf consists of sugar crystals wet with a solution of sugar *plus* the impurities which had not been removed by the previous processes. The refiner then has next to remove from this so-called "green loaf" the adhering syrup which contains the impurities; and the way he does it is to replace this impure syrup by a pure one. That is effected in this way. The loaf is kept in the mould, and on the surface a saturated solution of perfectly pure sugar—at least as perfectly pure as can be obtained on a large scale—is poured. Here is a specimen of a solution such as is actually employed in the refinery for that purpose. As this solution is already saturated before being poured on the face of the mould, there is no fear of the water present dissolving any of the sugar of the loaf. It gradually percolates down, and as it goes it displaces the green syrup still adhering to these crystals of sugar. It gradually pushes that out before it, and this clear liquid, the "fine liquor," as it is technically termed, is kept running on the face of the mould until the loaf is thoroughly purged from the original green syrup with which the mass was wetted. When the workmen know that is the case, they remove the rough surface from the face of the sugar by a fitting tool, and then it is in this state, and the loaf is then perfectly white, but still wet. The loaf I showed you before was wet with the coloured syrup, that has now been replaced by the clear one, but it is still wet, and all that has to be done is to finish draining it, and then to dry it thoroughly. This drying is accomplished by putting these loaves into large chambers, heated by steam, which are technically termed stoves. Although they are always heated by steam, they are nevertheless called stoves, so that whenever a fire happens in a sugar-house it is always said to commence in a stove. In these large chambers, heated by steam-pipes, the loaves are kept for four or five days, until they are thoroughly dry, when they are fit for the market. There is a loaf on the table, but it has not been in the stove, the wrong specimen having been sent by mistake; it has only been drained, but not dried. If it had been four or five days in the stove it would have been harder, but of course of the same quality. Of 100 lbs. weight of this sugar 99¾ lbs. would consist of absolutely pure sugar; indeed, I may say there is no loaf sugar which you buy which has not over 99½ per cent. of true sugar in it, so that you need not fear there is any great difference in the sweetening qualities of the various specimens of sugar, whether it be obtained from cane or beetroot.

I have now sketched an outline of the processes used in working up cane or beet-root sugar into the white loaf you see before you, but I daresay the question occurs to you, what becomes of all the syrup that has drained away. The syrup that drains away from the loaf in the first case is, as I showed you just now, somewhat lightly coloured, and contains some impurities. That is returned to the vacuum pan, and again concentrated until a certain amount of grain has been obtained in the pan. It is then allowed to stand for a few hours, and then passed into the centrifugal machine, to separate the grains from the syrup in which they float. This syrup is, of course, more impure than that employed, and consequently is much more sticky and darker in colour, and altogether less valuable for obtaining crystals from. However, a considerable quantity of sugar is actually obtained, but it has small and confused grains. I have here some such sugar as it comes from the centrifugal machine, and this we may take as the first product which is obtained from this syrup which has drained from the loaves. This consists of very small crystals, but if they are very small, for the same weight there must be a vastly increased surface, and as there is a greater surface, there is more room for the syrup to stick to, and consequently they will actually retain more syrup about them than crystals of a better quality. And not only so, but the syrup itself is more impure. Accordingly, this sugar is somewhat inferior in true sweetening power to what I showed you just now. This soft, yellow sugar contains a certain amount of impurities adhering to the crystals, but still contains 87 to 93 per cent. of pure sugar, and 3 to 7 per cent. of altered sugar possessed of sweetening powers, the remainder consisting of 3 to 5 per cent. of water, and a small quantity of salts and colouring matter. It is quite clean and wholesome, and only differs from raw sugar in having a better colour, and in being free from insoluble impurities. In sweetening power it is only inferior to loaf, *i.e.*, pure sugar as 9 or 9½ is less than 10.

From this first soft, yellow sugar, a syrup has been drained away, which is still darker in colour than that which I have just referred to. This, in its turn, is concentrated, but, of course, it is a highly impure solution, and contains a great quantity of sticky bodies and salts of various kinds—common salt and gummy bodies of different kinds. Still, however, it contains sugar; therefore it is concentrated, and the liquid, which contains generally a very small proportion of grain in the pan, is allowed to stand in tanks for several days. At the end of that time, the syrup, or jelly as it is called, is filled with a number of grains of sugar. These are separated by a centrifugal machine, and there is then a second quality of brown sugar produced in this way. Here, again, you have still smaller crystals, as a rule, and they are surrounded with an excessively impure syrup, so that this sugar is really much more impure than the last, as well as darker in colour. I shall have to say a word on the impurities present in it, and in this I believe I am somewhat singular in my views. I believe the sugar present is not merely pure sugar wetted with a solution or syrup, but I believe in this case some of the impurities are actually in combination with the grains of sugar. Then, what becomes of the syrup from this last process? It is now so impure, and contains so large a proportion of bodies which are not sugar at all, that practically it is not worth any one's while to try and get the sugar out of it. Therefore, the syrup from this last portion, a very thick and dark-coloured body, is boiled with water, and allowed to cool, when it is called treacle. I have been asked what is the difference between treacle and golden syrup, and I may say that golden syrup is nothing but treacle passed through animal charcoal and made a little brighter.

Now, I come to the great question of what is treacle? This was a moot point for a long time. Molasses, whether from cane or from beetroot, possess very much the same properties, and the explanation of their constitution rests on the same basis. Taking refinery treacle as my example, I must first tell you what it consists of. Treacle contains, speaking roughly, about 35 per cent. of true sugar, about 30 per cent. of that inverted or uncrystallisable sugar which is produced by the action of acids or ferments upon cane sugar, about 20 per cent. of water, and about 15 per cent. of bodies that we know little or nothing about, but which we may class under the general name of dirt, but which certainly include many salts of potash and soda. Then you may say, as it contains 35 per cent. of crystallisable cane sugar, why is not that got out in a saleable form and sent into the market. Practically, it cannot be done. It is true that this solution still contains water, and we may regard the syrup therefore simply as a saturated solution of these various bodies in water, and the question is, Why don't you continue the operations which were previously performed, and drive off from the treacle, by means of heat in a suitable apparatus, some of the water, making the solution into a super-saturated one, allow it to stand, and then separate the remaining mother liquid from the crystals which were formed? Practically, you cannot do it. You have not got merely sugar and water, but other bodies, which require water to hold them in solution; especially those bodies which I call dirt are mostly uncrystallisable, gummy bodies and salts, and you have besides that this uncrystallisable sugar; and all these bodies require a certain amount of water to keep them in solution. If you drive off the water which is required to hold them in solution, you convert this stuff into something like hard-bake. Now, if you had a quantity of hard-bake or toffee with crystals of sugar dispersed through it, it would not be a very promising task to get the crystals out of the mass, and that is what, practically, you would have to do if you tried to concentrate the treacle much further. Evaporation has been carried to such a point that if you drive more of the water out, the impurities, or those bodies which are not sugar, will simply set solid, and prevent the recovery of any sugar crystals that might be formed, even if you could get them to form. Moreover, even if you were not to drive it to this extreme point, but merely drove off some, and so contented yourself with a very small yield of sugar, you are met by this difficulty, that when sugar is held in a solution containing alkaline, salts, chlorides, nitrates, and so on, of sodium and potassium, it actually forms combination with these salts, and these compounds are bodies which, although they do crystallise, do so with such extreme slowness that, unless you could allow the concentrated mass to stand for a very unreasonable time, it would still all remain fluid, and accordingly you are practically unable to win more sugar from molasses on a large scale than is actually done. Of course, in a laboratory experiment it is a different matter, and there possibly you might obtain the whole of the sugar.

I have now treated as fully as I can of the processes to which sugar is submitted in the refinery, although, as I told you, I have not been able to enter into the technical details. I have, therefore, only now to thank you most heartily for the kind attention with which you have listened to the remarks I have made on the various manufacturing operations connected with sugar.

A vote of thanks to the lecturer was passed on the motion of Vice-Admiral Ommanney, the chairman of the evening.

ANNOUNCEMENTS BY THE COUNCIL.

FOOD COMMITTEE.

This Committee met on Wednesday, the 17th, at four o'clock. Present—Messrs. Benjamin Shaw (in the chair), F. A. Abel, F.R.S., Professor Bentley, W. H. Michael, H. A. Pitman, M.D., Edward B. Savile, and James A. Youl. The Committee, amongst other things, took into consideration the letter from Her Majesty's

Commissioners in reference to the Food Division of the International Exhibition of 1873. It was referred to a Sub-committee to consider and report in what way the Committee can best aid in securing a good representation of this division of the Exhibition.

CHANNEL PASSAGE.

The Committee met on Tuesday, the 16th January, at three o'clock. Present—Messrs. Seymour Teulon, Vice-Chairman of Council (in the chair), F. A. Abel, Edwin Chadwick, C.B., C. W. Eborall, Grosvenor Hodgkinson, M.P., Vice-Admiral Ommanney, C.B., F.R.S., and Captain R. Scott, R.N. The Committee had before them drawings and sections, and full particulars of the boats now employed by the South Eastern Railway and the London, Chatham, and Dover Railway Companies.

INDIA COMMITTEE.

Conferences will be held on Friday evenings as follows:—

January 26th.—"On the Route to Western and South Western China by the Irriwadi and other Rivers of India, and the Commercial Advantages attached to it." The Conference will be opened by Commander F. E. Manners, and will commence at 8 o'clock.

February 23rd.—"On India as a Field for Private Enterprise." The Conference will be opened by Frederick Campbell, Esq., of Assam.

CANTOR LECTURES.

The Second Course of Cantor Lectures for the Session will be delivered by the Rev. Arthur Rigg, M.A., on "Mechanism." The first lecture will be given on Monday evening, February 5th, at Eight o'clock. Tickets for the course will be forwarded with the *Journal*.

Lecture I.—Monday, 5th February, 1872.

Structures, Machines, and Mechanism—Equilibrium and Motion—Force and Motion—Kinetics and Kinematics—Various motions required—Classification of Mechanism—Early contrivances.

Lecture II.—Monday, 12th February, 1872.

Motions produced by Rolling—Forms of Wheels—Circular, Elliptic, Logarithmic, and Lobe Wheels—Mangle Wheels—Star Wheels—Examples.

Lecture III.—Monday, 19th February, 1872.

Motions produced by Sliding—Forms of Teeth on Wheels—Teeth for Velocity—Teeth for Power—Cams—Screws—Worm Wheels—Examples.

Lecture IV.—Monday, 26th February, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies—Cam Pullies—Shafts not parallel—High Velocity Cords—Fusees—Illustrations.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links—Cranks—Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

THE LIBRARY.

The following books have been presented to the Library:—

Ninth report of the Board of Education of Victoria.

Patents and Patentees granted in Victoria, from 1854 to 1866 inclusive.

Abstract of Specification of Patents applied for in Victoria, from 1854 to 1866 inclusive. Ac to Bu. Illustrated by copies taken from the original drawings.

Indices of Patents in Victoria, for the years 1867-8-9.

All the above presented by William Henry Archer, Registrar-General for Victoria.

How to Publish a Book, by Ernest Spon. Presented by the author.

Cobden Club Essays, (second series, 1871-2). Presented by the Club.

Appel aux Amis de l'Industrie et de l'Invention. Presented by M. l'Abbé Moigno.

Journal of the Anthropological Institute of New York. Vol. 1. No. 1.

The Educational Calendar, for 1872.

Transactions of the Linnean Society of London. Vol. 27, part 4, and Vol. 28, Part 1. Presented by the Society.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, R.E., secretary.

Photography, as a fine art, will be represented at the forthcoming International Exhibition. Intending exhibitors should obtain and fill up a form of preliminary application; other forms, for labels, &c., may also be obtained from the Exhibition offices at Upper Kensington-gore. The exhibition will be restricted to such photographs as have been executed within the year preceding the date on which they must be delivered, viz., the 13th of March next. Immediately after their receipt, a committee, consisting of the following gentlemen—Dr. Diamond, Mr. R. A. Thompson, and Lieut.-Colonel Stuart Wortley, will commence the work of selection. The selected specimens will be arranged by the Exhibition officials. The exact *locale* of the photographs has not yet been determined on, but it is probable that they will find a place in one of the lower quadrant arcades, which are now being tiled and prepared for this year's Exhibition.

THE DUKE OF EDINBURGH'S COLLECTION AT THE SOUTH KENSINGTON MUSEUM.

By the permission of H.R.H. the Duke of Edinburgh, the collection which has been formed by His Royal Highness during his cruises in different parts of the world, has been sent to the South Kensington Museum, to be exhibited there for the next two or three months. The *private view* of this assemblage of mementoes will take place on Wednesday evening, the 24th instant, from eight to twelve o'clock. The objects and drawings have been arranged in the north court of the museum, where they fill many glass cases and cover many screens. Mr. Oswald Brierly and M. Chevalier are the artists who produced the drawings and sketches of the various places visited, and of the incidents which occurred during the cruises. Both these gentlemen accompanied His Royal Highness in his travels.

The present notice is intended to convey merely a general idea of the character of the collection. The individual divisions of it may possibly be hereafter described in detail.

In January, 1867, H.M.S. *Galatea* was commissioned by Captain H.R.H. the Duke of Edinburgh; and the enlarged copy of the track chart, which has been especially prepared for the edification of visitors, shows the tracks of the different cruises accomplished during the years 1867–71.

After spending some time in the Mediterranean, his Royal Highness proceeded to Rio Janeiro, which port was left on the 16th of August for the Cape of Good Hope.

Cape of Good Hope.

Whilst here his Royal Highness went out elephant shooting, and of this event there is an oil-painting by Mr. Brierly. The splendid head and tusks of the huge beast which afforded most exciting sport to the Duke are exhibited. A vivid account of the elephant-hunt, written by the Prince to his brother, the Prince of Wales, has been published (by permission) in the "Cruise of H.M.S. *Galatea*," by the Rev. John Milner and Mr. Oswald Brierly. Describing the time when the elephant was actually bearing down upon the hunting party, the Duke writes thus:—

"I had standing next on my right, George Rex, a farmer of the Knysna, and head man of the hunt, and faithful Smith, who never left me, close behind me, and close behind Rex stood Tom Rex, his brother, Archibald Duthie, and George Atkinson, also farmers of the neighbourhood. These four had settled to keep their fire to the last, and never fired. Next to George Rex stood Sir Walter Currie with (I can't call it a rifle) an enormous engine, No. 6, single-barrelled, and throwing a conical bullet about four to the pound; on my left, General Bisset, Captain Gordon, and Captain Taylor, the Military Secretary. That was the party. As soon as the elephant saw us, he gave up his chase and charged us. There was so much excitement prevailing, that I thought I had better wait as long as possible. The sight of this enormous beast towering above us, and coming on at this tremendous pace, which one can scarcely understand so unwieldly an animal in appearance going, was magnificent; his ears, which are three times as large as those of the Ceylon elephant, spread out square on each side. I could not help being reminded by it of a ship with studding sails on both sides. When he had reached about twenty-five yards from us, I fired at his head; the bullet struck, and he instantly seemed to stop himself as much as he could, and I gave him the shell just over the left eye, at which he swerved to the left and shook. Two or three others fired, and by this time he was nearly broadside on, when Sir Walter Currie's engine went off, with the bullet through his neck, and he rolled over, as I may say, at our feet, for seven yards was the outside he was from us as he lay, and we cheered lustily. He, however, continued struggling for some time, and I put four more bullets into his heart at about three yards. His height, as one measures a horse, was ten feet; the height of his head must, of course, be added to this; girth, 16 feet 6 inches; length from tip of trunk to tip of tail, 23 feet 5 inches."

From the Cape, the *Galatea* set out for Adelaide, which was reached on the 31st October.

Australia.

His Royal Highness made incursions into South-West Australia, stayed some time at Melbourne, and thence, *via* Tasmania, to Sydney. After remaining at this port (where a foul and dastardly attempt was made upon the life of His Royal Highness) nearly three months, viz., from 20th of January, 1868, to the 6th April, the *Galatea* commenced her homeward passage, the intention of touching at New Zealand, Honolulu, Valparaiso, the Falkland Islands, and some of the West India Islands, being relinquished upon the urgent advice of the doctor, who deemed it prudent for His Royal Highness to return to England as expeditiously as possible.

In the course of the foregoing cruise, collections, chiefly of birds, hunting trophies, native arms, and Australian silver work were formed.

Ornithological Collection.

Four cases are filled with birds. Two large ones are placed back to back, and there are two smaller ones at each end. Upwards of two hundred specimens represent the varieties of the feathered tribe in the portion of the southern hemisphere traversed by the *Galatea*. The beauty of the plumage is considerably enhanced by the picturesque arrangement of the birds. In one of the larger cases must be noted a very fine albatross with outstretched wings, measuring, from tip to tip, nearly 10 feet. When the bird was alive, this extent was greater by a foot, perhaps.

Testimonials, &c.

The trowels, mallets, &c., which afford pleasing evidence of the many laudable works initiated under the personal patronage of the Duke whilst in Australia, completely fill a sloping glass case. Near them is another case, containing nothing else than presentation caskets, addresses, testimonials, silver epergnes, &c. These are examples of the careful workmanship of Australian silversmiths. The art in them is perhaps not so good as could be desired, it being chiefly composed of natural representations of kangaroos and other animals, trees, and leaves applied as decoration, and not treated, as might be judged to be in better style, in a conventional manner.

In 1869, after returning to England, the *Galatea* again commenced a new cruise. This time the eastern hemisphere was the principal part of the world visited. During the three years, from 1869 to 1871, the following places were successively stayed at by the Duke:—The Cape, Ceylon, Madras, Calcutta, Bombay, the Philippine Islands, Hongkong, Nanking, the Japanese Archipelago, the Sandwich Islands, New Zealand, Falkland Islands, and Monte Video.

The objects serving as records of these places worthily represent the artistic abilities of the various nationalities.

Japanese Collection.

The Japanese element predominates. The lac-ware is strongly represented; a small, sloping desk, presented by the Mikado to his Royal Highness, is of old manufacture, and is especially remarkable. Below it is placed the autograph of the Mikado, written in black characters upon a gold be-sprinkled card. This sets forth, not only the Mikado's name, but also his imperial titles, &c. A dagger lying in front of this autograph is interesting from the fact that the Mikado himself designed, or prompted the design of it. The sheath is of lac work tipped with gold. The handle is of ivory, finely granulated in order to secure a good grip by the hand of the weapon.

Amongst the bronze work is a marvellous piece, about 300 years old, also a present from the Mikado. It is an incense burner, standing upon a naturalistic treatment of rugged rocks. Round the bowl is a representation of some event—probably taken from Japanese mythology —while the cover is made of a grouping of foliage, in which stand a cock and a hen. The entire bronze work surmounts a handsome, red wood, carved stand. The elaborate character of this work, of which the carrying out must have spread over a considerable period, cannot fail to excite the highest admiration. The mode of its execution is difficult to speculate upon; some parts may have been cast and then chased, though the undercutting which abounds throughout seems to point to its having been carved from a single piece of bronze. It is impossible to detect any seams or joinings.

Two or three cases are filled with Japanese and Chinese porcelain, amongst which should be remarked a grotesque tiger or cat, covered with a *sang de bœuf* glaze. Important in size and beauty are two vases about

4½ to 5½ feet in height. The ground of them is chiefly of blue dragons.

Japanese drawings are becoming well-known in England, but it is rare that any so beautifully executed are to be met with as the drawings of landscapes and ceremonials, diagrams of flowers, of birds, of fishes, and portraits, which occupy two glass cases.

Above a robe, of a graduated grey tone, with embroidered border of figures and flowers, is a painting on gold sprinkled paper. The incident depicted is a procession of grasshoppers, in the centre of which is the lady insect borne in a kind of "palki or palanquin," preceding the magnate, who is surrounded by his suite of nobles. The painting, as might be expected, is very descriptive, and every insect possesses an individuality which is most humorous.

Amongst the Japanese embroideries is a royal robe, in deep maroon silk, embroidered with the Imperial dragon. The dragon is to be constantly found in robes of this kind, used for State and other ceremonials; but none except a royal personage may possess a robe on which the dragon has more than four claws. The embroidery in question shows the dragon with five claws. At the foot of the case containing this robe is an album, of which the cover is an exquisite specimen of delicate embroidery in silks. All the paintings inside the album are upon rice paper, and are of a high class of artistic work.

Chinese Collection.

China sends some good bits of porcelain, and some dark wood and marble furniture. The toys are capital, the attitudes of the dolls being natural and at the same time amusing by their quaintness.

Indian Collection.

From India are several sumptuous embroideries, jewelled swords and weapons, &c. In the trophy of arms is a sword remarkable for the treatment of its blade, which is pierced by a series of circles, into which are loosely placed pearls. They are secured from falling out by the inner grooves of the circles. On each side of a fine red and gold velvet rug are two pairs of chowries. One pair is carved out of two blocks of sandal wood; the other one of two blocks of ivory. They are, however, unsuitable for use, as the slightest shake causes the delicately cut strips or hairs to snap off.

Muttra contributes a series of little bronze Hindoo gods, ornamented with dabs of red sealing wax. One of these represents Krishna as a baby nursed by his mother. The group forms the centre of a small bronze bowl. This may be filled with water, but when the water approaches too near to the feet of the god it gradually sinks down, passing away by a hole in the base of the bowl. The hole, to all appearances, has no connection with the inside of the bowl, and, although to inquisitive unbelievers the application of a syphon in the interior of the god's throne suggests itself, still this little toy idol is held in reverence by the natives of India. From Agra are a few comparatively unimportant specimens of the white marble mosaic work. Benares sends painted and carved alabaster gods.

From Bombay are some good examples of the sandal and inlaid wood and ivory boxes. Madras is represented by gold embroideries, near which are one or two pieces of Cingalese filagree work.

Sandwich Islands.

From the Sandwich Islands is a curious robe, looking more like a milliner's elaborated tissue paper pattern than a regal vestment, made at great trouble from the leaves of the plantain.

The Prince wore this on the occasion of a state reception which he held in the Sandwich Islands, of which M. Chevalier has made a painting.

The arms and weapons of the New Zealanders, and Sandwich Island natives are grouped into trophies.

Boat-head from Tahiti.

Of the objects from Tahiti, the most remarkable, perhaps, is the head of a war-boat. The ornamentation upon it bears a strong resemblance to the Runic style of carving; and the casts of the Norwegian doors from Sauland, early 12th century, which happen to be erected near the Prince's collection, afford a convenient opportunity for making a comparison between the styles of two art works executed at distinct periods, and at opposite ends of the world. The boat's-head is carved in wood, and the implement used was a sharp shell.

In concluding this cursory description of the Duke of Edinburgh's collection, it is scarcely necessary to again call attention to the sketches and drawings of Messrs. Brierly and Chevalier. They give much additional interest to the objects, and provide a comprehensive pictorial record of the cruises and incidents connected therewith, of H.R.H. the Duke of Edinburgh.

The exhibition will open to the public on the 25th of January.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

January 24th.—"On Improvements in the Process of Coining." By Ernest Seyd, Esq. On this evening, William Newmarch, Esq., F.R.S., will preside.

January 31st.—"On Individual Providence for Old Age as a National Question." By G. C. T. Bartley, Esq., Treasurer. On this evening, the Right Hon. the Earl of Derby will preside.

MEETINGS FOR THE ENSUING WEEK.

Mon.....Royal United Service Institution, 8½. Lieut.-Col. Fletcher, "The Employment of Mitrailleuses during the Recent War, and their use in Future Wars."
Social Science Association, 8. Discussion to be opened by Mr. G. W. Hastings on the Report of the Royal Sanitary Commission.
London Institution, 4. Professor Odling, "Elementary Chemistry."
Victoria Institute, 8. Mr. Ord, "On the Influence of Colloid Matters upon Crystalline Form."
Geographical, 8½. 1. Rev. Charles New, "Letter on an Ascent of Mount Kilimanjaro to the Snow-line." 2. Lieut. C. de Crespigny, "Explorations in Northern Borneo." 3. Dr. A. Rattray, "On the Island of Fernando Noronha."
Entomological, 7. Annual Meeting.
British Architects, 8.

Tues.....Royal Medical and Chirurgical, 8½.
Civil Engineers, 8. Mr. Charles Andrews, "On the Somerset Dock, Malta."

Wed.....**SOCIETY OF ARTS, 8.** Mr. Ernest Seyd, "On Im-Improvements in the Process of Coining."
Geological, 8. 1. Prof. T. Rupert Jones and Mr. W. K. Parker, "On the Foraminifera of the Family Rotalinæ (Carpenter) found in the Cretaceous Formations, with Notes on their Tertiary and Recent Representatives." 2. Rev. J. F. Blake, "On the Infra-Lias in Yorkshire." 3. M. D. M. d'Orueta, "Further Notes on the Geology of the neighbourhood of Malaga." Communicated by the President.
Royal Society of Literature, 8½.
Science and Art Department (South Kensington Museum), 2½. Professor Guthrie, "Elementary Physics and Chemistry."

Thurs...Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.
Society for the Encouragement of Fine Arts, 8. Dr. Zerffi, "On Mexican Art."
London Institution, 7½. Musical Lecture.

Fri.......**SOCIETY OF ARTS, 8.** India Conference. Commander Manners, "On the Route by the Irriwadi to West and South-West China."
Royal Institution, 9.
Quekett Club 8.

Sat.......Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."
Royal Botanic, 3¾.

Journal of the Society of Arts.

No. 1,001. Vol. XX.

FRIDAY, JANUARY 26, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

H.R.H. THE PRESIDENT.

The Council have placed in the hands of the Secretary of State for the Home Department the following Address of Congratulation to Her Majesty the Queen, on the recovery of H.R.H. the Prince of Wales from his late dangerous illness:—

To the Queen's Most Excellent Majesty.

The Humble Address of the Society for the Encouragement of Arts, Manufactures, and Commerce.

We, the Members of the Society for the Encouragement of Arts, Manufactures, and Commerce, desire to approach Your Majesty with our heartfelt congratulations on the recovery of our President, His Royal Highness the Prince of Wales, from the late dangerous illness with which he has been visited. We have deeply sympathised with Your Majesty and Her Royal Highness the Princess of Wales during the sad and anxious hours which have been passed, and we earnestly pray that His Royal Highness's health may soon be completely restored, and that His Royal Highness may be preserved a comfort to your Majesty and Her Royal Highness the Princess of Wales for many years to come.

Sealed with the Seal of the Society for the Encouragement of Arts, Manufactures, and Commerce, this 24th day of January, 1872, in the presence of

L.S.

P. LE NEVE FOSTER.
Secretary.

The Council have also passed a resolution of congratulation to H.R.H. the Prince of Wales, and have directed the following letter, conveying the same, to be transmitted to General Sir Wm. Knollys:—

23rd January, 1872.

Sir,—I am directed to request that you will be good enough to lay before His Royal Highness the Prince of Wales, the following resolution, passed by the Council of this Society at its last meeting:—

Resolved—"That the Council desire to record the deep satisfaction with which they have learnt that the recovery of their President, His Royal Highness the Prince of Wales, from his late dangerous illness may now be considered as established; and the Council desire to express their hearty congratulations thereon to their Royal Highnesses the Prince and Princess of Wales."

I have the honour to be, Sir,
Your obedient servant,
(Signed) P. Le Neve Foster,
Secretary.

General Sir William Knollys, K.C.B.,
Marlborough-house, S.W.

COMPLETION OF THE TELEGRAPHIC SYSTEM.

The Council have presented to the Prime Minister the following memorial, urging on the government the importance of at once purchasing and taking into their hands the ocean telegraphs, and consolidating the same with the internal telegraph service under the management of the Post-office:—

To the Right Hon. William Ewart Gladstone, M.P.
First Lord of the Treasury.

The Memorial of the Society for the Encouragement of Arts, Manufactures, and Commerce,

Sheweth—That this Society, acting in the interest of Arts, Manufactures, and Commerce, was one of the earliest, if not the earliest, to recognise the importance, and recommend the adoption, of the system of telegraphic communication by the government as part of the postal system of the kingdom, grounded upon the following considerations, viz.:—

That all means of internal communication, by telegraph as well as by post, ought to be under unity of administration, and that administration a public one, responsible to the public for the due performance of the service required.

That by the consolidation of the several competing trading companies' establishments under unity of public management, a capital might be saved; that this saved capital might be divided between the public and the shareholders; that to the public might be given a more complete service, by the extension of branch lines, which would not pay to the trading companies, but which would pay to the public, by utilising the existing establishments of the letter post, and that the public might be further benefited by reduced postage from shortened distances from the more numerous establishments, and also by generally reduced rates. That the effect of the improvements contended for would be to quicken all the operations of manufactures and commerce, and especially to benefit the retail traders of the country, by reducing stocks, and enabling them to send for goods, fresh and fresh, as they were wanted.

That to the shareholders might be given a price to compensate them for the risks they had undertaken, and for compulsory purchase.

Your memorialists submit that these several large conditions have been fully realised, so far as the adoption of the internal telegraphs as part of the postal system has proceeded; and that the advantages promised to the public from the measures first advocated in the proceedings of the Society are in due course of extension, especially those with relation to the retail trade of the country, in the reduction of the expense of stocks, particularly of perishable commodities.

That whilst acknowledging to the fullest extent the great advantages which private enterprise in ocean telegraphy has already conferred on the Arts, Manufactures, and Commerce of the country, your memorialists submit that the full benefit of such undertakings can only be realised to the public by placing the service in the hands of the government, to be administered as part of and in connection with the internal service, and for the following reasons, viz.:—

Under the existing conditions of external telegraphic communication, the charges are so high as very much to restrict the advantages of early telegraphic information to a few large firms, and to large transactions of thousands of pounds, whereas it ought to be habitually available for transactions of hundreds of pounds, or of smaller amounts. Moreover, cheap telegraphy tends to equalise information and to check undue speculation. Much of the "rebound of the revenue," which has excited astonishment, is due to what has already been done, by the improvement of the postal system for quickening information, as well as by the speeding of transit, to enable more transactions to be completed than heretofore within the same time.

That the existing conditions practically exclude the use of the telegraph for social information. As, for example, the charge of £4 10s. for the short sentence of a telegram sent to India practically excludes the use of the telegraph, in a great majority of instances, for the announcement of appointments, departures, arrivals, removals, marriages, deaths, and births, and speedy instructions on social affairs.

That the like obstructions are experienced in our relations with Canada and the United States of America, where it may be easily shown that, with the same submarine cables, double the amount of service might be rendered by a public postal telegraph system; for recently, while two out of the three cables were disabled, the entire work was performed by one, and that one the least perfect of the three.

That the existing rates for communication by submarine telegrams, by enforcing shortness, often render them dark, enigmatical, and confused, instead of clear and precise. They also greatly restrict public information through the public press. It is estimated that one-fourth the existing rates of charge to the United States would be remunerative as a public postal service.

That for intercolonial as well as for international communication, extensions of submarine cables are required, like the internal postal telegraph extensions now in progress—extensions which will not pay for separate private establishments for a trading profit; but which will pay by utilising the existing public postal establishments as part of the general public service through the post, conducted by a general responsible public administration. For example, extensions are much needed from Newfoundland to the West Indies, for the service of our naval station as well as our commerce there. Extensions are also needed through Canada and the British possessions to the Pacific. Be the duration of the submarine cables long or short—be the risks attending them what they may—it is submitted that the present necessities of our Arts, Manufactures, and Commerce must require them to be undertaken; and that the government can do so as a public service more cheaply than they can be undertaken as a private enterprise. For the government may undertake them at a cost of less than four per cent., while private individuals could not be expected to undertake them at less than 10 per cent. Private individuals must, moreover, engage separate special scientific service and vessels, whilst the government may utilise the services of the ships of the Royal Navy, and also of their naval officers, whose services in recovering the deep Atlantic lines displayed high nautical skill, peculiarly eligible for maintaining and extending this great means of international communication. The government may also render the scientific corps available for the service, and for the completion of the coast lines of telegraph for military as well as for naval purposes, and especially for the use of the mercantile marine on occasions of storms.

Your memorialists submit that, looking to the position of this great empire, it will be evident that it is of the highest importance that the population, foremost in industry and energy, should not be behind other nations with quick information for its proper action.

That it is, moreover, essential for the proper advancement of telegraphic communication that it should be under unity of management and responsibility to the public, it being impossible that there should not be clashing and bad working under divided and independent managements, such as those of the several trading submarine cable companies and the public internal postal service.

That experience has demonstrated to the government of the United States the expediency of following the example of this country in connecting the telegraphic with the public postal service; and, inasmuch as with that country, as with others, the effect of putting the international telegraph system on a public and responsible footing would be of the greatest commercial and social advantage, by reducing the charges on both sides, concurrent governmental action to that end may be confidently anticipated.

That as a telegraphic communication was first practically developed in this country, it may be claimed as due to its position, as the chief maritime country in the world, that it should initiate and complete the requisite change in question for the advantage of all nations.

Your memorialists have understood that it was in contemplation to have taken the submarine trading lines at the time of the purchase of the internal lines of the country, but that the state of public business in Parliament only permitted the attempt to pass a one-sided measure.

Your memorialists submit that there is every reason for the immediate practical completion of the measure, and that such a step is inevitable. That such being the case, all delay must be at the public expense, in purchasing up and increasing private and multiplied investments, which it will be obvious, ought no longer to be allowed to be made.

Exception was taken to the terms of the purchase of the internal private trading companies as excessive; and the exception may, in some instances, have been well founded. But the great bulk of that purchase-money may, nevertheless, be properly considered as a penalty for the governmental neglect to purchase the telegraphs when demonstration of the necessity of the measure, and applications were made for it ten years before, but were neglected; and it is manifest that a delay of another session of the internal portion of the measure at last adopted would have been more than countervailed by the increase of price on the accustomed terms of a compulsory purchase occasioned by further delay. It is fair and just, however, to observe of the existing investments in the submarine lines, that the great risks incurred with unexampled bravery, for the attainment of the greatest scientific achievement of this age, peculiarly entitle the capitalists representing it to a liberal compensation for benefits conferred on the public, similar to those already derived, in augmenting proportions, from the internal postal telegraphs.

On these several grounds your memorialists urge on Her Majesty's Government the completion, without delay, of a proper external as well as internal system of public postal telegraphy, by the acquisition, on recognised terms of compulsory purchase, of all the existing submarine lines of cable, and consolidating the same with the general postal system of this country.

And your memorialists will ever pray, &c.

Sealed with the Seal of the Society for the Encouragement of Arts, Manufactures, and Commerce, this 22nd day of January, 1872, in the presence of (L.S.)

P. LE NEVE FOSTER,
Secretary.

CHANNEL PASSAGE.

The Committee met on Tuesday last, at three o'clock. Present—Messrs. Seymour Teulon (in the chair), F. A. Abel, F.R.S., E. Chadwick, C.B., Capt. Donnelly, R.E., Major-General Eardley-Wilmot, Vice-Admiral Ommanney, C.B., F.R.S., and Capt. Robt. Scott, R.N.

Mr. Henry Cole, C.B., attended, and gave evidence as to the inconveniences and shortcomings of the existing arrangements. This evidence will be given in detail in a future *Journal.*

CANTOR LECTURES.

The Second Course of Cantor Lectures for the Session will be delivered by the Rev. ARTHUR RIGG, M.A., on "Mechanism." The first lecture will be given on Monday evening, February 5th, at Eight o'clock. Tickets for the course are forwarded with this *Journal.*

LECTURE I.—MONDAY, 5TH FEBRUARY, 1872.

Structures, Machines, and Mechanism—Equilibrium and Motion—Force and Motion—Kinetics and Kinematics—Various motions required—Classification of Mechanism—Early contrivances.

LECTURE II.—MONDAY, 12TH FEBRUARY, 1872.

Motions produced by Rolling—Forms of Wheels—Circular, Elliptic, Logarithmic, and Lobe Wheels—Mangle Wheels—Star Wheels—Examples.

LECTURE III.—MONDAY, 19TH FEBRUARY, 1872.

Motions produced by Sliding—Forms of Teeth on Wheels—Teeth for Velocity—Teeth for Power—Cams—Screws—Worm Wheels—Examples.

LECTURE IV.—MONDAY, 26TH FEBRUARY, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies — Cam Pullies — Shafts not parallel — High Velocity Cords—Fusees—Illustrations.

LECTURE V.—MONDAY, 4TH MARCH, 1872.

Motions produced by Links—Cranks—Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

LECTURE VI.—MONDAY, 11TH MARCH, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

THE LIBRARY.

The following books have been presented to the Library :—

Drawing for Stonemasons. By Ellis A. Davidson. Presented by Messrs. Cassell, Petter, and Galpin.

Gothic Stonework. By Ellis A. Davidson. Presented by Messrs. Cassell, Petter, and Galpin.

The Land Question. By William Botly. Presented by the author.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

SEVENTH ORDINARY MEETING.

Wednesday, January 24th, 1872; WILLIAM NEWMARCH, Esq., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society :—

His Royal Highness the Duke of Edinburgh, K.G., Clarence-house, St. James's, S.W.
Cowper, Charles, 3, Westminster-chambers, Victoria-street, S.W.
Dicksee, Rev. Samuel J. C., D.D., Malden-college, New Malden, Surrey.
Fennessy, Rodney J., 39, Old Broad-street, E.C.
Ginner, Samuel G., M.D., 166, Lambeth-walk, S.E.
Griffiths, John George, 119, King Henry's-road, N.W.
Kennedy, Thomas P., 62, Milton-road, Stoke Newington, N.
Nelson, E. M., 43, Little Britain, E.C.
Rothschild, Baroness Meyer de, 107, Piccadilly, W., and Mentmore, Leighton Buzzard.
Samuelson, Henry B., M.P., 69, Prince's-gate, W.
Sanderson, George, 75, Sloane-street, S.W.
Saw, Samuel, Upper Park-street, Greenwich.

The following candidates were balloted for, and duly elected members of the Society :—

Baker, Benj. Bloomfield, Roupell-park, Streatham, S.W.
Coddington, Thos. Butler, 9, Kensington-park-gardens.
Collcutt, Thomas Edward, 12, Finsbury-place south, E.C., and Elsfield-lodge, Ravenscourt-park, W.
Fildes, James, 44, Spring-gardens, Manchester.
Haworth, Abraham, Pall-mall, & Strutt-st., Manchester.
Maher, Michael, 41, Upper Temple-street, Birmingham.
Miller, Lieut.-Col. James, 20, Hyde-park-gate South, W.
Torrens, Lieut.-Col. R. R., M.P., Holne, Ashburton.
Walker, Enoch, 4, Banbury-terrace, South Hackney, E.

The paper read was :—

IMPROVEMENTS IN THE PROCESS OF COINING.

By Ernest Seyd, Esq.

The subject which I have the honour to bring before you to-night concerns the art of manufacturing coin. There are many matters connected with money, and the principles involved in monetary science, of great interest to the inquirer; that of the mere mechanical process of turning irregular pieces—lumps and bars—of the precious metal into regular coins, deserves attention, because it is closely related to the question of "brassage," or charge for coining, and to that of "seignorage."

In the earliest times, nuggets of gold, of more or less fantastic shapes, were used as ornaments, and subsequently as valuable, exchanged for other commodities. Nuggets or gold-dust, melted, hammered, and twisted into shapes for ear-rings or bracelets, are still to be met with among the Indian and half-caste populations in the remote regions of South America and elsewhere.

It is unnecessary that I should enlarge upon the first introduction of coins among the ancients, but it can well be imagined that their processes of manufacturing were very primitive. Coins were cast in individual pieces, or hammered out flat, or they were cut off from circular rods. The impressions upon them were produced by placing the discs between two loose dies, and by driving the metal into the design with the blows of a hammer Small or large pieces of metal, among the semi-barbarous nations of the East, to this day merely bear on one side a rough stamp or seal, indicating their value. To within the last few years, the Japanese, the most ingenious mechanics of the Eastern nations, manufactured pieces of money by manual labour. They have lately established a mint at Yokohama, fitted with modern machinery.

These primitive processes were necessarily laborious and expensive, and so the old mints were in the habit of levying a charge, which may have ranged from 1 to 10 per cent. Gradually, however, the methods of manufacturing coin improved, and became less expensive, and here the first origin of seignorage, and its distinction from a mere charge for coining, becomes explicable. The coining authorities continued to levy the old charges, although they had effected considerable economies in the manufacturing; hence they realised handsome profits, so that the right of seignorage became an exceedingly valuable one. The abuses to which these rights of seignorage have given rise, until they led to national ruin and revolution, are matters of history.

In the 17th century, the French made the first important progress by the substitution of the rolling-mills, which flattened the metal between a pair of powerful iron rollers. The screw-press was subsequently brought into use, and improved forms of it are, even to this day, employed at the British and other mints. For medal work, not requiring speed, but careful and successive manipulation, the screw-press will indeed always remain the best. The first mint machinery of this kind was driven by water or by horse-power. The introduction of steam, as a matter of course, gave an immense impulse to the whole process, and all kinds of improvements brought the art of coining to its present comparative state of perfection.

In the best European mints, those of England and France for instance, the actual cost of coining gold is estimated at from one-sixth to one-fourth per cent.; that of silver at from three-fourths to one and a quarter per cent. Now, when such fractions as a quarter per cent. are mentioned, there may be some who are likely to exclaim, "Oh, this is so small as to be scarcely worth consideration;" yet on large sums a quarter per cent. will tell, and when the charge for coining is borne by the importer of bullion, whose profit on exchange transactions is frequently limited to less than one-tenth per cent., it becomes a very serious item, preventing the importation of bullion to a certain extent.

In England, we attach so much value to the identity between bullion and coin, that we profess actually to coin gold free of charge to the importer, at the expense of the State. We wish thereby to gain a firm contract basis, and we have thereby succeeded in becoming the bankers for international trade. Besides this, the identity between bullion and coin has the effect of keeping the coin in the country. The Chancellor of the Exchequer, it is true, alleged the contrary some time ago, saying "that other nations made a quarry out of our gold coinage because we coined for nothing;" and therefore he recommended the levying of a seignorage of 1 per cent., in order to make the coin dearer, as he thought, so that it should remain in the country. Now, in all countries where a high mintage is charged or seignorage is levied, the coin has the tendency of leaving the country, as in the case of the United States, where $\frac{1}{2}$ per cent. mintage is charged.

The total exports of British gold coin, and foreign gold coin and gold bullion, from this country are as follows:—

	British coin. Ounces.	Bullion and foreign coin. Ounces.
1858	391,528	2,893,514
1859	291,244	4,447,940
1860	837,846	3,233,424
1861	2,254,596	644,370
1862	1,365,031	2,746,854
1863	1,606,923	2,381,781
1864	1,289,271	2,188,206
1865	870,859	1,369,855
1866	1,029,108	2,291,419
1867	326,304	1,669,522
1868	945,353	2,284,165
1869	736,322	1,396,912
1870	1,075,955	1,470,497
1871	1,887,338	3,317,959
	14,907,678	32,336,418

We re-imported into the United Kingdom of our own coin:—

	Imports of British coin. Ounces.
1858	327,292
1859	370,985
1860	40,766
1861	177,119
1862	473,784
1863	386,859
1864	182,809
1865	557,446
1866	1,041,084
1867	543,298
1868	354,387
1869	658,500
1870	820,143
1871	702,738
	6,628,200

So that during this period 8,279,478 ounces in British coin, and 32,336,418 ounces in bullion were absorbed, one-fifth of the exports only being coin. It must be pointed out that the years 1861 to 1866 were abnormal, on account of the American war, and so were the years 1870 and 1871, on account of the German-French war. In ordinary times, the proportions, as the statement shows, are much less than one-fifth. Take out the years 1858-59-60, 1867-68-69, as years of peace, and account for the re-import of our coin, and it will appear that we exported but 1,200,000 ozs. of coin, against 20,000,000 ozs. of bullion. As a rule, the greater portion of the coin returns to us. The impression prevails that such returned coin is worn light by the foreigner at our expense. This is an error; for the consignees of these parcels of sovereigns are obliged to pay large sums into the bank, where the light pieces are cut, and the consignees take care that, in the account sales of the remittance, the foreigner is charged with the loss.

It must be borne in mind that our colonies, India, Canada, West Indies, and notably of late the Cape, for diamonds, have absorbed a large proportion of the eight millions of ounces of our gold coin, which remains there as currency.

Compare these statements with the exports and imports of gold bullion into the United States, where there is a high mintage charge:—

Imports of Gold into the United Kingdom from the United States.

	British Gold Coin.	American Gold Coin.	Bullion.
	Ounces.	Ounces.	Ounces.
1858	93,916	534,586	608,989
1859	46,854	1,290,002	802,508
1860	9,618	543,195	516,963
1861	3,226	1,822	5,403
1862	202,273	1,705,258	697,570
1863	136,735	1,627,175	224,076
1864	58,202	1,815,046	94,880
1865	39,124	888,725	218,201
1866	87,136	1,804,247	335,087
1867	20,596	1,034,757	266,790
1868	24,857	1,392,997	418,293
1869	79,828	292,322	107,546
1870	28,757	1,361,135	451,370
1871	24,468	1,440,245	146,481
	855,690	15,731,512	4,894,157

showing that the United States export more than three times as much coin as bullion to England, the proportion being 16 coin to 5 of bullion.

The imports from England into the United States are as follows:—

Exports of Gold from the United Kingdom to the United States.

	British Gold Coin.	American Gold Coin.	Bullion.
	Ounces.	Ounces.	Ounces.
1858	14,588	—	—
1859	2,568	—	—
1860	414,801	1,357	27,110
1861	1,730,860	63,333	83,326
1862	8,500	937	—
1863	3,234	7,136	—
1864	11,428	36,876	—
1865	13,822	1,906	—
1866	210,174	51,491	—
1867	8,207	8,410	—
1868	1,704	27.809	—
1869	195,324	76.220	—
1870	10,712	8.151	—
1871	20,973	7,710	163
	2,646,895	291,336	110,599

which shows that, out of the 15,000,000 of ounces of American coin sent away, only 291,000 ounces came back, and but 110,000 of bullion. Now, although the current of gold from the United States is generally in our favour, yet at times it turns in favour of America. Why, then, should foreign coin be sent there in preference to bullion? Simply because the tax of ½ per cent. of mintage prevents the importation of bullion; it makes bullion too cheap for export; hence it leaves the country before it is legitimately due, and makes it thus dear for re-importation.

These statements furnish proof that we export less coin than the nations which charge a seignorage, and that it is rather ourselves who "make a quarry" for our own benefit out of such supplies of coin. We, in England, have consequently good reason for adhering to free or cheap mintage, so as to maintain the utmost identity between coin and bullion.

Now, independently of this controversy in regard to seignorage, or that whether the State or the importer should bear the actual cost of coining, the question, "How cheaply can we convert bullion into coin?" remains important in either case.

This involves the further question, "Are the modern mints all that can be desired, in reference to economy and speed, in manufacturing coin?" Is the coin turned out by them beyond the reach of improvement? Are their processes, and the machinery used, as perfect as they should be? It cannot be expected that they should be; for, although a great advance has taken place in all that concerns mechanical arts, State mints suffer from the disadvantage of being monopolies, not liable to the healthy influence of competition. A private manufacturer, in seeing or discovering improvements, can throw aside his old machines and use better ones, but the director of a mint cannot make alterations without the authority of the government, which shuns outlays of that kind. It may also be said that government institutions generally are not anxious to bring about economical reforms. It can be shown that in the present processes of coining considerable improvements may be introduced. The subject is a technical one, but I will endeavour to make it clear to readers not versed in the technical processes; for, by so doing, the public, as well as the legislators, may better appreciate the necessity for making these reforms. The principal technical points involved concern facts respecting the temper of medals, with which every fairly-instructed person is acquainted, the rest are matters of *rationale* in mechanics easily appreciated.

The conversion of gold and silver bullion into coin takes place in three principal stages:—

1st. The metal is standarded, *i.e.*, the proper quantity of alloy is added to it, when it is melted for casting.

2nd. The bars, of a certain shape, are rolled between powerful steel rollers, in order to flatten them out, until they obtain the thickness equal to that of the coin, when round discs, of the size required, are punched out of them by a machine.

3rd. The discs (blanks or planchets) are, to all intents and purposes, money, but they require the impression to render them current. This impresssion is given to them under the coining press.

The first proceeding, the standarding and melting down, requires no improvement, excepting, perhaps, the use of gas for melting instead of coke. Gas can be made at the mint without requiring much refining; the manipulations connected with its use in the mint are much cleaner and more regular.

The third process, that of stamping the coins, is also a simple one. The British Mint uses the old complicated screw-presses, which deliver a heavy and short blow, making a great noise. The modern lever presses, working silently, but with the more gradual, though intensely powerful pressure, ought to be used instead. I recommended these machines in my book on "Bullion and Foreign Exchanges," in 1868; and, with the re-building of the mint, they will, no doubt, be substituted for the present machines.

The second process, that of casting and rolling the bars, so as to obtain from them the "blanks," or uncoined pieces of money, is the most laborious and expensive in the business of minting, and to that I wish to call your special attention.

The metal, after having been duly standarded, is cast into bars or rods, about 2 feet long by 1⅝ inch wide, and 1 inch thick. In the British Mint, the thickness has lately been reduced, while in foreign mints the bars or rods are shorter, flatter, and now and then still thinner; but, whatever the thickness may be, in the casting of these bars a practicable limit must be observed, and it seems agreed that ½ an inch is about that limit.

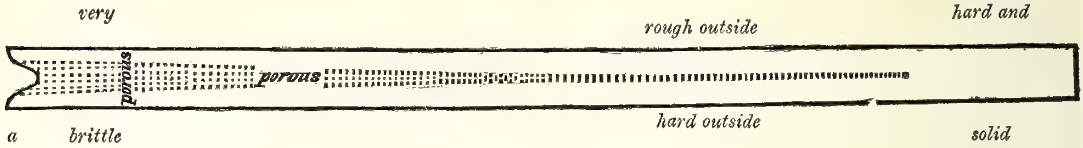
The bars are then passed through a succession of powerful rollers, in order to reduce them to the thickness of the coin, which, of the sovereign for instance, is about one-twentieth of an inch. Thus rolled, the bars are converted into flat fillets, or ribbons (as they are called), and the discs or planchets are punched out of them. These planchets are the pieces of money, requiring but the stamping process to render them fit for current coin. The discs, being all of the same size as regards diameter, it is also necessary that they should be of the same thickness, so that they may be of the same precise weight. It follows, therefore, that the ribbons of metal from which they are punched out should be of equal thickness throughout; and the degrees of exactness required for this purpose will be perceived, when I state that a difference of one ten-thousandth part of an inch makes the sovereign either too light or too heavy, and the piece must either be rejected or adjusted.

But even when the rolling is successful in rendering the ribbon accurate in thickness, there arises another difficulty. The density of the metal in the various parts may be different. All metals can be compressed, and on the spots where they are more condensed their specific gravity is greater than in other parts less compressed. Here, then, are the chief difficulties of the process. Elaborate and frequent successive rollings take place, during which the metal becomes brittle, and requires several annealings (an expensive and troublesome proceeding) to render it soft again, and fit for further working. Frequent gauging and tryings are required, in order to ascertain, at the various stages, how the work progresses, and many rejections are made before the fillets are pronounced fair work; and even when, in the end, the coins are punched out and checked over again, a proportion of from 20 to 25 per cent. still requires rejection, after all the care and trouble taken. The loss of time, power, and labour is thus considerable, and constitutes, as I said before, the chief expenditure attending the business of coining.

The light coins and other spoiled work, moreover, must all go back again to the melting-pot; the heavier pieces, to be sure, may be filed down. This filing down cannot well be done by machinery (although a creditable attempt has been made in that way), and hand-labour alone can properly adjust the overweight; and this is a most expensive and tedious process when millions of pieces are in question, and adds greatly to the cost of coining, not to speak of the loss of filings, which, in spite of all care and precaution, must take place. Nevertheless, several foreign mints use gangs of hands for this purpose, and work their planchets or blanks to a slight over-weight, relying upon the hand-adjustment and a lesser quantity of absolute rejections. The masters of these mints claim that they produce results superior to those of machine weighing, as in use at the British Mint, while the latter claims superiority for its own method, which consists of much greater endeavours to render the ribbons as accurate as possible, and subsequent weighing by Cotton's automaton balances (poising 20 pieces per minute), by which one-fourth to one-fifth of the coins are rejected. The elaborate process, the time, labour, and expense, with the final result of so large a proportion of useless work, seems to have settled down into a kind of fate, to which mint operations appear to be subjected; and if we have the right to presume that the mechanical progress of the age must have brought minting to a state of perfection, no more need be said about the matter. But I can show that the whole of these difficulties are caused by the unscientific and uncouth methods of casting and rolling now in use. Imposing and perfect as the machinery of a mint appears to a visitor, the scientific man and the engineer will, nevertheless, be able to appreciate the distinction between the present method of casting and rolling and the improved method, both of which I will now describe.

The Present Process (British Mint).

Casting.—The metal, standarded and in fusion, is poured into iron ingots forms, a series of which are held upright in an iron frame. The inside of these forms (for sovereigns) measures 1 inch thick by $1\frac{5}{8}$ wide, and 24 inches long; it is greased or oiled before the cast is made; and the forms are slightly warmed, but, in comparison to the great heat of the fluid gold, they are to all intents and purposes cold. Now, when the cast is made into these cold moulds, and the top at *a* (see sketch below) be watched during the second or so it takes in setting hard, it will be observed that, at the moment of setting, the centre of the surface suddenly sinks in, forming a funnel-shaped cavity of one-third to two-thirds of an inch in depth. The rapid contraction of the mass causes this movement, which is just as suddenly arrested as if in its purpose it were interrupted and stopped on the way.



It is natural that the molten metal, coming in contact with the bottom of the mould, should set first, and also that at the sides, touching the cold iron; the rest of the mass, in the interior of the cast, must consequently bear the whole effects of the contraction, which, arrested by further cooling, renders the interior of the bar less solid—more porous, so to speak—than the outside and the lower end. The annexed illustration will explain these effects, which vary in degree between the bottom and the top, and which may otherwise vary according to the degree of heat in the gold or in the forms, or the greater or lesser speed or regularity in the casting. The dotted lines represent the porous parts of the inside. Although the molecular structure of gold is too minute to admit of the verification of this fact by sight, even if the bar could be cut open by means which would not disarrange the soft face, yet that the cooling, as it thus takes place, must have the effect described, will be admitted by every chemist who knows how rapidly gold parts with heat. The microscope shows the holes plainly in the fracture, and traces of porosity are visible on the outside. The rapid cooling will also now and then enclose small air bubbles, which, when the metal is flattened out, render it leafy. The coins punched out from these parts sound dead, and must be rejected, but such dead-sounding pieces are frequently found in circulation.

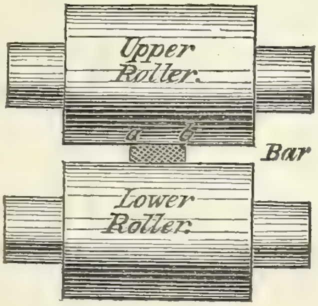
The cast bar, thus, at the beginning of its existence, has different degrees of solidity and hardness, while the subsequent immersion of the still red-hot piece in cold water has no effect on its structure, and but a partial influence on the differently tempered places. In ordinary castings and subsequent workings of gold or other metals for purposes different from minting, these differences in the quality would create no perceptible difficulty whatever; but when it is borne in mind that the "ribbons" to be rolled from the cast must be to less than the one ten-thousandth part of an inch exact, their importance will at once be seen.

The excessive greasing of the inside of the ingots forms causes irregularity and roughness on the sides of the bar, from the rapid burning or steaming of the oil in contact with the white-hot metal; also the insides of the moulds themselves become rough through oxidisation and other causes, so that a smooth cast from them cannot be expected after a few days' use. The moulds can be taken to pieces, but they are so constructed that they cannot well be smoothed down except by planing, and this cannot be often done, as it widens them.

The bars thus cast, instead of being of equal temper, structure, and density throughout, and perfectly smooth outside, present the following features:—They are hard and solid in some parts, which parts, in the subsequent rollings, will not press down as readily as the softer parts, and in any case they are likely to become more dense. The irregularities on the outside surface, occurring on hard or soft parts, will increase these differences. The porosity of the centre of these bars is especially noticeable with silver. Many of these silver bars split up under the roller, one-half curling off to the right, the other to the left.

It is proper for me here to state that Mr. Hill, the superintendent of the mint, has lately adopted $\frac{1}{2}$-inch bars for gold, which enable him to roll them out without annealing, and have otherwise proved satisfactory. But in the main points, as regards irregularities in the cooling, these bars are, on the whole, more liable to rapid contraction than the thicker ones, as must always be the case with thin castings.

Rolling.—The sovereign bars are either one or one-half inch thick, and require reduction to one-twentieth of an inch. They are passed between pairs of rollers, and by a successive narrowing of the space between these rollers they are gradually reduced. Supposing now that these rollers were perfectly rigid, not liable to bend in the slightest degree, the rolled piece passing between them would still be irregular, inasmuch as the different temper and structure of the cast exhibit various degrees of elasticity, which, however slight, in gold will assert itself. But the rollers are not rigid. In the first place, their pivots do not fit into the brasses with absolute firmness, so that when the bars are introduced, the upper roller is apt to jump up against the upper brasses, but they are actually liable to bend. The large rollers are, say, 12 inches thick and 18 inches long, and, as the accompanying illustration shows, the bar passes between, so that the full force of the enormous pressure is concentrated upon a width of 1½ to 2 inches, reacting with a leverage power of about 7 inches towards the pivots; under which such rollers, however strong apparently, must slightly bend; the consequence of which is that, instead of a perfectly parallel pressure, a pressure between two arches takes place, and the section of the fillets passing between the rollers is thicker in the middle than at the sides. Moreover, the rollers will spring or yield, as they have to deal with the varying resistance either of the hard, solid, and elastic, or the soft, more spongy, and compressible parts. Besides this, it is frequently the practice to run a single fillet continually near one edge, or one in the middle and another at the edge. A fillet thus run at the edge of the roller is thinner at the side nearest the pivot. Fillets so rolled, instead of running straight, will also frequently have a twist to one side.



Although steel rollers, 12 inches thick and 18 inches long, appear to be powerful agents, yet the fact that they must bend when they exercise so great a pressure upon 1½ or 2 inches of space between them cannot be denied; and it must be recollected that we have to deal here with the $\frac{1}{1000}$ and $\frac{1}{10000}$ parts of an inch. But the fact is beyond dispute, inasmuch as the worker of a mint always complains that the fillets get generally thicker in the middle than at the sides. No amount of annealing, careful and progressive rolling, or spring-pinches, and even that useful machine, the draw-bench, can overcome these effects; and the subsequent expensive manipulations are the consequence of the original irregularity. Moreover, the different density, in spite of all attempts at correction, will cause difference in the weight of the blanks, although they may be of equal thickness; and also the different "grain," when the discs are cut from the ribbons, may give a difference in the partial fracture round the disc, or punch, and a consequent difference in weight.

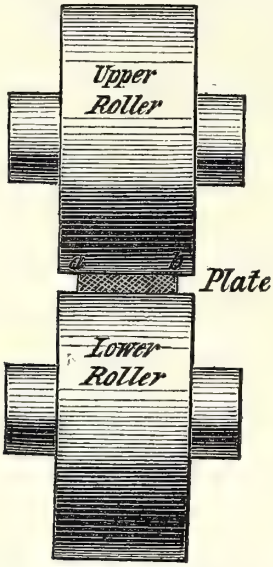
It will be seen from this, that if the first operation (the present method of casting) imparts its own irregularities, the next operation (that of rolling) contributes a still larger share of them; and hence arises an endless network of complications, which must absorb an enormous amount of machinery, labour, and attention, with final results which are, after all, relatively unsatisfactory. No wonder that the managers of the British Mint, with all their efforts in the direction of economy and order, and with more liberal tendencies in the way of improvements, object, nevertheless, to the recent reductions of the remedy for weight to the one five-hundredth part, and argue in favour of its increase, so as to lessen the expenses of the present laborious proceeding. It is fortunate, on the other hand, that the tendency of the age is towards the attainment of the utmost possible accuracy in such matters.

Another point in the present rolling system requires attention. The bars are flattened or thinned in one direction only, that of length. Originally ½ inch or 1 inch thick, 1⅜ broad, and 24 long, the first series of rollers makes them about one-fifth inch thick, 1½ wide, and seven to eight feet long; these being cut into lengths of 18 inches, as "fillets," they are (after going through the annealing process) again lengthened to about 6 feet, by one-twentieth of an inch thick by 1¾ of an inch broad. The whole length of the bar therefore stretches to about 400 inches. This continual stretching of the fibre (admitting the term) of the metal, renders it pliable and wire-like in one direction, but weak and brittle in the other; and if a square piece be cut off from the ribbon and tried for breakage with two pairs of pliers, it will bend in the length, but break easily at right angles, and so will the planchets or sovereigns, if seized in the direction of the rolling. The material of the coin is thus less solid, not at rest, and is more liable to the effects of abrasion. The rollers are not thick enough, not only for the purpose of rigidity, but also on account of the wide angle between their circumference and the horizontal line of the plate. Frequent rollings, encouraging brittleness, are therefore necessary. This description and criticism of the present system of casting and rolling, now leads the way to the consideration of—

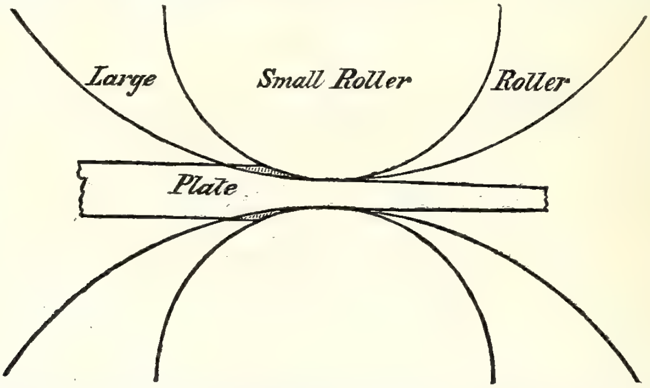
The Improved Process, as proposed by myself.

Casting.—Instead of casting rods or bars, as is done at present, I propose that the metal should be cast into plates of from one-half to three-quarters of an inch thick, eight to ten inches wide, and twelve to fifteen inches long. I do not bind myself to these dimensions, they may be varied in accordance with the machinery to be adopted, or as otherwise may be deemed suitable; but the principle of the plate must be adopted, for reasons which will presently appear.

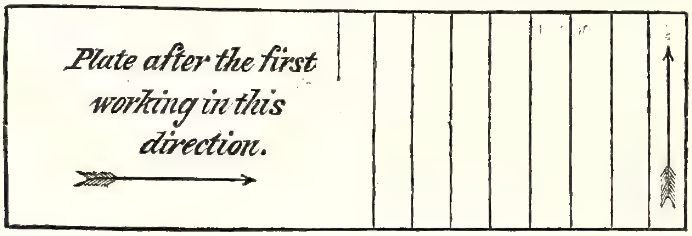
The moulds to be used for these casts should consist of two loose plates of iron (two to four inches thick) so arranged that slips can be inserted and held between their faces at the sides and at the bottom. The object of having the two iron plates loose is that of enabling the workmen to clean, grind, and polish their faces as often as required. Rubbing them, face downwards, upon a flat surface, with emery or some other grinding and polishing ingredient, can be done (with care) by an ordinary workman; and a top should be placed on the moulds when in the furnace and after the cast is made. The use of oil or grease for lubricating these moulds should be discontinued altogether, and a dry lubricator, such as black-lead, should be used, if lubrication is at all necessary. Casts made into these moulds will be perfectly regular and smooth; but in order to render them also more equal in temper and molecular arrangement, I propose that the moulds should be heated to red heat, or to some degree of heat which is found compatible. This may be done in a furnace chamber, heated by a blast of coal, gas, or otherwise. The two mould-plates, being 1 or 2 inches thick (or thicker if advisable), will retain the heat for some time, and the cast when made into them, instead of cooling rapidly and irregularly, as previously described, will set slower, and admit of a better consolidation and concentration of the particles of metal. A cast so made, and as equal in temper and density as every precaution and forethought can make it, can be rolled with much greater regularity.



Rolling.—The rollers should not be cylinders longer than thick (18 inches by 12), as now used, but should be more of the millstone shape, much thicker than wide, and not much wider than the cast passing between them. This shape would render them very rigid, and I contend that, even if the rollers now in use, of 12 inches thick, were but 3 inches wide instead of 18, they would be much firmer; or if made in three sections (in firm bearings), they would actually do more work than they do at present. But, in order to secure almost absolute rigidity, I propose that the rollers should be 24 inches thick (or even more), and wide enough only to leave room for the slight spreading of the plate. Thus, for plates of 8 inches wide, 12 inches would be enough; for plates 10 inches wide, the rollers might be 30 inches thick and 15 inches wide. These large rollers would be very efficient, even if they had to roll narrow bars instead of plates; for not only does their greater strength render a deflection almost impossible, but the pressure from the bearings is more vertical; and when, as I propose, this pressure is to be exercised, not upon a narrow pivot-like point, but upon a plate nearly filling the width of the rollers, and thus distributing the force, a mathematically certain result of accuracy may be anticipated. There are also other advantages connected with the use of these large rollers. The work performed by them can be done more deliberately, yet more quickly. The present rollers roll one or two pieces 1 to $1\frac{1}{2}$ inch wide, but these larger rollers can roll plates 8 or 12 inches wide (as the case may be), and may also be driven at half the speed, and yet their larger peripheries will "flatten" double as much as the others, as this illustration shows. This will lessen the frequency of rollings, which is the great cause of brittleness. The greater ease with which these large rollers perform their work involves the same principle as that of ordinary road wheels. Small wheels require a much greater propelling force than large ones.



Two methods of using the plates cast and the millstone rollers may now be suggested. The plates, by means of powerful descending shears, before being rolled, may be cut into strips of a suitable width, and then be flattened out in the usual way. Indeed, if the rods as now used could be cast thin enough, a great deal of rolling could be saved, but this cannot be done in cold moulds, for the bars become too brittle and broken in structure, whilst the heating of the moulds for rods would lead to too rapid oxidisation of the inside of the moulds. The plate cast in hot moulds has a better structure, and so have the strips cut from it; and, as it is not at all impossible that by this method even one-quarter inch plates may be cast, the experiment is worth trying. If, however, the rolling machinery is powerful enough, much time and labour may be saved by rolling out the entire plate first. I propose that these large rollers should first be used to effect the reduction of the plate to one-half of what is required; thus the plate one-half an inch thick would require a first reduction to one-third of that thickness, say one-sixth of an inch; and when this thickness has been reached, the plate may have spread a little, from five inches having become six inches wide, and nearly three times as long, so that the cast of 10 inches long may then be of the length of 25 inches. When the plate has acquired this size, an important improvement in the system of rolling may be made. For, instead of continuing the rolling in one direction, I propose, when the plates have been so rolled, that fillets should be cut from them "transversely," as here shown,—



which fillets (say of two inches wide by nine long) are to be rolled in their turn lengthways; it follows that the subsequent rollings take place at right angles to the first. The metal is thus spread in two directions, the equilibrium in the molecular arrangement is so far restored, and I am inclined to allege that for the same reasons which compel the blacksmith to hammer his iron first one way and then the other, in order to avoid splitting and brittleness, this cross-rolling will go far to remedy the brittleness which the gold has acquired in the first rolling; and the enormous saving to be effected thereby can only be appreciated by those who know what "annealings" during the process mean.

There is another advantage connected with this cross-rolling, easily explained. If, in spite of all the careful casting and the effect of the rigid first rolling, there should still be irregularities along the length of the plate, it is evident that these will be "cut across," *i.e.* divided into many parts, each part undergoing a separate subsequent treatment; the importance of this action is, in my opinion, beyond dispute. The fillets cut off from the plate by powerful shears, will start for the next rolling with clean edges, and thus a saving in "scissel" will be effected. The fillets will subsequently become ribbons of about 30 or 40 inches long; and from them, I am convinced, the Master of the Mint will be able to cut blanks of much more equal weight, structure, and temper.

These are, in the main, the outlines of the system which I recommend for the better manufacture of coin.

The suggestions which I have made, may, to a certain extent, be regarded as inventions.

They consist of—

1st. The method of casting in hot moulds and cooling.
2nd. The moulds and their construction.
3rd. The millstone-shaped rollers.
4th. The cutting of the strips from the plates.
5th. The system of cross-rolling.

It is true that other metals are rolled into plates, and the British and private mints, I believe, roll bronze in a similar way. The manufacture of bronze coins, however, is quite a different thing from that of gold and silver coins. The former have a remedy, or allowance of 2 per cent. or more, whereas the Mint Master must work his blanks to near one-tenth per cent. exact, so that the making of bronze coins can be altogether left out of question here. A tradition also prevails in the British Mint, that the plate system has been tried for silver, and failed. But, without inquiring into the method of how the plates were cast, it is sufficient for me to mention that the rollers in use must have been quite inadequate to the attempt; they must have "arched," so as to thicken the middle of the plate considerably. It is the complete provision for every characteristic and eventuality alone which can ensure success, and I may thus claim that the method recommended by me is of the nature of an invention.

I now have great pleasure in stating that, through the kindness of Mr. Fremantle, the Deputy-Master, Mr. Hill, the superintendent, and Mr. Roberts, the chemist of the Mint, I have been permitted to make an experiment at that establishment. An iron mould for casting was made, for a plate of gold 12 inches long, 8 inches wide, and $\frac{1}{2}$-inch thick. The inside of the mould was slightly coated with blacklead, rubbed on with a brush, then put together and heated to red-heat in a furnace. Standard gold was then cast into it. At the moment when the cast set hard, I expected a considerable contraction at the top of the opening, but only a trifling sinking-in of the surface took place; I consequently had reason to fear a vacuum formed in the plate itself, but when the mould was opened the plate was perfectly sound, solid, smooth, and soft. I found this remarkable and satisfactory result:—The inside of the mould measured precisely 12 inches by 8, and $\frac{1}{2}$-inch thick. The heating of the mould caused the expansion of these dimensions by one-eighth or one-sixteenth of an inch perhaps; yet the gold plate measured barely $11\frac{7}{8}$ by $7\frac{11}{12}$ of an inch, plain proof that it had contracted in all directions. During the slower cooling process the particles of metal had found time to consolidate or arrange themselves, and so the plate became thoroughly homogeneous. The fear, also, that the metal might adhere to the sides of the mould, especially as the iron was red-hot, proved quite groundless.

Some weeks afterwards, time was found for rolling the plate. The old rollers described, and liable to bend, had, of course, to be used. It was feared that the plate might split, become too brittle, or otherwise unmanageable, but it rolled out with great ease until it obtained the length of 35 inches perfectly smooth and firm. Three strips were then cut off transversely, for further rolling at right-angles under the smaller rollers, until they were of the thickness of the sovereign. The two narrow strips, for single rows, furnished blanks of equal weight, with the exception of the end pieces; the blanks cut from the middle of the broad strip were heavier than those from the side, as we expected, because the rollers used had bent asunder.

We were unable to mill and coin the blanks, as the mint was then engaged on silver, but from the appearance of the blanks there is little doubt that they can be coined without previous annealing, at all events by a lever press.

This experiment was made under most unfavourable circumstances. The mint was exceedingly busy. The mould was heated very irregularly, and although Mr. Hill had the large set of rollers polished on purpose, yet the whole machinery, from its unusually long spell of constant work, was not in the best condition; the shears were jagged. Again, the strips cut off were from the worst end of the plate, and, above all, the rigid rollers, as prescribed by my plan, were absent. We had to make many more rollings, to feel our way, than would be necessary if the machinery had been complete, so that there was, *primâ facie*, more cause for brittleness. Yet, with all these disadvantages and the necessary make-shifts, the result was satisfactory, and confirmed the *rationale* of the proceeding.

I regret to say that I cannot call upon the officers of the mint to give their views on this matter, for, as *employés* of the government, they must not speak, nor indeed commit themselves by expressing, even to me, a decided opinion in its favour. Nor can they do so in strong terms until the process has had a still fairer trial. Such a fairer trial, however, cannot take place until the important principle involved in the casting in hot moulds, and the next still more important one, that of rolling by perfectly rigid millstone-shaped rollers, has been verified, and that cannot be done until such rollers are provided. It is possible, also, that the officers of the mint are desirous of endeavouring to carry out improvements without adopting any of my suggestions.

Now, as the mint is about to be re-built and fitted with new machinery within the next three or four years, it might be said, "Let us wait until then." I recommend, however, that certain comparatively little expensive arrangements should be made at once at the present mint, in order to test the system fairly, so that the machinery of the new mint might be made in accordance with the results obtained now.

For this purpose I recommend the acquisition of—

Firstly, one pair of heavy rollers, 24 to 30 inches in diameter, by 15 to 18 inches wide.

Secondly, of horizontally-descending shears, 18 inches wide, to cut off the strips.

Thirdly, one or more sets of moulds for casting plates.

The above heavy rollers may cost from £800 to £1,000. The shears are not expensive, and the moulds would not cost many shillings each.

The Chancellor of the Exchequer and the Master of the Mint might agree with each other for this outlay, and nothing would be lost by it, for these heavy rollers are equally useful both for the rolling of bars and of plates. Indeed, 18-inch rollers are used in Calcutta for bars, although they have the fault of being 2 feet wide. If these tools could so be procured, I would recommend the following proceeding:—Plates should be cast of 1 inch thick, 12 inches long, and about 11 inches wide.

In reference to the thickness of one inch, Mr. Hill and myself differ a little. He thinks, and this view is confirmed by his experience with 1-inch bars, that the fillets would require annealing; but I think the present rollers are at fault in this matter. If 12 inch rollers will roll $\frac{1}{2}$ inch plates with ease, 24 or 30 inch rollers will do the same thing for 1 inch plates, the question of greater or lesser brittleness is that of the angle of the tangents between the circumference of the rollers and the plate. But whether the plate be 1 or $\frac{3}{4}$ inch thick, the objects of making it as large as possible are—

Firstly, that of enabling the moulds at once to absorb the whole contents of a melting-pot, now charged with about 1,260 oz.

Secondly, that of reducing the plates to a thickness of, say, $\frac{1}{4}$ of an inch, so that the strips cut off at right angles, when reduced to one-twentieth of an inch, become ribbons of about 5 feet long.

The cross rolling may be effected by the smaller rollers now in use, provided that the strips are not wider than a sovereign, so that single rows can be punched out.

The advantages of the plan are the following:—

1. Whereas now the 1,260 ounces require to be divided into ten bars, with liability to over-filling and spilling, change of temperature during the pouring, and remnants in the pot, the cast can be made at once, and the pot completely emptied, so as to exactly fill the mould.

2. The cast will become perfectly equal in temper, homogeneous and soft throughout.

3. It will be entirely free of oxide of copper, excepting at the opening end, which will be cut off.

4. Nearly 90 per cent. of ends will be saved. The ends of each of the ten bars now cast, to the length of from $\frac{3}{4}$ to 1 inch, require cutting off, and must be remelted, causing much waste of time and labour, and irregularity. For plates, only one end requires cutting off, and each plate will have an equal weight.

5. Instead of making ten assays for the ten bars, two assays (or three if required) may be taken off the plate, extra spaces or dents with narrow necks being left in the mould, so that the projections thus made in the plate can be cut off easily. These first advantages and economies certainly involve the putting together and the heating of the moulds. The moulds are of simple construction, held together by overhanging clamps and wedges; they may be heated in an ordinary annealing furnace.

6. The rolling down of one plate, although heavier for handling, will take much less time than that of ten bars, even when there is less speed in the turning.

7. The first series of rollings, reducing the plate to the desirable thickness, will render it perfectly smooth and equal, and the strips cut off with the descending shears will represent, so to speak, thin, sharp-edged, and sound little bars for the next rolling.

8. These strips will require but a moderate amount of further rolling, with this advantage, that whereas the first rolling in one direction has imparted to them a granular structure, causing elasticity and hardness, the cross rolling will spread the grain again in the other direction, and so modify any degree of brittleness previously brought about to a considerable extent.

Now, here arises a very important point. The blanks produced from the bars now cast, the fillets and ribbons of which are continually rolled in the same direction, certainly become so hard and brittle that it is found absolutely necessary to anneal them before they go under the dies. This annealing process renders them very soft, which softness, to a very great extent, is not taken away by the single blow of the screw press, and remains in the coin. Hence the coined sovereigns are too soft, and wear away too fast.

My process of cross-rolling, although it restores the equilibrium in the grain of the metal, does not make the blanks soft; they remain still elastic, and to some extent hard, but they are malleable enough not to injure the dies; and they can certainly be coined by a lever press, which squeezes rather than delivers a sudden blow, upon the coin, as the screw-press does. Hence cross-rolled blanks have the right degree of hardness, fortified by the stamping, and such coins will resist abrasion in an extraordinary degree.

These results, I think, can be verified, if the authorities were willing to incur the moderate outlay for the heavy pair of rollers, as I recommend it. The saving in labour and expense, and on account of better work, may be 25, 50, or 75 per cent. The figure will naturally depend upon the willingness and energy brought to bear upon the carrying out of the principles here involved. The system is like a chain, in which every link is constructed in accordance with the best conceptions confirmed by practice; the freer this chain is of makeshifts, or old-fashioned matters, the more efficient will it be.

In the above proposal, for instance, I have confined myself to the use of one pair of heavy rollers, the other weak rollers now in use to continue as long as so-called single rows, for punching out the blanks, are stretched. For if, in consequence of the bending of the rollers, these single strips became thicker in the middle, the blanks would, nevertheless, be of equal weight. But if the smaller rollers were also perfectly rigid, made of the millstone shape, say 10 to 15 inches thick by 4 to 6 inches wide, broader ribbons could be made to be of equal thickness, saving a great deal of offal or scissel, as the drawing on the wall shows, which means that 15 to 20 per cent. of scissel may be saved, or so much per cent. in the cost of coining. Single rows give at least 65 per cent more scissel. The British Mint has hitherto worked broad ribbons, for the very purpose of effecting this economy, but the system of casting, and the weak rollers, neutralised the process. The mint intends, I believe, to try these single rows with their present machinery. No doubt, the rejections by the final weighing, now 20 to 25 per cent. will be reduced to 10 or 5 per cent., but there will be a loss of 15 to 20 per cent. in scissel to account for it. It must be borne in mind, that these losses in spilling, in hard ends, and in refuse and scissel generally, are the most unpleasant part in the process. Single rows will also involve more handling and labour, and all the benefits of cross-rolling and the improved temper of the coin will be lost. I therefore recommend the adoption of my plan of cross-rolling in its completeness.

Again, in order to show what I mean by the energetic application of the system, if the machinery of the new mint should be planned in accordance therewith, I would recommend the use of a number of heavy pairs of rollers of a simpler construction. The present heavy rollers, in order to widen or lessen the space between them, require an expensive and delicate screw adjustment, and a long coupling shaft, jerking the motion of the machine. For one of these expensive mills, I would substitute four or five, with fixed openings between the rollers, in direct connection with the shaft, with simple cam wheels. These are much less costly, and the plates would pass between them in succession, in a short space of time, without intermediate cooling, which so much encourages brittleness. Great regularity and working power would be gained thereby, and the outlay would soon be covered by the saving effected in expenditure.

There are numerous other matters connected with this subject and the method I recommend, but an explanation of them here would take too much time; besides, they are, more or less, of the nature of *coups de main*, known only to those who can account for them by experience. But I shall be happy, at any time, to furnish a complete schedule of the tools required, and the manipulations necessary for carrying out this improved process of coining as it ought to be carried out.

If I may venture upon an estimate of the probable saving in expense and labour to be effected by my process, and the improvements in the better manufacture and structure of the coins, fairly borne out by what I have laid before you, I should say—

1. The present process involves a loss in spoiled work, such as spillings, hard ends, break-ups in the rolling, returned ribbons, scissel, brockage, and final rejections by the scales, ranging from 40 to 50 per cent. My plan, including scissel and rejections, would reduce this to from 10 to 15 per cent., may be less.

2. In addition to this advantage, tantamount to so much saved in expense, my process would save 50 per cent. in labour.

3. The working power of the mint would be much increased, and enable it to satisfy sudden demands (such as lately occurred) with greater expedition.

4. The coins made, both gold and silver, would be of a much better structure and temper, and harder, able to resist abrasion much longer.

The expenditure of the mint is stated at £50,000 per annum. The losses on light gold coins, borne by banks, may amount to £80,000 per annum (one bank alone loses £5,000 yearly). The loss on silver coin, borne by the state, is also considerable. Any sensible per-centage saved on these amounts is therefore of importance to the state, as well as the bankers and the public.

I hope that I have not fatigued you in bringing forward this matter. In doing so I had no other object in view than that of doing something for the public good; and I know that Englishmen, who have so warm an affection for the gracious Sovereign on the throne, hold the coin which bears her title and her image, together with all the high economical principles attached to its origin and use, in high estimation, and that they will lend a willing ear to all proper suggestions which can be brought forward on its behalf. I thank you for the patience with which you have listened to my discourse.

DISCUSSION.

Mr. Hendriks thought Mr. Seyd had made a serious mistake in putting the cost of gold coinage at only a quarter per cent., for he took the maximum of the two figures given to refer to England, inasmuch as it was notorious that the charge in France was much less than here. During the last ten years the coinage of gold had been five millions, and of silver £200,000, per annum, while the expenses of the mint had been £25,000 per annum on an average, which showed at once that if the whole charge were thrown upon the gold coinage it would amount to about one-half per cent. He knew that Mr. Seyd was justified in his statements by those put forward by the authorities of the mint, for Mr. Hill, the assistant coiner, in evidence given to the Royal Commission, had put the cost at about ·72d. for each sovereign, which was equal to 6s., or rather more than a quarter per cent. In that estimate, however, he thought a great mistake was made, as Mr. Hill assumed that the time of the mint was only occupied half the year in coining gold, and, consequently, his estimate proceeded on an average production of something like five millions, at a cost of something like £15,000 a-year in 1866 to 1867. But, taking it in this way, and setting aside the copper as unimportant, it would be found that the cost of coining the silver upon Mr. Hill's plan, of equal division between gold and silver coinage, would be equal to about $6\frac{1}{2}$ per cent.. which was clearly fallacious. It appeared to him that the whole charge of the mint ought to be cast upon the gold, inasmuch as that metal only was the standard, the silver and copper (or bronze) being only tokens which might as well be coined in Birmingham or elsewhere as in London. The mint was solely maintained to keep up the gold standard. It must also be remembered that the £25,000 a-year was a minimum amount, nothing being charged for interest on the value of five acres of land in one of the most valuable parts of London; or for retiring pensions, police watching, and other matters. He believed therefore the real cost of coinage was more like $\frac{1}{2}$ per cent. Mr. Seyd observed that in all countries where a seignorage was levied the coin had a tendency to leave the country, and instanced the case of the United States. This, however, was, he believed, due to exceptional circumstances, for if Mr. Seyd were to apply the same rules of reasoning to Australian as to American exports of bullion and coin respectively, he would find that, notwithstanding the seignorage charged at the Sydney mint was as high as in America, there had been much more bullion than coin exported from Australia in the same years, 1858-71. The Chancellor of the Exchequer had been criticised for having advocated the imposition of a seignorage or charge for coinage in England, but this was contemplated by that gentleman, not as a national, but as an international measure, which was a very different thing. If all nations concurred, by a convention, in imposing a uniform charge, there would be no tendency for the coinage to flow unduly from one country to another, and there would be one zone of circulation instead of many, which would be a great advantage, and the seignorage would press equally on all sides, like the atmosphere, and would thus not be felt. He did not profess to be a judge of all the technical improvements suggested, but great thanks were due to Mr. Seyd for his public spirit in bringing them forward. It seemed to him, however, that there was one difficulty which met them at the threshold, viz., that it was almost impossible to make an alloy of gold and copper, or even of gold and silver, which was homogeneous and dynamically true in its composition in all parts. Although our English standard was $\frac{11}{12}$ fine, it did not at all follow that if 11 parts of gold and one of copper were put into the crucible, that the resulting mass would be $\frac{11}{12}$ fine in all its parts. Some parts would have more of the copper than the rest, and that was the great *crux* which had to be overcome. It had been aimed at for years, and with some amount of success, but it was generally admitted that perfection was practically unattainable. The most eminent chemists in France, after a careful examination, found that the quality of gold in the 20-franc piece differed from that in the 10-franc, and that again from the 15-franc piece, although each of the coins had been struck from the same ingot of metal. He believed Mr. Seyd's suggestions would in the main turn out to be valuable, but it did not follow that the test of much larger experiments than he had yet made was not essential before they could determine whether they would practically answer their intended object. It did not follow, because apparent success may have attended a few experiments on a small scale, that it would be the same with their application on a large scale. The Deputy-Master of the Mint had reported recently that the casting of plates had been found not to answer, but no doubt he would have no objection to repeat the experiment. Since the meeting which had been held on the subject of international coinage, various inquiries had been made, and it appeared that experiments had been made abroad with regard to the loss by wear and tear, which it was found was, in the Napoleon coinage, only half that of the English, and these experiments had been verified by independent testimony in Switzerland and in France. This led one to doubt whether the English standard of $\frac{11}{12}$ths was really equal in resisting wear to the foreign alloy of $\frac{9}{10}$ths. It was thought by many that the experiments of Hatchett and Cavendish, in 1803, had settled the question, but in point of fact they did not test an alloy of $\frac{9}{10}$ths fineness at all. Some improvements had been made in the new coinage, particularly in making the rim slightly concave, so as to prevent a large surface being exposed to friction, but it appeared to him that a good deal of the wear and tear must arise from the file-like edge of the coin, and this view was borne out by the fact which had been observed abroad that the wear and tear was much greater the first year or two than subsequently, and it was worthy of consideration whether it would not be an improvement to give the rim or edge of our gold coinage a plano-concave, instead of an indented, file-like character, which acted prejudically in wearing out the new coin very quickly.

Mr. G. J. Ansell said he had had some practical acquaintance with this subject, having been for fourteen years connected with the mint. It was quite a fallacy to suppose that there could not be a perfect mixture of gold and silver, or of gold and copper. It was found that scissel bars or those made from the cuttings, showed no variation whatever in the assaying, showing that any irregularity in the first casting arose from imperfect mixing. He had demonstrated this fact to Mr. Graham, in 1856, in the case of many thousands of ounces. Mr. Seyd had brought forward certain matters which he called inventions, and no doubt they were, but he (Mr. Ansell) had invented them years before, and probably the mould could be found in the mint now which he had warmed, although he did it in a charcoal fire, and not in a coke furnace. He had made many of the experiments suggested in the paper, and they were recorded in a report made at the time to the Master of the Mint. It was not feasible, however, to cut plates into fillets and roll them the cross way—not practically, because they would split and curl up. The plates when rolled were thicker in the middle than at the edges, and if they were cut lengthways the strips would curl round, while, if they were cut across and then rolled, they would split and open. It required the greatest care to keep the strips of metal flat, and unless this were done, it was impossible to work them. Of course these experiments of his were not made public, and therefore no doubt Mr. Seyd was entitled to all the credit of his invention, though he believed he had gathered some hints from him (Mr. Ansell). It was not true that when hot metal was poured into a greased mould the grease was oxidised; it was vaporised, and in fact a little oil, the merest film, was necessary, as it had the effect of reducing the copper of the alloy, which would tend to oxidise to its original shape again. Too much oil was no doubt useless and pernicious, and produced a very bad effect. Some years ago he proposed a plan to Mr. Graham—which, however, was never carried out—for preparing an iron tube, six feet long, to be heated by a lead bath, the top being planed out to the depth of $\frac{3}{8}$ths of an inch. This was to be kept at a red heat, the surface, to prevent oxidation, being coated with a mixture of fine carbon and clay, such as is used in fine moulds for castings. A stream of metal was to have been poured upon this table, which would have produced a plate of about 5,000 oz.; and be believed very good results would have been obtained by that means.

Mr. Botly suggested that one reason why the gold in France and Switzerland did not wear so much as in England, was because the people were more given to hoarding. The alloy was, of course, necessary, or the metal would be far too soft. With regard to the seignorage, he saw no reason why the cost of coining should not be charged by the mint. It would certainly be of immense advantage to have a uniform decimal coinage.

Mr. Seyd, in reply, said Mr. Graham stated before the Committee that the cost of coining gold was one-sixth per cent.

Mr. Hendriks said the very data Mr. Graham himself gave rebutted that statement.

Mr. Seyd said that more gold was coined in France than in England, and in the former country it was done by contract, at something less than one-fourth per cent., and the silver was coined for three-fourths per cent.; he did not suppose the contractors did it at a loss. Indeed, it was pretty well agreed on all hands that these charges would cover the actual expenditure. Mr. Botly probably referred to brassage when he said he approved of seignorage, the former being the mere charge for the expense of coining, and the latter something additional, which was quite a different matter. He agreed that there should be a charge for brassage. With regard to Mr. Ansell's statement, that he had tried the very experiments he had suggested, he could only say that he had been in the mint a good deal lately, and had heard nothing of it, and the question arose, had he tried in the same way? Even if he had made his moulds red hot, the small rollers now in use were quite inadequate to the proper trial of the experiment, the essential part of his invention being the use of these heavy rollers. It was said that the plates would split and curve, but he had not found it so. He had cast a plate, and found it perfectly soft and workable, and it ran out with the same ease as the bars. It was also cut across, and the fillets thus produced rolled without curling, so that whatever Mr. Ansell had done, it is quite clear that, in spite of his experience, he did not know how to roll plates, whilst he (Mr. Seyd) seemed able to do so. Mr. Seyd indignantly denied that he had made use of any information supplied to him by Mr. Ansell. He did not require any from him. His book on bullion was ready and printed when he first saw Mr. Ansell, and some scanty information on ends and scissel was given by the latter, but not used. That book contained all that he (Mr. Seyd) had published on the mint, excepting the paper now read before the meeting, and for that Mr. Ansell would have been quite unable to contribute even a scrap of information. He must apologise to the meeting for noticing this personal attack made upon him by Mr. Ansell. As regards oil, he (Mr. Seyd) had never said that the oil oxidised the moulds during the casting; indeed, it vaporised and burned, but the rancid and other impurities of the oil adhered to the sides of the mould, which, when the cast was withdrawn, were very hot and became oxidised in contact with the air. At all events, it is a fact that the insides of these moulds became rough very soon. As regards experience in matters of this kind, Mr. Ansell had stated that he had 20 years of it in the British mint. He (Mr. Seyd) had all his life been engaged in the bullion business, and had closely watched minting operations in the chief foreign mints. But all this would lead to acrimonious personal discussion, which could not affect the merits or demerits of the proposal brought before the meeting.

The Chairman said the meeting was much indebted to Mr. Seyd for bringing forward in such a lucid, straightforward way the various suggested improvements in the manufacture of gold coin. What the parentage of these suggestions might be he had no means of saying, nor did it seem of much importance. No one, however, could be insensible to the importance of improving the manufacture of gold coins; he certainly was not. The loss by wear and tear was very great to individuals, and the same thing often produced displays of ill temper amongst persons who found themselves in possession of coin which had fallen below the passable limit. Therefore, everything which science could do to diminish the wear and tear and abrasion of new coin was not only a national gain, but was also of importance with regard to everything which constituted gold coin a perfect medium of exchange. He could only hope that these suggestions might be found useful and carried out, and certainly the paper itself bore testimony to the willingness of the authorities of the mint to entertain any suggested improvements, for they had even allowed Mr. Seyd to make various experiments. This, however, was no more than might be expected from the gentlemen who were now at the head of that establishment. He had before him a report from the deputy-master, describing his visit to various European mints in 1870, and making certain suggestions for the improvement of our own establishment. Allowing for official reserve and phraseology, he did not know of any official paper which bore stronger evidence of a desire to profit by every improvement.

There were suggestions for improving the process of rolling, of cutting, of stamping, and especially in favour of the press which Mr. Seyd had referred to. Under all these circumstances it might well be hoped that when the premises of the mint were removed to another site, improved apparatus would be erected; indeed, Mr. Fremantle in his report pointed out that the present premises wanted entire re-arrangement, so as to admit of the introduction of various improvements which had been devised by men of science. Upon the whole subject no one was better fitted to speak than Mr. Seyd, whose name had been before the public for some time as one of the most intelligent and well informed of those who interested themselves in this subject. Certainly his book on bullion exchanges stood in the first rank, and many of the suggestions he had therein made had since been carried out, whether in consequence of his work or not he could not say, but he was inclined to give him the credit, particularly as regards the trial of the pyx, the mode of treatment of sovereigns, and, still more, the adoption by the Bank of England of an increased allowance for light gold. The Bank now gave £3 17s. 9d. for light sovereigns instead of £3 17s. 6½d., which of itself was an alteration of great importance. He would not go into the question of the cost of coinage, or the propriety or impropriety of this country changing a seignorage, though he was one of the heretics who thought the present system answered exceedingly well, and there were large national considerations in favour of maintaining it. It had answered very well for the last fifty years, and the mint, as a whole, was a very profitable establishment; for though gold was coined free, there was a large profit on the silver and bronze. Indeed, Professor Graham had stated that the profit made on the issue of the new bronze coinage was £300,000, which would go a long way towards wiping off any loss on the coinage of gold. In conclusion, he moved a cordial vote of thanks to Mr. Seyd, which was carried unanimously.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

General Purposes Committee.—The Marquis of Ripon presided on Wednesday, over a meeting of the General Purposes Committee, appointed by Her Majesty's Commissioners for the Exhibition of 1851 to carry out the current series of Annual International Exhibitions. There were also present, Sir Francis Sandford, Mr. Edgar Bowring, Mr. T. F. Gibson, and Major-General Scott (secretary).

Meeting of Musical Committee and Manufacturers of Musical Instruments.

This meeting was held in the East Lecture Theatre of the Royal Albert Hall, on Saturday, the 20th January, 1872, at 12 (noon) for the purpose of considering what musical pitch should be recommended to Her Majesty's Commissioners for adoption in the forthcoming Exhibition, for those instruments admitted to the Exhibition, and used in the recitals.

Lord Gerald Fitzgerald, the Hon. Seymour Egerton, Mr. Frank Morrison, Mr. Alan Cole, members of the Musical Committee of the Hall, attended, and among those present were the following:—Sir Julius Benedict, Mr. John Hullah, Mr. G. A. Macfarren, Herr E. Pauer, Mr. W. Ganz, Mr. Pitman, Mr. J. Riviere; Messrs. Broadwood, Henry Brinsmead, Distin and Co., Boosey and Co., Bevington, Kohler, Forster, &c., were also represented.

Upon the proposition of **Captain the Hon. Seymour Egerton**, seconded by **Sir Julius Benedict**, **Mr. John Hullah** took the chair.

Mr. Hullah stated the purposes for which the meeting had been convened, and referred at some length to the occasions when the adoption of a uniform musical pitch had been discussed. The French diapason-normal, which is extensively adopted at most of the musical conservatories throughout Europe, is fixed at 512 vibrations to C. The pitch suggested by the Society of Arts is 528 to C, and the Sacred Harmonic and the Italian Opera House pitch (Sir M. Costa) has C 546. He invited suggestions from those present.

Mr. Hopkins (from Messrs. Broadwood) said that the firm of Broadwood has three pitches, the lowest of which is the French diapason-normal, and the highest is the opera pitch. In winter, this latter corresponded to the pitch of the organ in the Royal Albert Hall. In the summer the pitch of the organ was higher even. Their medium pitch corresponds to that suggested by the Society of Arts. He himself thought that the French pitch should be chosen.

Mr. Bevington and **Mr. Forster**, organ builders, both supported the desirability of adopting some one pitch for the instruments to be shown.

Mr. J. Scates (representing Messrs. Boosey and Messrs. Distin and Co.), said that a certain expense attended the alteration of instruments to various pitches. Messrs. Distin had for years adopted a pitch arrived at by Sir George Smart, and used at opera concerts. It is the pitch called the opera concert pitch. As orchestras had generally, if not invariably, to tune to the pitch of the wind instruments, and as Messrs. Distin and some Belgian firm he represented as well, extensively sold wind instruments, he suggested that the opera concert pitch should be used.

Lord Gerald FitzGerald wished to inquire if the pitch of the organ in the Royal Albert Hall would be lowered to suit the recitals?

The Chairman understood that the organ would not be employed in connection with the recitals.

Mr. Henry Brinsmead advocated an uniform pitch, and thought the authority of Her Majesty's Commissioners advantageous to the establishment of such a pitch. He advised the formation of a committee of scientific and practical men to consider the subject.

Sir Julius Benedict referred to the exhaustive information on the subject collected by the Society of Arts in 1860, through their Committee, which sat for over two years, and ultimately recommended the adoption of a pitch of 528 vibrations to C. Tuning-forks were circulated, and everything done to induce the adoption of this pitch. In foreign countries like France, at State academies and such like, the pitch was enforced by a decree. In England, however, the action was different. He considered that, judging from past experience, the musical instrument makers themselves ought to come to some agreement on the subject.

Mr. G. A. Macfarren then passed a resolution to the Chairman, and requested him to put it to the meeting. Mr. Macfarren showed that the present high pitch quite changed the keys of compositions written a hundred and more years ago. To enable the performance of certain compositions, they had now to be actually transposed to lower keys, but these, he ventured to assume, were far nearer the original key than the key nominally correct, but really made incorrect by the high pitch. Still, in these circumstances, there was a tendency to raise the pitch. No regard appeared to be paid to the strain thus put upon singers, or to the damage, more or less grave, arising from provisions which it is found necessary to make in old and valuable stringed instruments, in order that they may bear the increased tension of the strings. The Society of Arts had gone carefully into the matter, and he therefore moved that its pitch, viz., that of 528 vibrations to C, should be recommended to Her Majesty's Commissioners for adoption, in preference to the French pitch.

Mr. H. Brinsmead seconded the resolution.

Herr Ernst Pauer requested to be allowed to suggest that Her Majesty's Commissioners should be asked to circulate tuning forks of the pitch they adopted.

The Chairman then put the resolution, which was carried with only one dissentient.

Mr. Pitman asked if instruments not tuned to the adopted pitch would be inadmissible to the Exhibition?

The Chairman replied that the admission of instruments rested with the Committee of Selection.

After some further desultory conversation, in which it was pointed out that the meeting had been convened purely for Exhibition, and not national purposes, as respects musical pitch, a vote of thanks was passed to Mr. Hullah for having acted as chairman, and the meeting broke up.

Captain the Hon. Seymour Egerton, and Lieut. E. G. Clayton, R.E., were present on behalf of her Majesty's Commissioners.

Meeting at the Mansion-house.

On Monday, the 22nd January, a public meeting, convened by the Metropolitan and Provincial Association for the Defence and Advancement of Trade Interests, of which Mr. W. H. Smith, M.P., is president, was held in the Egyptian-hall of the Mansion-house, the **Right Hon. the Lord Mayor** presiding, to consider the manner in which the International Exhibition of last year was conducted.

Mr. Arthur A'Beckett, the secretary, read a letter from Lord Overstone, one of the Royal Commissioners for the Exhibition of 1851, assigning reasons for not being able to attend the meeting, but in reference to the complaint of the association stating that he thought it ought to receive very serious consideration at the hands of the Commissioners.

The Lord Mayor said it was no doubt well-known to the meeting that International Exhibitions were first suggested and encouraged by the late Prince Consort; and he might say at once he was convinced that his Royal Highness would have been as grieved as the meeting could possibly be if he had thought they could ever be perverted. He also felt assured that the Royal Commissioners of the Exhibition of 1871 could not have invited the Queen to take part in the opening ceremony, or the Archbishop of Canterbury to ask a blessing on the enterprise, if they had supposed it would degenerate into a huge bazaar. Its general objects were to foster and develop skill in various ways, to promote the advancement of art, and generally to promote the refinement of mankind. There was no intention in its inception that particular individuals should be benefited beyond what might properly accrue to them incidentally, in the carrying out of the general purposes of the exhibition on that basis. It was taken in hand in the hope that it would tend, more or less, to elevate mankind throughout the whole civilized world. That being so, he was sorry the Commissioners should appear to be lending themselves to a course so much to be deprecated, and against which he thought the meeting had a right to protest.

Mr. R. W. Crawford, M.P., in moving the first resolution, said he had taken some trouble to investigate the subject, and he thought there was ample ground for protesting against the acts of the Commissioners. The resolution was to the effect—"That this meeting views with regret and alarm the determination of the Royal Commissioners to convert the International Exhibitions at South Kensington into enormous retail shops, and pledges itself to use every loyal means to prevent the intended scheme being carried into effect."

Alderman Sir R. Carden, in seconding the resolution' said a public meeting had probably never before been convened at the Mansion-house for a better purpose. It had been convened in a just cause, and he defied the Commissioners not to yield to the suggestions of such a gathering of the citizens of London.

The motion was put and carried with acclamation.

Mr. Alderman William Lawrence, M.P., proposed the next resolution:—"That the scheme of the Royal Commissioners is entirely subversive of the original design of International Exhibitions as proposed by the lamented Prince Consort, viz., 'the improvement of public taste, and the promotion of art in manufactures,' and is inimical to the interests of, and unjust to, the trading community at large." He reminded the meeting that it was at a magnificent banquet in that hall, at which the Prince Consort was entertained, in 1849, that the first great impetus was given to the Exhibition of 1851, and he thought it was a legitimate object for them to ask the Royal Commissioners to revert to the first principles, which resulted in its great success, and in improving the manufactures not only of this, but of every other country in the world. The Exhibition of 1862 was carried out in much the same manner, and it was also a great success. The meeting had no desire to deprive the foreigner of his right to send his goods to this country for exhibition; all it wanted was that in forthcoming International Exibitions the principles which governed that of 1851 should be fully and fairly carried out.

The resolution was seconded by **Mr. Bayman**, supported by **Mr. A. B. Daniell**, and unanimously adopted.

On the motion of **Mr. Sheriff Bennett**, seconded by **Mr. P. Graham**, a standing committee, composed of the Lord Mayor, Mr. Alderman Finnis, Mr. R. W. Crawford, M.P., and about a dozen other gentlemen, with power to add to their number, was appointed for the purpose of removing the grievance complained of by a humble address to the Queen, by petitioning both Houses of Parliament, and by all other available means.

The meeting was also addressed on the general question by Mr. John Jones, Mr. Coningham, formerly M.P. for Brighton, Mr. Mappin, Mr. Copeland, Mr. W. M'Arthur, M.P., and Mr. Attenborough.

The Exhibition of Articles of Food in 1873.

Sir,—Referring to the proposal of her Majesty's Commissioners, that the Society of Arts should assist them in connection with the proposed exhibition of substances for food, will you allow me to suggest that I think a very important impetus may be given towards the removal of that prejudice which exists in the minds of the British public against the use of imported foods, such as Australian meat, &c., if arrangements were made whereby the proper cooking and dishing up of such foods can be shown, and also by giving opportunity for the tasting of them, either free or by payment. Curiosity will do much to stimulate a regular daily consumption, and the great difficulty I and others have found in getting the poor to eat Australian meat will be got rid of, namely, the idea that such meat is, as they say, "Shoved off on to them to enable others to get better and cheaper butcher's meat." Make it a seeming luxury, and it will soon become a necessity. I have taken a great interest in this question, and have written in other journals a good deal upon it, and I venture to make the above suggestion to the Food Committee of the Society of Arts.—I am, &c.,

Anne Isabella Larkins.

Sir,—I beg leave to submit a few observations for the consideration of the Food Committee of the Society, with reference to the letter of General Scott, Secretary to her

Majesty's Commissioners for the Exhibition of 1851, published in the *Journal* of the 12th inst., announcing an Exhibition of "Substances used as Food," to be held in 1873.

Having served as a juror on articles of food in the International Exhibition of 1862, my attention was, at a very early period of my duties, attracted to the inadequacy of the means employed to bring new articles of food to the notice of the public, so as to enable it to judge, in a practical manner, how far they might be suited to general consumption, and how far a reduction of cost would be attained by substituting new articles for those generally in use. I would particularly notice—

1. Preserved meats in tins.
2. Salted meats from Australia.
3. Fresh butter from France.
4. Dried and compressed French vegetables, and
5. Indian teas.

As I was the exhibitor of all the Indian teas on that occasion, and as their purity and excellence are as yet but little known, I shall allude to them first.

My exhibition consisted of about 150 specimens of green and black teas, from the tea-growing districts of India, viz., Assam, Cachar, Darjeeling, Kumâon, Dehra Dhoon, Kangra, and Chota Nagpoor. These teas attracted great attention from their novelty as an Indian product, and from the perfect manner of their manufacture. I was constantly interrogated by visitors to the Exhibition about their quality, price, the mode of manufacture and cultivation, and especially as to their economy in use compared to China teas. They were also highly approved by the jurors and other persons who had opportunities of drinking them, and the result was the award of medals and honourable mentions to eight or ten of the manufacturers. So far, something was done to bring this new article of food, which is of the purest and best kind, to the notice of the British public through the intervention of the International Exhibition, but it was very inadequate to the wants of the public in general, who had no better means of judging of these teas than admiring them in a glass-case. What I propose for the consideration of the Food Commitee is that, at the Exhibition of 1873, the public should have the opportunity of drinking Indian teas as well as looking at them, that intending exhibitors should be informed of this opportunity, and invited to send sufficiently large samples of the teas to admit of this being done without much cost to the Society of Arts. From my experience on the last occasion, I feel very sure that the tea planters and tea companies who desire to exhibit will respond liberally to this invitation. In 1862, large samples—20lbs. in some instances—were sent to me, and went eventually to the India-office, as the Indian Government had provided free carriage for them from India. On that occasion, I believe that the exhibits represented no more than a crop of a million pounds for all India. It will be very different in 1873, as I have good reason to believe that more than 20 millions of pounds will be the out-turn of this season (1871).

2. It appears to me that the same opportunity of eating the Australian meats, fresh in tins and salted, should be given to the public. This is especially required, as the meats cannot be seen, and as the largeness of the tins (7 lbs.) prevent the poorer classes from trying them without an outlay of three or four shillings.

3. I would draw the attention of the committee most pointedly to fresh French butter. In 1862, we had exhibits of this article of the greatest excellence. One sample from Paris, to which a medal was awarded, was rich and delicious, keeping perfectly sweet and fresh for a month. It is rare in London to get butter a week old which is not rancid from some defect in making, which is avoided in France, at least it was quite avoided in the exhibits of 1862. I would, therefore, enable the public—and dairymen in particular—to taste French butters of the very best quality, that they may be incited to emulation in the making of a very important article of our daily food.

4. Lastly, I would have French compressed vegetables and meat made available by cooking to the public. There are, no doubt, other articles of food which may occur to the Committee as requiring equal assistance to enable the public to test them. I hope, however, that these suggestions will be favourably received, and that we may see a refreshment pavilion opened in 1873, in connection with the Exhibition of "Substances used as Food."—I am &c., A. CAMPBELL.

Farnham Royal Slough, January 23rd, 1872.

CORRESPONDENCE.

THE PROPOSED NAVAL UNIVERSITY.

SIR,—In the Society's *Journal* of the 1st December last, you were good enough to find room for a letter of mine, advocating the opening of the proposed Naval University to the mercantile marine, instead of its being regarded as a Royal Navy College exclusively, and especially in the event of that grand national pile, Greenwich Hospital, being appropriated as its congenial home. I trust, indeed, that neither class jealousy nor professional etiquette would prevent our gallant young officers from associating and studying together within those noble courts and walls. In the letter above referred to, I ventured at some length to urge the desirableness of connecting the commercial navy with the proposed university, alike on the grounds of humanity, in the greater safety of life at sea, of science, in improved navigation and seamanship, and improved construction, and of public economy, in the better and readier manning of our ships, and the provision of a body of officers specially qualified for the nautical profession, and fitted to act, in the event of a naval war, as a valuable support or reserve to the Royal Navy.

It has, therefore, been most gratifying to me to read in the Society's *Journal*, of the 15th December, the brief but emphatic letter of the able ex-Chief Constructor, Mr. Reed, declaring his concurrence in the opinion put forward in my communication, and adding that he "should consider it a great mistake to establish a national naval university on a narrow basis;" and expressing further his conviction "that innumerable benefits would arise from opening to the mercantile navy the doors of a well-established and wisely-managed college for the general and technical education of naval officers of all classes."

If evidence were required to show the great need there is of improvement, both in our ship-building and our practical seamanship, it would be too abundantly found, if (taking my figure from Sir Edward Sullivan's letter in this day's *Times*,) a score or two of the cases out of the "1,865 ships, registering over 400,000 tons, and manned by over 16,000 men and boys," which "were wrecked on our coasts as close to them," in 1870, were publicly investigated and sifted from top to bottom.

To take, however, several incidents which have recently occurred, and which affect most seriously our nautical reputation, I would allude to the disgraceful loss of the P. and O. Company's fine steamer *Rangoon*, from drifting, in fine weather, upon rocks which ought to be as well known to the pilots and captains frequenting Point de Galle, as the Bank is to the drivers of City omnibuses. I could instance the almost grotesque blunder through which H.M.S. *Agincourt* involuntarily tested her strength when she delivered and received a tremendous "thud" upon the rocks off Gibraltar, and was placed in inglorious peril for many hours; and by the absurd grounding of the *Racehorse*, off the Isle of Wight. Again, with regard to the very recent loss of the *Delaware*, with her lading of manly lives and valuable property, when only some two or three days' out of the Mersey, landsmen may fairly ask what business had the ship so near Scilly? Where was science? Where seamanship—I mean of the ready and foreseeing kind—in that case? In instances like those of the *President*, lost now many years since, and the *City of Boston*, lost in 1870, both in some unknown mysterious way, but probably crushed and sunk by icebergs, it might be asked, are not the tracks and seasons of icebergs known sufficiently for commanders to be able almost certainly to avoid them? Or, take again the awfully sudden foundering, off Cape Finisterre, Spain, of H.M. ironclad *Captain*. Can any one now regard the earnestness and persistent confidence shown against all odds, by the late gallant Cowper Coles, and by Captain Burgoyne, (brave son of a brave father), and proved by their going out in the ship, and evinced also by the then First Lord, when entrusting his son to her, otherwise than as a species of heroic infatuation? No one doubts the high-minded patriotism of the three distinguished men just alluded to, or challenges their sincerity. Speaking *ex post facto*, it is now pretty obvious that this mighty vessel was over-masted for her flotation and stability; that, as a whole, form, material, beam, low free-board, and weight of armour, rig, engines, offensive armament, and general equipment, she involved a paradoxical combination of conditions; and paradox vindicated itself under circumstances which carried desolation and tears into hundreds of families, whose sons (ill spared) found, at one fell swoop, a coffin and a grave in what was intended to be their castle and safe home at sea.

And has not this terrible incident increased very much the distrust of our iron-clads? Ought not "science" to have discovered beforehand that the *Captain* would necessarily be unsafe in a gale of wind, or when rolling heavily? Seamanship may, in many cases of imminent danger, do something, and may effect the saving of the ship, but it cannot reconcile principles in hidden and deadly antagonism. Or take, again, the degrees of "roll," as recorded in the last autumn cruise of the iron-clad squadron. Is there not one, at least, of these ships which ought not to be trusted, with men, guns, and all in, outside the Solent? Can safety co-exist otherwise than as a temporary state with the highest degree of "roll" actually registered on that cruise?

The reflection I make from the above considerations is this, to use Mr. Reed's words, that a "well-established and wisely managed" naval university "for the general and technical education of naval officers of all classes," is very much needed, and that such an institution would be a glory to the nation.—I am, &c.,

A Salt's Son.

Dryelande, January 12th, 1872.

ABOUT COLOUR.

Sir,—Referring to Mr. Benson's letter in the *Journal* for the 12th inst., I beg space to remark that what he says about "blue" simply confuses the question, without being a reply to my criticism. A hue midway between green and "violet," or "blue-violet," is as much entitled to a simple distinctive name as yellow, which is similarly placed between green and red; and if we do not call that hue "blue," what are we to call it?

In his second paragraph, Mr. Benson seems to me to have gone slightly beyond the mark in two ways:—1st. He assumes, apparently, that I am only just now experimenting and investigating the subject, whereas the experiments I referred to were made a dozen years ago. 2nd. Like other disciples, he seems inclined to dogmatise more than his teachers. I do not think the authorities he names have "accurately determined" what precise colour sensations should be called simple or primary, nor even in their writings have implied that they themselves think they have. At any rate, being acquainted with their experiments, I maintain that the facts brought out do not logically warrant the assumption that such accurate determination has been obtained.—I am, &c.,

E. Hunt.

Glasgow, January 13, 1872.

THE FORESTS OF INDIA.

Sir,—I have read the very able paper on the "Forests of India," and would like to make a few remarks on it.

"Elephants every year are becoming fewer, especially in Southern India, and their destruction must be considered a mistaken policy."*

Some five years ago, the Madras government took this very question up, and the destruction of elephants was strictly forbidden. The Cingalese capture and carry away to Ceylon large numbers of these animals, this will in a measure account for their gradual disappearance from our forests.

The Conolly plantations† are a great success; but what about the abortive attempt of the Forest Department in other districts, Kurnool for instance.

Daily, each engine worked on the Madras lines consumes 35,000 pounds of wood, and, assuming the average tree to weigh (when dried) one thousand pounds, the fuel annually required for efficiently working the railways of that presidency would, in trees, represent three-quarters of a million. Colonel Wragge has most ably and persistently, from time to time, brought to notice the enormous expenditure incurred by Indian railways, owing to the excessive cost of fuel, and his remarks naturally suggest the grave question to our minds:—Is the iron way the mode of locomotion best suited for India; and if it is not, which is? There are several important objections to railways existing in prospective.

1. Cost. Mile for mile, the first cost of a railway is three times as much as that of a navigable canal.

2. The drain on the country. That whereas the railway has, and is, destroying our forests at an alarmingly rapid rate, canals have not and cannot injure them.

3. Failure in meeting the wants of the country. The natives along the line have returned to the old mode of despatching goods.

4. Canals possess all facilities which railways offer, and the additional one of extending irrigation.

I believe that a perfect network of remunerative navigable canals could be cut all over India, connecting the interior with the great sea-port towns. The peculiar direction of the rivers, the fact that the rainfall is enormous at their sources, the scanty quantity of coal, are causes sufficient to my mind for asserting that our Eastern Empire is peculiarly adapted by nature for internal navigation and irrigation.

The Madras Irrigation and Canal Company have completed a canal from the Tombodra (eighteen miles above Kurnool) up to the town of Cuddapah. Now this work can, without any difficulty, be connected with existing irrigation works in the Nellore district, and were this accomplished, Bellary, Kurnool, Cuddapah, and Nellore would have perfect water communication with the great sea-port town of Madras. Again, by connecting the channels on the river Bhowany with those on the Cauvery (an undertaking quite practicable), the coffee planters of the Shevaroys, Anamalies, and Neilgherries would be enabled to transport their produce by water to the towns on the south-east coast.

Favourable sites abound all over India, which could, with reasonable outlay, be converted into capacious tanks, capable of holding many millions of cubic yards of water. An additional reason why hydraulic should have the preference over railway works may be adduced from the late famine. All ryots holding lands under channels suffered no losses, their fields produced grain, &c., in normal quantities, but they saw the crops of their less fortunate neighbours fail; they saw this disaster succeeded by poverty, want, disease, and death. It was a cruel and heartrending sight to see, as I have done, starved beings wander about the country, searching for food, eating grass or leaves, and, in one case, dung, to appease the cravings of hunger. Many a grateful peasant have I met who blessed the name of Cotton, an officer, by the way, who has received no adequate reward for his splendid services.—I am, &c., R. F. Taylor, Captain.

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* Page 122. † Page 136.

30, Cave's-terrace, Shepherd's-bush,
16th January, 1872.

NOTES ON SCIENCE.

Science has come to the aid of those *bon-vivants* whose principal facial organ betrays by its rubesity the depth and strength of their potations. The "jolly red nose" of the inordinate lover of alcoholic stimulants, may now be relegated to the list of curable diseases, thanks to a French physician, Dr. Bernier, who has successfully treated some cases of this kind by the local application of an electric current. Among other patients, a lady of high rank, to whose nose the wire of the doctor's galvanic battery had been applied, has now the satisfaction of moving among her fellow-beings, free from the bacchanalian line which had long tainted that important facial organ. This is the latest triumph of electricity.

To the popular eye the only metals which are distinctly coloured are gold and copper. The scientific eye, however, in the degradation of the light, reflected from polished metallic surfaces, discovers the existence of colour in almost every metal, although it is so diluted with white light as to be almost invisible. To render apparent the colours of metals, the best way is to arrange two plates of the metal face to face, and at a little distance apart, and project upon one of them a beam of light, in such a way as to cause it to be reflected from one surface to the other at a small angle of incidence. If the number of incidences be enough, all the white light will have disappeared, and only the pure coloured rays be visible. This is the way in which the colours of metals have been determined. Starting at this point, Professor C. A. Seeley has communicated to the New York Lyceum of Natural History another method of developing the true colours of metals. When white light is decomposed by a coloured body, the reflected coloured ray is complementary to that part of the white light which is transmitted or absorbed; if a coloured body be seen both by transmitted and reflected light, the colours so seen should be complementary, or nearly so. To these statements there appear to be exceptions, for example, the coloured transparent salts of metals show the same colour by reflected as transmitted light. Professor Seeley, however, believes that such discrepancies are capable of being explained away, for it may be shown that the supposed reflected light of the exceptions is really a part of the transmitted light, which has been returned by internal reflection; such mixture of the transmitted with the reflected light implies a considerable degree of transparency of the substance under test. The lustre and whiteness of metals have a close relation to their opacity and density; perhaps their relation is that of effect and cause. If the opacity and density of metals be progressively decreased, the optical metallic character will, in this same ratio, be diminished; the true colour, by reflected light, would become brighter and freer from white light until it came to be contaminated with more and more of the returned transmitted light. Such changes are beautifully exemplified by the gradual addition of the solvent to aniline colours in crystals. Aniline colours, prussian-blue, indigo, carmine, and all other dye-stuffs which have very great tinctorial powers, have the metallic lustre, and their colour by transmitted light is nearly complementary to that by reflected light. In their relation to light, Professor Seeley suggests that metals are closely analogous to those dye-stuffs which show a bronzed surface by reflected light. Metals are more perfectly bronzed because their opacity and density are greater. This theory requires for its demonstration a transparent diluent, or solvent of metals which shall have no chemical action on them. For a few of the metals such a solvent is an anhydrous ammonia. If the menstruum be added to the white alkali metals, the whiteness disappears, and is replaced by copper redness, which, at last, gives place to the blue of transmitted light. The changes of tint in this case from copper redness to transparent blue, may be exactly repeated by treating pure aniline blue with alcohol. The alkali metals are then copper red in reflected light, and by transmitted light, blue. That the salts of copper are blue is, in this connection, perhaps of consequence. The solution of metals without definite chemical action is an idea having comparative novelty.

So far as the reports of the scientific observers of the solar eclipse have been collated, everything was highly successful. Writing to *Nature*, from Ootacamund, on the 19th ult., Mr. Norman Lockyer gives a graphic account of the eclipse, as witnessed by him at Bekul. Speaking of the corona, he describes it "as beautiful as it is possible to imagine anything to be." It looked strangely weird and unearthly. The air was dry, there were no clouds, and everything was quite serene. There was in the landscape no ghastly effects, due to the monochromatic lights which chase each other over the gloomy earth. The corona was of the purest silvery whiteness. Trying the spectrum of a streamer above the point at which the sun had disappeared, he says it was undoubtedly the spectrum of glowing gas. At this station, five fine photographs of the eclipse were obtained. Captain Maclear, writing on the 6th inst., on board of the s.s. *Indus*, describes how, when totality came on, the light decreased, and the lines in the spectrum increased with great rapidity, both in number and brightness, until it seemed as if every line in the spectrum was reversed, after which they quickly vanished, and all was darkness. The colour of the corona appeared to him to be a light pinkish white, very brilliant. He saw no streamers. The rest of the sky, and everything around had a blueish tinge.

The scientific world will regret to learn that, owing to the state of Professor Huxley's health, he has been compelled to relinquish all work for the present. To recruit his health, he has gone to Egypt, from which country he is expected to return in the spring.

The effect of mercurial vapour on iodide of silver is well known to those who are acquainted with the experiments and photographic process originated by Daguerre. M. Merget has made some further interesting researches into the vaporisation of mercury. The following processes have arisen out of his experiments:—Trace upon a sheet of paper a drawing of any kind, with a solution of either nitrate of silver or chloride of gold; the drawing or writing thus made will be invisible. If the paper be placed over a vessel containing mercury, sufficient vapour will be generated, even at an ordinary temperature, to communicate to the previously invisible drawing a black tint. One would scarcely have expected that a brilliant and heavy metal like mercury would emit a vapour, yet of the fact here mentioned there cannot be any doubt whatever. It was the accidental presence of a little mercury in a drawer, in which M. Daguerre had stored away one of his experimental photographic plates, that led to the discovery associated with his name; and M. Berget's recent applications of this almost insensible vaporisation bid fair to assume great importance. One of these applications is as follows:—"Expose a sheet of paper, or a piece of wood above mercury. The vapour will insinuate itself within the pores of the paper or wood, and when a sheet of prepared paper is placed against the sheet or the wood, the details of vegetable construction, however delicate they may be, will be seen reproduced upon the paper with scrupulous fidelity; in fact the sensitiveness of the process is such that it will indicate the slightest traces of mercury, either in the bodies of animals or in the atmosphere. In all looking-glass manufactories, no matter how large and well-ventilated they may be, it has been proved that from the floor to the ceiling the atmosphere is constantly saturated with mercurial vapour. Workmen who only remained for four hours a day in such a place, have their skins, beards, hair, and clothes, impregnated with mercury, so that, even outside of the workshop, they remain under the influence of the deleterious emanations from this metal. The hands of a workman in one of these factories, when placed over a sheet of prepared paper, left a faithful image of it. In connection with this subject, it is proper to observe that it has been known for some time that the vapour of sulphur is an antidote for that of mercury.

Some experiments for showing an improved quality of gun-cotton, as made by Mr. Punshon, took place at Wormwood Scrubbs on Wednesday last. Mr. Punshon claims to be able to produce a gun-cotton of any required explosive quality, so as to suit any purpose for which it may be wanted, and at the same time ensure perfect uniformity of manufacture. He also claims that by his treatment the difficulty of stowage is got rid of, and that his gun-cotton may be stored dry without any liability to decomposition and consequent spontaneous explosion. He accomplishes his objects by covering the particles of gun-cotton with sugar, with chlorate and potash, or other salts, so as to separate the particles of cotton, and by varying the proportions and quantities of these materials to suit the special explosive quality required. The experiments, however, on Wednesday were simply to test the quality of the cotton as prepared for rifle shooting as compared with gunpowder. The cartridges contained 50 grains of cotton, and were tried against gunpowder cartridges containing 50 grains, 70 grains, and 84 grains. The first trial was against a target composed of fourteen pine boards, of one inch thick, clamped together, and at 25 yards' distance. In this case, the bullets in each instance passed through all the boards, and splashed against the iron target behind; but at longer distances, up to 200 yards, the gun-cotton still penetrated, while the gunpowder cartridges, containing 70 grains, and ultimately 84 grains, had to be used to effect the same amount of penetration. At 500 yards, the shooting from the shoulder with the gun-cotton cartridges was regular and good.

The famous Polytechnic School of Paris is at present, as it always has been, both a military and civil college, while the Ecole de Saint Cyr prepares young men for the army only. It is now proposed to make the character of the two schools more completely distinct, by transferring the Ecole Polytechnic from the War to the Public Works Department of the State. If this plan be carried out, this school will, in future, like the Ecole des Arts et Métiers, only train pupils as civil engineers and chemists for the services of the mines, forests, telegraphy, ponts et chaussées, and the tobacco and other manufactories of the state. The school of Saint Cyr will then assume greater importance as the only establishment for military education. On leaving this school, the young officers will proceed to one of the special military colleges at Rouen, Saumur, or that of the military staff of Paris. It is further proposed to establish, in connection with Saint Cyr, preparatory military schools in various parts of the country, to which the children of officers and of soldiers and national guards killed during the war with Germany will be admitted gratuitously.

CALENDAR OF MEETINGS.

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ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

January 31st.—"On Individual Providence for Old Age as a National Question." By G. C. T. Bartley, Esq., Treasurer. On this evening, the Right Hon. the Earl of Derby will preside.

February 7th.—"On the Forests of England, their Restoration, and Scientific Management." By Thomas Wingfield Webber, Esq., Officiating Deputy Conservator of Forests, Central Province of India.

February 14th.—"On the Study of Economic Botany, and its Claims Educationally and Commercially Considered." By James Collins, Esq., F.B.S. Edin., Curator of the Museum of the Pharmaceutical Society of Great Britain.

INDIA CONFERENCES.

Conferences will be held on Friday evenings as follows:—

This Evening, January 26th.—"On the Route to Western and South Western China by the Irriwadi and other Rivers of India, and the Commercial Advantages attached to it." The Conference will be opened by Commander F. E. Manners, and will commence at eight o'clock.

February 23rd.—"On India as a Field for Private Enterprise." The Conference will be opened by Frederick Campbell, Esq., of Assam.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....Social Science Association, 8. Mr. W. Vernon Harcourt, Q.C., M.P., "On Organisation of Courts of Law and Equity."
London Institution, 4. Professor Odling, "Elementary Chemistry."
Medical, 8.
Actuaries, 7. Mr. C. J. Bunyon, M.A., "On the Value or Measure of Proof in a Liquidation of current Life Insurance Policies, considered with reference to the decisions in Bell's and Lancaster's cases."
Royal United Service Institution, 8½. Mr. Nathaniel Barnaby, "Modern Ships of War, as illustrated by the Models in the Institution."

Tues.....Civil Engineers, 8. Mr. Geo. Gordon, "On the Value of Water, and its Storage and Distribution in Southern India."
Royal Institution, 3. Dr. Rutherford, "On the Circulatory and Nervous Systems."

Wed.....**SOCIETY OF ARTS, 8.** Mr. George C. T. Bartley, "On Individual Providence for Old Age as a National Question."
Science and Art Department (South Kensington Museum), 2½. Professor Guthrie, "Elementary Physics and Chemistry."

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. Mr. George Bentham, "On the Classification and Geographical Distribution of Compositæ."
Chemical, 8.
Royal Society Club, 6.
Artists and Amateurs, 8.
London Institution, 7½.
Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."

Fri.......Geologists' Association, 7½. Annual Meeting, and Rev. T. G. Bonney, "On the Chloritic Marl Deposits of Cambridge."
Philological, 8¼.
Royal Institution, 9. Prof. Tyndall, "Remarks on the Identity of Light and Radiant Heat."
Archæological Institute, 4.
Royal United Service Institution, 3. Staff-Captain F. J. O. Evans, R.N., "On the Present State of our Knowledge respecting the Magnetism of Iron Ships, and the Treatment of their Compasses."

Sat.......Royal Institution, 3. Mr. Donne, "On the Theatre in Shakespeare's Time."
Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."

Journal of the Society of Arts.

No. 1,002. Vol. XX.

FRIDAY, FEBRUARY 2, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

H.R.H. THE PRESIDENT.

The following letter has been received from General Sir Wm. Knollys, in reply to the resolution of congratulation to H.R.H. the President:—

Sandringham, King's Lynn,
January 31, 1872.

Sir,—I am directed by the Prince of Wales to request that you will convey to the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, and accept yourself, his sincere thanks for the resolution they have passed and you have transmitted, expressing their satisfaction and offering their congratulations on His Royal Highness's recovery from his late dangerous illness.

I have the honour to be, Sir,
Your most obedient servant,
W. Knollys.

P. Le Neve Foster, Esq.

MOSCOW EXHIBITION.

The Committee have received a communication from Berlin, informing them that the Minister of Commerce there, in reply to a letter addressed to him on the subject of transit per rail, through North Germany, of goods from the United Kingdom destined for exhibition in Moscow, has consented that these shall be placed on the same footing as exhibits from Germany—*i.e.*, *ordinary rates* going, and returns *free*.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

EIGHTH ORDINARY MEETING.

Wednesday, January 31st, 1872; The Right Hon. the Earl of Derby in the chair.

The following candidates were proposed for election as members of the Society:—

Crawford, Tyson, Messrs. Dolland and Co., 1, Ludgate-hill, E.C.
Davidson, T. F., 80, Newgate-street, E.C.
Dipnall, James F. T., Beckenham, Kent.
Dow, Patrick C., 39, Lime-street, E.C.
Erlanger, the Baron, 43, Lothbury, E.C.
Evered, R. B., 28, Drury-lane, W.C, and Surrey Works, Smethwick, near Birmingham.
Gibbons, George, 9, Southwark-street, Borough, S.E.
Harris, Rev. J. C. Lloyd, Billinghurst, Sussex.
Hopkins, Henry, 42, Houndsditch, E.
Isaacs, Henry A., 60, Fenchurch-street, E.C.
McLeod, Sir Donald Friell, Bart., K.C.S.I., C.B., 1, Clarendon-road, Victoria-road, Kensington, W.
Malam, William, Langley-villa, Forest-hill, S.E.
Mills, Charles H., M.P., 67, Lombard-street, E.C.
Mitchell, Benjamin, 8, Dacre-park, Lee, Kent, S.E.
Nicholls, H. F., Mayor of Bridgwater.
Norwood, C. M., M.P., 2, Billiter-street, E.C.
Pease, Charles, Darlington.
Talbert, B. J., 11, Argyle-street, Regent-street, W.

AND AS HONORARY CORRESPONDING MEMBER.

Delondre, Augustin, Rue des Juifs, 20, Paris.

The following candidates were balloted for, and duly elected members of the Society:—

Ashby, Frederick William, Staines.
Caine, William S., 16, Alexandra-drive, Liverpool.
Campbell, Frederick, 82, Hereford-road, Westbourne-grove, W.
Cape, Lawson, M.D., 28, Curzon-street, W.
Cawley, Charles E., M.P., National Club, S.W.
Chaplin, Henry, M.P., Blankney-hall, Sleaford.
Dietrichson, Lauritz, 127, Lancaster-road, Notting-hill, W.
Dougall, James Dalziel, 51, Bedford-gardens, Kensington, W.
Dunn, John Messenger, 30, Claverton-street, St. George's-square, S.W.
Edmondson, Joseph, Balmoral-place, Halifax, and Brunswick-mills, Halifax
Espinasse, Francis, 4, Stafford-place, Buckingham-gate, W.
Finnie, William, M.P., Newfield, Kilmarnock.
Goldsmid, Sir Francis Henry, Bart., Q.C., M.P., Rendcomb-park, Cirencester.
Guthrie, Professor, F.R.S., Royal School of Mines, Jermyn-street, S.W.
Hart, Mrs. Ellen, 10, Carlton-terrace, Harrow-road, N.W.
Haworth, Jesse, Pall-mall, and Strutt-street, Manchester.
Holden, Angus, Woodlands, Bradford.
Jones, Charles, Windsor-road, Ealing, W.
Jones, Rev. John, Hawthorn-villa, Anfield-road, Liverpool.
Jones, John, Middlesborough.
Lee, Henry, J.P., Sedgley-park, Manchester.
Nunn, Richard Joseph, M.D., Savannah, Georgia, U.S. America.
Park, James, 52, Gracechurch-street, E.C.
Saywell, George, 1, Percy-circus, Pentonville, N.
Smithson, Joseph, Balmoral-place, Halifax, and Brunswick Mills, Halifax.
Taylor, Thomas, J.P., Aston Rowant, Tetsworth, Oxfordshire.

Warren, Joseph, 146, New Bond-street, W.
Weichert, William, 19, Bute-dock, Cardiff.
Whittall, Alfred, 3, Clarendon-terrace, Harrow.

AND AS HONORARY CORRESPONDING MEMBER.

Roche, Martin, M.D., President of the Polytechnic, corner of Chesnut and Eighth streets, Philadelphia.

The Secretary drew the attention of the meeting to a series of twenty-eight carved oak panels, forming part of a dining-room wall decoration, executed for C. B. E. Wright, Esq., Bolton-hall, Yorkshire. The subjects are designed by Mr. George Lock, and consist of scenes, in which the animal life of Britain is represented. They are exhibited by Messrs. C. Hindley and Sons, of 134, Oxford-street, and have been executed by their workmen, whose names follow, without the aid of models. Messrs. Neaves, Moutrie, P. M. Gyselman, Richards, Grimwood, B. Gyselman, Hobbis, Anderson, Macnamara, Marshall, Pierlay, Egere, Sparrow, Modere, Baldwin, and Bastianello.

The paper read was :—

INDIVIDUAL PROVIDENCE FOR OLD AGE AS A NATIONAL QUESTION.

By George C. T. Bartley.

Societies exist for charitable purposes of almost all descriptions. So numerous, indeed, are they that it is difficult to think of any human want which has not some sort of association for its relief. That this is so we may be justly proud. A great proportion of these charitable institutions have grown up in our own time, and it is somewhat consoling to think that, in spite of the many prophets who seem to delight in proving that the old country is becoming rapidly and irretrievably degenerate, the creation of so many noble institutions has accompanied our increase in wealth. In spite of all that has been done, however, poverty and wretchedness seem to have developed in the same degree as the growth of our riches and our charities. No doubt several causes may be cited as having tended to produce this, and varying opinions will be given to explain the apparent anomaly. Some will say that it is the introduction of machinery; some may put it down to free trade ; others to political faults, or administrative blunders. I will not attempt to advocate or reject any one or other of these explanations. I venture, however, to think that there are two causes besides any I have mentioned, which have tended pre-eminently to produce this state of affairs, and those are, the great absence of individual providence, and the fact that charity has been looked upon as consisting only of almsgiving and relief, and has almost altogether failed to inculcate and encourage habits of individual providence.

The energy of each charity is directed almost entirely to alleviating one branch of suffering. Like a trader, it advertises and touts for custom, and, indeed, practically, if not absolutely, invites recipients for its alms. This is so much the case, that the prevention of poverty and distress, by inculcating habits of individual providence, so far from coming within the functions of most charities, may almost be said to be antagonistic to their work. Thus, an energetic pension society endeavours to increase its funds and the number of its recipients; it is its business to do so, and it can hardly be expected to preach effectively the evils of improvidence, and to encourage people to put by for old age, in order to do away with the relief which it is its province to offer. It can hardly strive to make itself useless, nor point out the evil consequences of extravagance, for it exists chiefly for the purpose of making up for such deficiencies. Institutions for the relief of destitute orphanage or widowhood act in the same way. Their object is excellent, and there is no doubt but that they do incalculable good in numerous cases. It is nevertheless apparent that the community would be the better off if such charities were not required. Such a condition of society is not likely to happen in our time, but the nearer we approach to it the better, and our laws and habits should be directed towards such a standard of social excellence. No one can deny that it would be better for a widow and her family to be left with £100 insurance money, their own through the husband's providence, rather than that she should be left with nothing but her widow's weeds, so that charity should have to supply the very means of existence. To steer clear of the two evils, namely, of encouraging improvidence by too lavish almsgiving, or of allowing a neglect of providence to be visited with too severe a penalty, as would be the case were charity to stop her work, is a most delicate task.

The difficulty of increasing individual providence, and even of bringing the subject before the public and the employers of labour is great, from several considerations. When distress comes in consequence of a neglect of it, as in the case of a father dying or becoming permanently disabled, and leaving a number of children unprovided for, it is impossible to point at the widow and orphans, or to lecture the drowning man, instead of trying to save him. We feel we must do something; our hearts yearn to alleviate in some way the distress we witness, and no one would say but that we are right in giving way—if we only do so wisely—to our charitable feelings. Again, in the time of prosperity, we are apt to be equally unsuccessful in our efforts to inculcate providence. The well-to-do man may resent any suggestion on the subject, or if he do not go so far as this, he will probably think there is no hurry for him to begin. He will wish to put off the evil day, as he secretly will think it, for all men are more or less prone to procrastination in such matters.

Another obstacle to inculcating habits of providence is that little or no sentiment can be brought to bear on the subject, as is so easily done with charity, and few, comparatively, can therefore be induced to labour in such a cause. To a touching case of distress the hardest will sometimes subscribe his money, and even devote his time; but it is difficult to get up energy for the prosy work of inducing a rough, strong man, in full health, to provide for his family in case of his death, or for his own old age. He will very likely be found to be obstinate and pig-headed, and may fancy you have some personal interest to serve in what you are suggesting. Again, the abundance of charity may, and often does, tend directly to induce a man to trust to Providence, as he calls it; and he will say, or at any rate think, "Well, if anything happens to me, I suppose some charity or other will look after my wife and children."

Many there are, even in a superior position, making regularly two or three hundred a year, who do not attempt in any way to provide for their families, and who seem to expect, like Mr. Micawber, that something will turn up somehow. The conduct of these, however, is really intense selfishness. With such, it is not my purpose to argue; they should know their duty and best interest, and how to perform it, as well as I can tell them; and, if they continue to act as they do, they and their families must take the consequences. The industrial classes, living by weekly wages, are, however, in a very different position. I hold it to be equally their duty in nearly all—might I say, in all?—cases, to provide according to their means; yet their failing to do so, which is so common, is due often to ignorance, to the want of opportunity, and to the hand-to-mouth means of living which so many of them are compelled to adopt.

I propose to say a few words :—

1. On the means which now are in active operation, and are understood more or less by the industrial classes, for encouraging habits of providence, and how they are made use of.

2. How they fail to provide for old age.

3. On the means which do exist for enabling a man to put by, in small weekly sums, for old age.

4 On the means which it seems desirable should be

taken to encourage providence for old age, and to make known among all classes the facilities which exist for this purpose.

1.—On the Means which are now in Active Operation, and are understood more or less by the Industrial Classes, for Encouraging Habits of Providence, and how they are made use of.

A.—Trades Unions.

The most important and organised means of encouraging providence among the industrial population is that supplied by the trades unions, the benefit societies, and the savings banks. All trades unions are benefit societies. It is part of their function, not only to watch over the interests of their particular trade, but also to afford relief to their members when incapacitated from work by accident, sickness, or a scarcity of employment. They also usually allow a sum for the funeral expenses of the members and their wives, and in some few instances provide superannuation allowances to members incapacitated by old age. Trade unions have, however, other functions besides these, which are, perhaps, better known by the outside world, so much so that the very mention of the word union seems almost to frighten many persons. They are looked upon as the causes of strikes, and of most misfortunes in trade matters. Without expressing any opinion as to the advantages or the disadvantages of their work in these respects, it is but just to acknowledge that their action as benefit societies has been immense, and that they have induced habits of economy and self-denial among the industrial classes to a very considerable extent. It may, perhaps, be said that they were the first to do anything of importance in this respect amongst the working population.

The assistance which these societies usually afford is as follows :—

1. Donation benefit.
2. Sick benefit.
3. Tool benefit.
4. Accident benefit.
5. Emigration benefit.
6. Funeral benefit.
7. Contingent and benevolent fund benefit.
8. Superannuation benefit.

1. *The Donation Benefit.*—This is in all trades unions the largest class of expenditure. Every member who is out of work for a certain number of consecutive days in a week, usually three, is allowed a certain sum per week. In the Engineers' Union it is 10s. a-week for the first fourteen weeks, 7s. for the next thirty weeks, and 6s. after that so long as the member remains out of employ. In 1869, this union expended in this way £59,980. It must not be inferred that this implies that so much was expended in support of trade disputes, for only £2,200 was thus applied. I fear that last year the amount of this item will unfortunately be found to have been very much greater, owing to the unfortunate disputes among the engineers of the North. The whole of the balance, namely, £57,780, must, therefore, be regarded as having been set apart by the members themselves, when in good work, as an insurance against want during a time of scarcity of work.

2. *The Sick, the Tool, the Accident, the Emigration, the Funeral, and the Contingent Benefits.*—Some unions have all these benefits, whilst others only undertake one or more of these branches of assistance. Generally speaking, they are managed similarly in most trades unions, though the details and the amounts paid in and allowed to members requiring any particular benefit necessarily vary somewhat. They are strictly provident schemes, and, on the whole, are justly managed, and have one and all done immense good to the working classes, and, consequently, to the community at large.

3. *The Superannuation Benefit.*—This is one of the branches of the trade union scheme which bears especially on my subject, and will be more fully considered in the next section.

B.—Benefit Societies.

These societies do not interfere in trade disputes or trade matters, but as far as their benefits are concerned, their action is usually very similar to that of the trade unions. Inasmuch as they avoid the uncertain and frequently heavy expenses of trade matters, benefit societies should be, and in many cases no doubt are, financially in a sound condition. Some of them include in their programme a provision for old age ; but their purpose is chiefly confined to sickness, and to providing money for the expenses of funerals both to members and their wives. They cannot be regarded as supplying a regular superannuation system, nor indeed, do the amounts usually paid by members render such an arrangement possible.

Several ideas have been advocated for the improvement of both trade and friendly societies. Their expenditure on collection and administration is often unnecessarily large, and might be much reduced by combining a number of small societies together. Their usual practice of meeting at public-houses is an evil in every way; and some of the best friends of the working classes, both members of their own order and others, have long advocated a reform in this respect.

A very serious consideration has been raised concerning both the unions and the friendly societies, and that is as to the soundness of their financial position. Where they profess to superannuate their members, it would be impossible for most of them to meet the demand if, as the natural aim of all these associations should be, every member continued regularly on the books, and all who lived claimed the allowance. As regards the other benefits, there should be no doubt as to the ability of the association, and particularly of a friendly society, to meet all the ordinary demands on its funds. The tendency is, no doubt, to offer too much for the subscription; but any actuary could say, after a few hours' examination, whether the risk is fairly covered, and what further subscription should be asked, or what fewer benefits promised. In all these associations it should always be remembered that it is impossible to get more out of a quart pot than is put in. One person may have an undue share, but some other must suffer; manage it how you will, the quart is only a quart after all.

C.—Building Societies.

These societies, as is well known, afford facilities to persons, by means of advances, repayable by instalments, to enable them to build and purchase their own houses. When well-conducted, they have done and are doing considerable good. They are, in the best sense, provident societies, and indirectly, to a certain extent, they provide for old age.

D.—Savings Banks.

The working of these institutions is so well known to those present that it is scarcely necessary for me to dwell much upon them. Those under private management have of late years been somewhat reduced in number, and absorbed into the more general scheme of the Post-office. The facilities afforded by this government department are excellent ; no higher encomium can be given than the statement of the fact that a perfectly secure place of deposit for the smallest savings has been brought within the reach of every person in the kingdom.

Considering, then, these four systems which are in operation for the encouragement of providence among the working classes, and the great extent to which they have developed, it must be acknowledged that a spirit of providence is to be found, and that there exists a greater desire for providing for the future, as far as accident and illness are concerned, than is generally believed.

II.—How Means for Encouraging Providence now in Active Operation fail to Provide for Old Age.

The superannuation benefit above referred to, though forming part of the scheme of some trades unions and benefit societies, is by no means universal with either of these bodies, nor is it much taken advantage of in those which do adopt it. In the Engineers' Union it has, however, been increasing of late, and absorbed, according to the last report, no less than one-tenth of the income of the society. In 1861, the amount thus spent by the union was but £2,439; in 1869 it had grown to £8,055, or an advance of more than three hundred per cent. The members had only increased during the same period from 22,862 to 33,539, or barely fifty per cent. The general secretary, Mr. W. Allan, in his last report, draws particular attention to these facts, and is evidently alive to the importance of them, though it appears from the evidence before the Trades Union Commissioners that the society does not calculate on anything like all its members ever coming to claim this benefit. It is, indeed, perfectly certain that the funds of no trade union could meet the demands made on it from this source, if all the members (after allowing, of course, a proper rate of mortality), kept on its books regularly, and in due time became claimants. Among the engineers the scale of pension is as follows:—

(a) A man joining at 32 years of age, and paying for 18 consecutive years, may, if *worn out*, obtain 7s. a week for the remainder of his life.

(b) A man joining at 25 years of age, and paying for 25 consecutive years, may, if *worn out*, obtain 8s. a week for the remainder of his life.

(c) A man joining at 20 years of age, and paying for 30 consecutive years, may, if *worn out*, obtain 9s. a week for the remainder of his life.

Members of the chief trades unions pay but 1s. a week for all the benefits of the union. Certain fines are also payable, which produce considerable sums; but allowing for all possible sources of income, it is evident that the fees are so arranged as not to suppose it possible for all, or nearly all, of the members ultimately to receive the superannuation benefit.

There are two reasons which particularly tend to prevent members receiving the pension, and these are:—1st. The constant cessation from the union; that is, members frequently leave the union and rejoin it again, and in this way do not qualify by 18 successive years of membership, which are usually required to secure a pension. 2nd. The condition that superannuated members must be worn out, and, that when they are receiving a pension, they must not work at their own trade, even for lower wages than those given to able-bodied workmen. They may, indeed, work at any other trade than that of the union from which they derive their pension; but not many could do much at a new trade at fifty, if worn out. They prefer, therefore, to go on working as long as they can before claiming, even if eligible, to be put on the superannuated list.

In spite, however, of the comparatively few who receive pensions, the number is increasing in the more influential unions in which this benefit exists. So much is this the case that it may be said to be causing some alarm among the officers. The General Secretary of the Engineers, Mr. Allan, stated in his report last year:—"It will be observed that £8,055 17s. 8d. has been paid to superannuated members, and this, to my mind, becomes a very important question; I cannot refrain from alluding particularly to it, in fact its importance cannot be overlooked. . . . . It, therefore, becomes a serious question, and one which, sooner or later, must claim the attention of the members. The amount paid per member in 1861 was 2s. 1½d. per annum, whilst in 1869 it was 4s. 9¾d."

It must be evident to anyone considering the subject, what the results on trades unions would be if the tax for superannuation became very heavy, as it must become if a large proportion of members claimed the benefit of it. If, for instance, it were necessary to have a special levy in order to meet it, a number of the younger members would soon drop off, and either give up the idea of a union altogether, or form a new one unburdened with the weight of pensions for the former generation. If the levy had to be repeated once or twice, the chance is the old union would break up altogether. The system, therefore, on which a union is formed appears to be such that the superannuation benefit can never become the regular provision for the old age of the masses.

The Royal Commissioners on Trades Unions urged the desirability of separating the funds devoted to benefits from those applied to trade purposes. No doubt this would be desirable, though it is never likely to be adopted. We cannot expect men not to see the great strength which these benefits have in keeping the unions together. A member pays for years, so that if ill, or out of work by accident, he may obtain some allowance as a right. He knows that a part of his subscription goes to support trade disputes, and though he may be anxious for the welfare of his trade, yet, very likely, he would not subscribe a separate sum merely for the indirect benefit thus secured to him, particularly as non-union men generally obtain any advantages secured by the efforts of the unions. If he disapproves of any particular action of his union, he cannot leave it without forfeiting all the advantages for which he has been paying. The managers of unions see this, of course, and are not likely—in fact it would be unreasonable to expect they should—give up such powerful instruments for keeping the unions together as they know the benefit branches to be.

I think, however, they might, with great advantage to themselves and their members, give up the superannuation benefit, and use their great influence in encouraging and spreading the scheme for providing for old age, which I shall presently explain. It is better for a union not to undertake a responsibility which it is evident is beginning to be seriously felt, and which, would press too heavily on the funds if all the members who lived long enough tried to obtain the pension to which they should in theory be entitled.

III.—On the Means which do Exist for Enabling a Man to put by in Small Sums for Old Age.

Allowing that trade and benefit societies do provide, as far as they go, for sickness, accident, the cost of burial, &c., we still find that old age, to many thousands of us, remains with little other provision than charity or the workhouse. Some say that it is charity's best work to provide for grey hairs. This, as a proposition, I cannot for a moment allow, though, no doubt, in some cases it holds good. As a general and universal law, such an idea would be fatal to individual and national prosperity. It would simply mean that charity is to supplement wages; that a charity fund is, in fact, to do away with the necessity for a man's providing for himself, and encourage him to spend all as fast as he earns it, and then become dependent on the favour of his neighbours. Others advocate that the workhouses should be made into relieving almshouses for the old. This again is evidently opposed to sound doctrine. It is making the forced economy of the present generation provide for the want of providence of the past, an arrangement in every way wrong. Children, when required, should, of course, be willing and glad to assist the parents; but this should be the exception, not the rule. Almsgiving itself and the workhouse are, no doubt, both necessary in individual cases; but the less the country requires these assistants the better. If either is to provide generally for old age, it must be done at the expense of wages, for it is evident that both wages, charity, and the rates have to be paid out of much the same fund, and that is from the results of previous economy—that which is either enforced by law, as in the rates, or that which is voluntary, as in charity—of some members of the community.

I can imagine some one meeting me with the argument that, were these views true and carried out, charity, that brightest gem of human nature, would be superseded and abolished as old-fashioned. I think not. The giving of alms is not necessarily charity. We may give all our goods to feed the poor and yet not possess that greatest virtue. This fallacy prevents many persons from acting wisely. They cannot disconnect charity from giving money or direct relief in some shape. If every one of the thirty millions in these isles could drive his carriage and pair, a great field would still remain for charity, and acts of the greatest and truest charity would still be found needful to render life happy. *Charity's highest aim is not to give relief, but to prevent distress;* and what greater field can there be than in working to induce all classes so to live as to keep themselves free from requiring assistance, which must always be galling to the honest and independent, however humble their station in society may be.

As surely, therefore, as old age and a comparative inability to work is certain to come to a proportion of us, so surely must it, in some way or other, be provided for. Charity and the Poor-law are now the only prospect to many thousands, and this as we have just seen should not be allowed to last. Many may think me hard, but the truth in such matters must be faced. For individual success, for national prosperity, and for universal advancement, the weekly wage-classes must themselves provide according to their means for the coming winter of life. Provision for sickness and accident no doubt come first, but some certain prospect for old age is next in importance.

The annuity system of the Post-office, though comparatively little known, meets this want most admirably. By a weekly payment during a certain number of years, a pension—varying, of course, with the sum paid—may be secured for the rest of the subscriber's life. Thus, a man at twenty years of age paying 1s. 11d. per week till he is 55. obtains, without further payment, at 55, and for the remainder of his life, 10s. a-week. If he began to pay at 25 years of age, he would have to set aside 2s. 4d. a-week to secure the same provision; if at 30 years, 3s. 1d.; if at 35 years, 4s. 2d.; and if at 40 years, 5s. 11d. More or less, up to £50 a-year, may be secured, according to payment or length of time elapsing between the commencement of paying and the first instalment of the annuity becoming due. The calculations of these payments are somewhat complicated, but I have drawn out a few tables and append them to my paper, so that any one wishing to consult them will find them in the next issue of the Society's *Journal.*

It may be said that few can afford to put by, and no doubt the effort of self-denial is great, particularly at first. I may, however, be allowed to use a remark which has often been made, and that is that the cost of one glass of beer or spirits a-day would go far towards providing the amount necessary to enable a man to provide well for his old age. At the present time, too, the industrial classes are taxed heavily by subscriptions and various collections for their companions. Besides a man's club, or union, or friendly society, in many places of business scarcely a week passes without some form of petition going through his shop. To these he is almost bound to subscribe, the amount varying with the individual case of distress or the popularity of the deceased or afflicted companion. This tax would, of course, be obviated by the arrangement of a systematic provision by all.

This system of deferred annuity may also act as a life insurance and savings bank combined. If commenced early, and before the expenses of a family are severely felt, a considerable sum may have accumulated sufficient to obviate the necessity of either of these means of providence being required. On the scale above given, if the person does not live long enough to enjoy the annuity, or wishes at any time to withdraw, the whole sum paid in is returned without any deduction. Thus, the man at 20, dying at 21, would leave about £5 to his family, or dying at 26, would leave nearly £30, and so on.

This scheme, which, of course, contains many details, is most carefully carried out, and has been in operation for some seventeen or eighteen years. It has, however, been taken advantage of by the industrial classes, for whose benefit it is expressly framed, to a very slight extent. On the 31st December, 1870, only 335 contracts were in existence, representing deferred annuities to the amount of £7,342 16s. Such a result, for the whole country, it is not necessary to say, is almost the same as if the scheme had not been taken advantage of at all. This is attributable, no doubt, partly to ignorance and partly to carelessness, and it would be hard to say which of these two obstacles is the more difficult to remove.

Even if a man be willing to lay by for old age, and, in a moment of good resolve, commences to do so, it is surprising how soon the habit may be given up if to carry it out the least exertion or trouble has to be bestowed upon it. If, after receiving the week's wages, it is necessary to walk across the street, or even to go to another counter, in order to pay the instalment of a premium, that simple act will soon diminish the number of premiums paid. This is very forcibly shown in the recent evidence at Glasgow, before the Royal Commission on Friendly Societies. Mr. Stewart, manager of the City of Glasgow Friendly Society, stated that that society gives its collectors a commission of 25 per cent. on all the members' payments, and offers to allow this to any member who will come himself or send his payments direct to the office. Not a single member has taken advantage of this offer. This means that they prefer to pay a collector at their own door 1s. rather than take 9d. to the office of the society, which is usually close at hand. This apathy is to be regretted, but as it exists, we must take human nature as we find it, and endeavour to act accordingly. The cost of collectors in many friendly societies is enormous, and yet they cannot do without them. 25 to 30 per cent., which is the regular payment, is a most extravagant mode of collecting, such as no institution of rich City merchants would tolerate for a moment.

The only economical and practical way of collecting is that of deducting from the wages. It is the simplest, most certain, and least unpleasant. A man agrees to put by weekly one shilling, more or less, as the case may be, and he gets perfectly accustomed to his wages without it; in a year or two he hardly knows that he is putting anything by. If, however, he has, even at the same table where he receives his wages, to give back a sum, it seems like an expenditure or a tax, and at times he is reluctant. As thousands join a friendly society and continue in it because of the visit of the collector, so many thousands more would agree to set apart a small weekly sum if it were deducted from their earnings, and they understood the system. They would continue to live on the reduced wages, at first by habit, but as time went on it may be hoped they would fully appreciate the advantages they were securing for themselves.

To facilitate this way of paying premiums, and in order to encourage a system of regular deductions from the wages or salaries of insurers, it is laid down in the Post-office regulations that at the office of any government department, any railway company, or any manufacturer, the Postmaster-General may, if he think fit, allow an office to be opened for the receipt of proposals and for the receipt of premiums and instalments. The Post-office, in such a case, will pay to the employers remuneration for the work done by them, their officers, or servants, as shall be agreed upon between him and them. This is usually arranged according to the number of payments made, at so much per thousand.

In thus referring to the Post-office system, it must not be supposed that I am anxious to do away with a single institution or society which exists for encouraging providence, unless it be really insolvent, and then the sooner it goes the better. Improvements which begin by abolishing all the work already bearing fruit are usually worth but little. The friendly and benefit societies, which number some 22,000 in this country alone, provide, as far as they go, for sickness and accident. I should wish to see them increased, not in number, for many might be combined with advantage and economy, but extended in operation on a sound and secure basis. Improved education, coupled with the organisation I shall presently suggest, will, I trust, lead to this, and to their being better managed in many ways. With the exception of a few of them, however, they do not, and, as at present constituted, they cannot, supply a regular provision for old age, nor do I see why they should attempt to do so. However well managed a society may be during one year, it is liable, by accident, fraud, or mismanagement, to be in difficulties in a subsequent year. The only way in which a provision for old age must be made, particularly to a man who can put by only in pence, or at best in shillings, is on *absolute security* as far as such a thing can be obtained. A benefit society, however sound it may be when a man joins, may become insolvent, in spite of all his care, before he is old. Even when it confines its operations to sickness and funeral expenses, its breaking up is a serious matter, and a severe shock to the spread of provident habits, but the subscriber has, at any rate, had some benefit during the period of his membership. If, however, it has attempted to supply a pension for old age, and the savings of a life-time of providence and care are swept away, one of the cruellest blows possible is inflicted, not only on the person himself, but on all around and belonging to him. From these considerations, it seems to me that the provision for old age among the industrial classes should almost always be in the government securities. A rich man may provide in a number of securities, and thus balance one risk against the other, but the poor man cannot do so. The legislature has provided for this, and has most wisely arranged, as we have seen, a plan by which small savings shall be as secure as the country itself. Without wishing to imply that all should be *required* to make use of the Post-office, or inferring that this is the only sound institution existing, I think it wise, and certainly the best policy, for the reasons given, that, in advocating providence, encouragement should be given as much as possible to the idea that the provision for old age should be built on about the strongest rock of security to be met with on this round earth.

From what I have already stated, it is evident that the arrangements which at this moment exist to encourage providence, though not perfect, are considerable, and put within the reach of nearly all the opportunity of providing at least something for themselves, if they care to do so. There are some points in the Post-office system, as well as in the rules of the friendly societies, which might with advantage be modified, but I have not dwelt on these, as it is not my purpose on the present occasion. A great deal more is prepared than is taken advantage of; and I would wish to suggest some practical means of bringing the existing machinery into much more general and practical working in all parts of the kingdom. If left to spread naturally, as it were, I believe it will be a long time before much is done. I wish to see a uniform, national habit spring up, by which regular and systematic weekly amounts will be put aside to provide for old age.

The little sums put by at uniform intervals are the only ones to be depended on. They amount almost invariably to much more than large and pretentious efforts when spasmodic and uncertain. A shilling a week will usually come to more in a year or two than a sovereign laid by *whenever it can be spared.* It is said that 2s. a week put by at interest from the age of 18 to 60 years amounts to £800. I have not checked this calculation, but it cannot be far from the mark. What I want to see introduced is, the devoting of a regular sum each week from a man's earnings to provide for old age. The putting aside, in fact, of something as systematically as he buys his Sunday's dinner. The amount will of course vary, but I would rather a man devoted a penny a week, yes, or even a halfpenny a week, to this purpose than nothing at all. It may surprise some when I state that this last amount, viz., one halfpenny a week, with fourpence added each year, will purchase for a man of 20 an insurance policy, on government security, of about £7.

IV.—On the Means which it seems desirable should be taken to Encourage Providence for Old Age, and to make known, among all classes, the facilities which exist for this purpose.

To secure the ends I am aiming at, I think that these arrangements would be desirable:—

1. That an association of large firms,* employers of labour, and leading members of the industrial classes, be formed, to extend information amongst all persons as to the facilities afforded by the Post-office, and other means which exist for encouraging individual providence, and the benefits to be derived therefrom.

2. That firms and houses of business be urged and assisted by this association in forming on their premises offices for the receipt of proposals for annuities, &c., and the receipt of premiums. That persons be encouraged to allow the premiums to be deducted regularly from their wages, and that arrangements be made for systematically carrying this out.

3. That the association adopt the idea, and try to promulgate it, of regarding a man's policy of insurance, annuity documents, or any proof of providence, as part of his character in seeking employment, and endeavour gradually to spread the system of considering some such provision as a regular condition of employment in new appointments.

As regards these points, I have no doubt difference of opinion may exist. Few will object to the first two. The second will entail some little trouble, but I may remind employers that many subordinate accountants would be glad to undertake this, if for no higher object than that a small extra salary may thereby be secured. The third point may cause some to hesitate. I am fully aware how difficult it is to carry out any change, however beneficial it may be, which affects the relations between employer and employed, and it is possible the idea will be looked upon as an interference with the liberty of the subject. In truth, it can hardly be so, however. We inquire into a man's habits of steadiness, sobriety, and honesty, and ask him to produce testimonials to substantiate his assertions. The fact of his having regularly paid his premiums for some years would do much to prove practically the first two, if not all, the above qualities.

At first, perhaps, it might be desirable at most places to adopt merely the first two points above given, and, if so, it would be a half loaf immensely to be preferred to no bread. I myself am so far an enthusiast as to hope that evidence of providence in some shape may become an ordinary condition of employment, at least with married persons. I can see no sound reason why this should not be so. It seems to me that a man's fellow employés might say with perfect fairness, "We object to anyone working with us so living that when old he must go on to the parish, or, in case of his premature death, his widow and children must be left destitute. It not only disgraces us all, but virtually the burden falls upon us. We consider that he is as bound to provide, according to his means, for his family, in the event of his death or disability, as he is to feed and clothe them during his working lifetime." This would obviate the endless petitions which are sent round in almost every firm on the death of some employé. Many a hard-working man pays weekly considerably more in this way than he would if he amply provided for his family by the annuity or insurance system. The trade unions have, no doubt, the greatest power for carrying out such a reform, and I trust that it will not be long before they use this most important means of elevating and strengthening their order.

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* This association is now being formed, and a prospectus is appended at the end of this paper.

The government is the largest employer in the country, and might do very much more than it does to inculcate providence among its servants. Some, it is true, are entitled to pensions, and this is really an enforced insurance. A man is paid less than his full value, in order that a certain allowance may be made to him after a period of years, or before, if he becomes incapacitated by sickness. Formerly there was a compulsory deduction from the salaries to provide this fund. The larger number of *employés*, however, are not eligible to obtain pensions; yet every post in the public service, from that of a dockyard labourer to the more aristocratic office of a junior clerk, is eagerly sought for. If on all new appointments, the condition of lodging insurance or (better still) annuity-papers were imposed, it could be no hardship. This might even apply to a temporary appointment. I think the government, which frames laws and Acts of Parliament to reduce pauperism and other evils, has a right to say, "We will engage no one unless we are reasonably sure that he will not, on leaving our employ, swell the pauper roll, or die and leave his family destitute." Firms and manufacturers would very likely follow the example were this done by government. In the case of those persons already engaged this rule could not fairly be enforced, but a little personal influence and trouble, on the part of superior officers, would induce a great many voluntarily to do what they could not fail to see would be for their own benefit. When men began to see and understand the advantages of the system, it is not unreasonable to hope that they would cease to oppose, and would willingly agree to it.

The work of the association or society I suggest should be to promulgate information as to the best means by which the wage-classes, domestic servants, &c., can put by weekly sums to provide for old age; to make known more generally the advantages offered by the Post-office by purchasing deferred annuities and life assurances by weekly and other payments; to facilitate the means of collecting such small weekly sums by inducing manufacturers and employers of labour to open, on their premises, offices for the receipt of such sums as arranged for by the Post-office; and generally to endeavour to create habits of providing against old age and possible premature death among those earning small wages. It should not give relief in any form, or be in any way of an eleemosynary character, but should merely make known among all, by means of lectures, addresses, personal intercourse, and other means, in all parts of the kingdom, the facilities which exist for enabling a man to provide for himself in proportion to his earnings, in the best manner, as in allowing a regular weekly deduction from the wages, and at the smallest possible sacrifice compatible with sound commercial security, such as in the government Post-office deferred annuities, &c. The society should also endeavour to effect alterations or extensions in the government systems at present in existence if this should be required, and to frame others if experience from time to time proves them to be necessary.

I can imagine some raising an objection—that, do what you will, thousands will still be improvident, that an Act of Parliament, or even the Rack itself, will not force such to do what they should. I am no Utopian and I am fully aware of this. I can only say I regret it, but the fact induces me to think, more strongly than ever, that some active and general system of providence is necessary, so that this unfortunate residuum of incorrigibles—and I certainly believe they are not the majority—may be reduced to the lowest possible limit.

The importance of providence to a nation cannot be over-estimated. For it to exist in a nation, it must be found in individuals, not among the rich only, but equally among those who count their earnings in shillings. Individual providence, if not the backbone of national progress, is so important a vertebra in the column that without it the stability of the whole must be seriously impaired. Some may still fear that all this argues too much of worldly wisdom, and that one must leave room for Christian charity to do her work. They may secretly fear that were this scheme in full working and successful order, charity, that noblest virtue, would soon be abolished, and commercial and parsimonious thrift would rule supreme in her place. Such need not be alarmed, for, in conclusion, I again assert that a far nobler field for charity than almsgiving is the prevention of distress, which can be best done by inducing and stimulating everyone, as far as in him lies, to provide for himself and they of his own household.

APPENDIX A.

Table, showing what 1s. a week will secure in the Government Securities.

A man whose age last birth-day was	Allows one shilling a week to be deducted from his wages, that is each year			This he has devoted to the purchase in one sum on the *returnable scale* of £1 annuities, as fast as sufficient money accumulates. The cost of these will be as follows.			The £1 annuities he will have secured will accumulate as follows.	Each to begin when he has reached the following ages.
	£	s.	d.	£	s.	d.	£	Years.
18	2	12	0		—		—	—
19	2	12	0	3	16	3	1	55
20	2	12	0	3	18	9	2	,,
21	2	12	0		—		2	,,
22	2	12	0	4	3	11	3	,,
23	2	12	0		—		3	,,
24	2	12	0	4	9	5	4	,,
25	2	12	0		—		4	,,
26	2	12	0	4	10	1	5	56
27	2	12	0	4	13	0	6	,,
28	2	12	0		—		6	,,
29	2	12	0	4	19	1	7	,,
30	2	12	0		—		7	,,
31	2	12	0	4	19	9	8	57
32	2	12	0		—		8	,,
33	2	12	0	5	6	4	9	,,
34	2	12	0		—		9	,,
35	2	12	0	5	13	5	10	,,
36	2	12	0		—		10	,,
37	2	12	0		—		10	,,
38	2	12	0	5	17	9	11	58
39	2	12	0		—		11	,,
40	2	12	0	6	5	6	12	,,
41	2	12	0		—		12	,,
42	2	12	0		—		12	,,
43	2	12	0	6	10	3	13	59
44	2	12	0		—		13	,,
45	2	12	0	6	18	10	14	,,
46	2	12	0		—		14	,,
47	2	12	0		—		14	,,
48	1	15	2	7	12	10	15	,,

1. If a man dies before he obtains his annuity, the whole of the money is returned by the government. Thus, if a man had paid the above sums from 18 years of age to 27, and died, his family would receive £26.

2. This table applies, with a few shillings alteration at

starting, to a man beginning at any age to purchase annuities. Thus, if a man of 30 began he would secure, by paying 1s. a-week till he was 48, an annuity as follows:—£3 to begin at 57; £5 to begin at 58; and £8 to begin at 59, and continue as long as he lived. If he died at 40, his family would receive £26; if he died at 45 they would receive £39.

3. A man leaving off paying for a year or two, or for any period, does not forfeit his claim to the annuity he has previously paid for.

4. No examination of health, &c., is necessary. The most unhealthy person can purchase annuities.

5. A man who has paid as above, commencing at 18 and ending all payments at 48, receives, at the age of 55, £4 a year; at 56, £7; at 57, £10; at 58, £12; at 59, £15. The £15 a-year he continues to receive as long as he lives.

APPENDIX B.

Table, showing what 1s. a week will secure to a man willing and able to Insure his Life for £50, and Purchase Annuities.

A man whose age last birth-day was 18	Allows one shilling a week to be deducted from his wages, that is, in the year.			He devotes each year 19s. to pay the premium on a life insurance policy for £50, and the remainder, £1 13s., to the purchase in one sum, on the *not* returnable scale of £1 annuities, as fast as sufficient money has accumulated. The cost of these will be as follows.			The annuities of £1 each he will have secured will accumulate as follows.	Each to begin when he has reached the following ages.
	£	s.	d.	£	s.	d.	£	Years.
18	2	12	0		—		—	—
19	2	12	0	2	5	5	1	55
20	2	12	0	2	7	4	2	”
21	2	12	0		—		2	”
22	2	12	0	2	11	10	3	”
23	2	12	0		—		3	”
24	2	12	0	2	16	10	4	”
25	2	12	0	2	14	10	5	56
26	2	12	0		—		5	”
27	2	12	0	3	0	1	6	”
28	2	12	0		—		6	”
29	2	12	0	3	5	9	7	”
30	2	12	0		—		7	”
31	2	12	0	3	6	1	8	57
32	2	12	0		—		8	”
33	2	12	0	3	12	3	9	”
34	2	12	0		—		9	”
35	2	12	0		—		9	”
36	2	12	0	4	2	8	10	”
37	2	12	0		—		10	”
38	2	12	0	4	2	11	11	58
39	2	12	0		—		11	”
40	2	12	0		—		11	”
41	2	12	0	4	15	1	12	”
42	2	12	0		—		12	”
43	2	12	0		—		12	”
44	2	12	0	4	19	9	13	59
45	2	12	0		—		13	”
46	2	12	0		—		13	”
47	2	12	0		—		13	”
48	1	9	8	5	19	10	14	”

1. The 19s. a-year, or 4½d a week, for life insurance has to be continued up to 60 years of age, and then it ceases altogether. If it is not paid any year the policy is cancelled.

2. Whenever the man dies his family receives £50.

3. None of the amounts paid in can be withdrawn. Leaving off paying the £1 13s. for annuities for a year or two, or for any other period, does not forfeit the claim to the amounts already paid for.

4. Examination as to health is necessary in this case, and must be satisfactory, or an applicant cannot avail himself of the advantages of the life insurance.

5. At 55 the man who has begun at 18 and continued to 48 to pay the annuity of £1 13s. receives £4 a year; at 56, £7; at 57, £10; at 58, £12; and at 59, £14. The £14 a-year he continues to receive as long as he lives, and if he die while paying the 19s. a-year for life insurance, or if he live to a greater age than 60, if he pays in until he is 60, he leaves £50 behind him.

APPENDIX C.

Table, showing the Amount which must be put by each week, at any age from 18 to 50, on the Returnable Scale, in order to purchase absolutely, each year, without any further payments, a £1 annuity, to begin at a certain age.

A man whose age last birth-day was	Allows to be deducted from his wages the following weekly sum.		Amounting each year to			This enables him to purchase, each year, a £1 annuity, so that at the end of each year, he will have secured annuities as follows.	To begin when he arrives at the following ages.
	s.	d.	£	s.	d.	£	
18	1	5¼	3	13	10	1	55
19	1	5¾	3	16	3	2	55
20	1	6¼	3	18	9	3	55
21	1	6¾	4	1	3	4	55
22	1	7¼	4	3	11	5	55
23	1	8	4	6	8	6	55
24	1	8¾	4	9	5	7	55
25	1	8¼	4	7	3	8	56
26	1	9	4	10	1	9	56
27	1	9½	4	13	0	10	56
28	1	10¼	4	16	0	11	56
29	1	11	4	19	1	12	56
30	1	11¾	5	2	4	13	56
31	1	11¼	4	19	9	14	57
32	2	0	5	3	0	15	57
33	2	0¾	5	6	4	16	57
34	2	1½	5	9	10	17	57
35	2	2¼	5	13	5	18	57
36	2	3¼	5	17	1	19	57
37	2	2½	5	14	1	20	58
38	2	3¼	5	17	9	21	58
39	2	4¼	6	1	7	22	58
40	2	5	6	5	6	23	58
41	2	6	6	9	7	24	58
42	2	7	6	13	10	25	58
43	2	6¼	6	10	3	26	59
44	2	7¼	6	14	6	27	59
45	2	8¼	6	18	10	28	59
46	2	9¼	7	3	4	29	59
47	2	10¼	7	8	0	30	59
48	2	11½	7	12	10	31	59
49	2	10½	7	8	7	32	60
50	2	11½	7	13	4	33	60

1. If a man began at 18, and continued in this way until 50, he would at 55 have £7 a year; at 56, £13; at 57, £19; at 58, £25; at 59, £31; and at 60, and for the remainder of his life, £33 a year, that is, 12s. 8d. a week.

2. If he begins later he will have a proportionate benefit from the date of his commencing to put by. Thus, if he began at 30, he would have secured by 50 an annuity of £1 at 56; of £7 at 57; of £13 at 58; of £19 at 59; and of £21 at 60, which annuity of £21 would continue for the remainder of his life.

3. A man leaving off paying for a year or two, or for any period, does not forfeit his claim to the annuities he has previously purchased.

4. No examination of health, &c., is necessary. The most unhealthy person can purchase these annuities.

5. If a man dies before receiving his annuity, the whole of the amount he has paid would be returned to his family; thus, dying at 30 years of age, about £56 would be returned, and so on.

Note.—If at 18 the man agreed to devote regularly 2s. 1d. a week, this would, by placing what was not at once required to be expended in the savings bank, enable him to meet all his payments after 35 years of age, though continuing to set aside but 2s. 1d. a week. If he died before 50 his representatives would also have so much more to receive.

APPENDIX D.

Table, showing the amount which must be put by each week at the ages of 18 *to* 50, *by a man willing and able to insure his life for* £100, *and to purchase absolutely, each year, without any further payments, a* £1 *annuity, to begin at a certain age.*

A man whose age last birth-day was 18.	Allows to be deducted from his wages the following weekly sums.		Amounting each year to			He devotes, each year, £1 18s. 4d., to pay the premium on a life insurance policy of £100, and the remainder, being as under,			to the purchase, each year, of £1 annuity, so that, at the end of each year he will have secured annuities as follows.	To begin when he arrives at the following ages.
	s.	d.	£	s.	d.	£	s.	d.	£	
18	1	7	4	1	10	2	3	6	1	55
19	1	7½	4	3	9	2	5	5	2	55
20	1	8	4	5	8	2	7	4	3	55
21	1	8½	4	7	10	2	9	6	4	55
22	1	9	4	10	2	2	11	10	5	55
23	1	9½	4	12	7	2	14	3	6	55
24	1	10	4	15	2	2	16	10	7	55
25	1	9½	4	13	2	2	14	10	8	56
26	1	10¼	4	15	9	2	17	5	9	56
27	1	10¾	4	18	5	3	0	1	10	56
28	1	11½	5	1	2	3	2	10	11	56
29	2	0¼	5	4	1	3	5	9	12	56
30	2	0¾	5	7	1	3	8	9	13	56
31	2	0¼	5	4	5	3	6	1	14	57
32	2	1	5	7	5	3	9	1	15	57
33	2	1¾	5	10	7	3	12	3	16	57
34	2	2½	5	13	11	3	15	7	17	57
35	2	3¼	5	17	4	3	19	0	18	57
36	2	4	6	1	0	4	2	8	19	57
37	2	3¼	5	17	7	3	19	3	20	58
38	2	4	6	1	3	4	2	11	21	58
39	2	5	6	5	1	4	6	9	22	58
40	2	6	6	9	2	4	10	10	23	58
41	2	7	6	13	5	4	15	1	24	58
42	2	8	6	17	10	4	19	6	25	58
43	2	7	6	13	7	4	15	3	26	59
44	2	8	6	18	1	4	19	9	27	59
45	2	9	7	2	9	5	4	5	28	59
46	2	10¼	7	7	8	5	9	4	29	59
47	2	11¼	7	12	9	5	14	5	30	59
48	3	0½	7	18	2	5	19	10	31	59
49	2	11½	7	12	10	5	14	6	32	60
50	3	0¾	7	18	5	6	0	1	33	60
51	0	9	1	18	4	nil.				
52	0	9	1	18	4	,,				
53	0	9	1	18	4	,,				
54	0	9	1	18	4	,,				
55	0	9	1	18	4	,,				
56	0	9	1	18	4	,,				
57	0	9	1	18	4	,,				
58	0	9	1	18	4	,,				
59	0	9	1	18	4	,,				
60	0	9	1	18	4	,,				

1. If the £1 18s. 4d., or 9d. a week, be not paid regularly, the policy is cancelled.

2. Whenever the man dies his family receives £100.

3. None of the amounts paid in can be withdrawn, though leaving off the payment of the annuity amounts for a year or two, or for any other period, does not forfeit the claim to the amounts already paid for.

4. Examination as to health is necessary in this case, and must be satisfactory, or an applicant cannot avail himself of the advantages of the insurance policy.

Note.—If at 18 the man agreed to devote regularly 2s. 2d. a week, this would, by placing what was not required at once to be expended in the savings bank, enable him to meet all his payments after 34 years of age, though continuing to set aside but 2s. 2d. per week, if he died before 50 his representatives would also have so much more to receive.

APPENDIX E.

A man at any age may obtain a due proportion of the advantages set forth in Appendix (D), by paying, yearly or weekly, in addition to the amounts set forth in Appendix D, the amount according to his age, as stated below; that is to say, he may obtain a life insurance policy of £100, and an annuity varying in amount according to the year from which he commenced to set by.

Year at which he commences to put by.	Extra annual amount required to be paid by him.			Being per week.		
	£	s.	d.	£	s.	d.
19 ……	0	1	2	0	0	0¼
20 ……	0	2	3	0	0	0¾
21 ……	0	3	6	0	0	1
22 ……	0	4	8	0	0	1¼
23 ……	0	6	0	0	0	1½
24 ……	0	7	4	0	0	1¾
25 ……	0	8	10	0	0	2¼
26 ……	0	10	4	0	0	2½
27 ……	0	12	0	0	0	3
28 ……	0	13	8	0	0	3¼
29 ……	0	15	6	0	0	3¾
30 ……	0	17	6	0	0	4¼
31 ……	0	19	7	0	0	4¾
32 ……	1	1	10	0	0	5¼
33 ……	1	4	3	0	0	5¾
34 ……	1	6	10	0	0	6¼
35 ……	1	9	8	0	0	7
36 ……	1	12	9	0	0	7¾
37 ……	1	16	0	0	0	8½
38 ……	1	19	8	0	0	9¼
39 ……	2	2	7	0	0	10
40 ……	2	7	11	0	0	11¼
41 ……	2	12	9	0	1	0¼
42 ……	2	18	1	0	1	1½
43 ……	3	4	0	0	1	3
44 ……	3	10	9	0	1	4½
45 ……	3	18	4	0	1	6¼
46 ……	4	7	1	0	1	8¼
47 ……	4	17	3	0	1	10½
48 ……	5	9	1	0	2	1¼

APPENDIX F.

A man commencing at any age may obtain a due proportion of the advantages set forth in Appendix B, by paying yearly or weekly half the amount, according to his age, set forth in Appendix E, in addition to the 1s. a-week given in Appendix B. That is to say, he may obtain a life insurance policy of £50, and an annuity varying according to the year from which he commences to put by. Thus, a man of 32, by paying the half of £1 1s. 10d. a year, or 5¼d. a week, that is, 10s. 11d. a year, or 3d. a week, in addition to the 1s. a week, secures a policy of £50, and an annuity of £2 at 57; of £4 at 58; and of £7 at 59, and for the remainder of his life.

APPENDIX G.

The following is prepared by W. S. Portal, Esq., for distribution, as showing succinctly the leading features of the Post-office system:—

Government Annuities.

Income in Old Age Secured by Her Majesty's Government.

ANY MAN wishing to have an income of five shillings a-week after he is sixty years old, for the rest of his life, can secure it from the Government, by paying into the Post-office eightpence a-week, from the time that he is nineteen years old.

All the money so paid in, can be taken out again, if he wishes it, at any time before he is sixty, without any deduction whatever; and if he dies before sixty it will be paid back to whomsover he may appoint.

Any man may secure from the Government the same income of five shillings a-week after he is sixty years old, for the rest of his life, by paying into the Post-office fivepence a-week, from the time that he is nineteen years old, and one penny at the end of each year; but in this case he cannot draw his money out again, nor will it be paid to any one else if he dies before he is sixty.

ANY WOMAN wishing to have an income of five shillings a-week after she is sixty years old, for the rest of her life, can secure it from the Government, by paying into the Post-office ninepence a-week from the time she nineteen years old.

All the money so paid in can be taken out again, if she wishes it, at any time before she is sixty, without any deduction whatever, and if she dies before sixty, it will be paid back to whomsoever she may appoint.

Any woman may secure from the Government the same income of five shillings a week after she is sixty years old, for the rest of her life, by paying into the Post-office sixpence three-farthings a-week from the time that she is nineteen years old; but in this case she cannot draw her money out again, nor will it be paid to any one else if she dies before she is sixty.

Any larger pensions, up to £50 a-year, can be secured from the Government by proportionate payment.

APPENDIX H.

The Provident Knowledge Society.

To make known the best means for Providing for Old Age, &c., by regular Weekly or other Periodical Payments.

The object of this society is to promulgate information as to the best means by which the wage-classes, domestic servants, &c., can put by weekly sums to provide for old age; to make known more generally the advantages offered by the Post-office for purchasing deferred annuities and life assurances by weekly and other payments; to facilitate the means of collecting such small weekly sums, by inducing manufacturers and employers of labour to open, on their premises, offices for the receipt of such sums as arranged for by the Post-office; and generally to endeavour to create habits of providing for old age and possible premature death, among those earning small wages.

The society will not give relief in any form, or have an eleemosynary character. It will merely make known among all, by lectures, addresses, personal intercourse, and other means, in all parts of the kingdom, the facilities which exist for enabling a man to provide for himself in proportion to his earnings, in the best manner, and at the smallest possible sacrifice, compatible with sound commercial security, such as in the Government Post-office Deferred Annuities, &c. The society will also endeavour to effect alterations or extensions in the goverment systems at present in existence, if this should be required, and to frame others, if experience from time to time proves them to be necessary.

The following noblemen and gentlemen have signified their general approval of the objects of the society, and will shortly form a committee to take steps for carrying out the work proposed:—The Earl Granville, K.G., Sir Charles E. Trevelyan, K.C.B.; A. J. Mundella, Esq., M.P.; Henry Cole, Esq., C.B.; Capt. Douglas Galton, C.B.; Wyndham S. Portal, Esq.; C. J. Freake, Esq.; John H. Chance, Esq.

The following amounts, to be paid either in one sum or in instalments, have been promised towards the expenses of the movement, and for carrying out the objects of this society:—John H. Chance, Esq., Birmingham,* £50; George C. T. Bartley, Esq.,* £50; Miss Shirreff, £10 10s.; Sir Daniel Cooper, Bart., £5; Major-General Scott, C.B., £5 5s.; Charles W. Holworthy, Esq., £5 5s.; Thomas E. Harrison, Esq.; Capt. Douglas Galton, C.B.; Rev. T. J. Stratton.

DISCUSSION.

Dr. Stallard was very glad to find that the subject had been taken up by the Society of Arts, for it was one of the most important problems for political economists and philanthropists to solve how it was that the great measure alluded to in the paper had fallen so flatly upon society. There was no doubt it was owing to ignorance and carelessness, and that the public required instruction in this matter. But amongst reasons for its failure, he thought the first was, that it began at the wrong end so far as the wants of the working classes were concerned. They wanted, first, to provide something for seasons when they were out of work, and, next, something for times of sickness; and this want was only imperfectly met by benefit societies, and required further development. Until these two important matters had been provided for, the working classes would never think of life insurance or annuities to any general degree. There was a system in action, in some parts of the Continent, by which the employers and employés combined in contributing to a fund to provide for sickness and old age. He very cordially supported the idea suggested by Mr. Bartley, that some extended machinery was wanted for introducing this system of annuities, and regarded it as one of the first objects to be kept in view, in securing a thorough system of house-to-house visitation. What was wanted was an organisation which should bring the intelligence of the intelligent to bear upon the ignorance of the ignorant. In that way only could this admirable system be promulgated throughout society. Operations must, however, begin by the class above that of the labourers, and even in the middle-classes there was not so much providence in these matters as there ought to be. A good example was wanted, and it would be well if those present would form themselves into an association, pledging themselves to adopt the Post-office system of deferred annuities. He also thought it might be advisable to make the proof of some such effort as this, on the part of working men, the test for giving out-door relief by the guardians of the poor, and thus a very important distinction would be drawn between the provident and improvident, which would have a powerful moral effect on the lower orders of people.

Mr. R. Dudley Baxter said he had come in some sense to an opposite conclusion to that set forth in the paper. The scheme there brought forward was a system of providing for old age by a very elaborate machinery. He could not help asking himself whether such a system of weekly contribution, continued through life, was best adapted to the wants of the labouring classes. Was a working man likely to be able, with all the difficulties and temptations that beset him, to carry out such a continuous effort week by week through life? When life-assurance was practised by the upper classes, there was a large margin of income, generally speaking, out of which the annual premiums were paid. If there was a decrease in the income, some superfluity or luxury could be discarded to counterbalance it; but in the case supposed there was but a very small margin between subsistence and starvation, and this increased the difficulty ten-fold. In many cases the loss of a week's work meant the total inability to pay anything. He did not, therefore, much wonder that only 335 individuals out of 30 millions had availed themselves of the Post-office annuity system during 34 years. Another feature was the great expense of collecting and keeping accounts on such a system; and there was yet another difficulty, which, though it had not even been alluded to, did, he believed, to some extent exist. He referred to the possibility of fraud on the part of the Post-office officials—in many cases small shopkeepers, or their clerks or assistants—and though he did not impugn their honesty as a class, he believed that instances did occur, in which the ignorance of the depositors was taken advantage of—in fact such cases had come to his knowledge in different parts of the country. Again, the poor man received a much lower rate of interest than his richer neighbour, only 2½ per cent., which of course diminished materially the inducement to save. What was the state of things elsewhere? In France, there was a large mass of peasants living on much lower wages than the same class in England, not asking for nearly as much poor relief, and, at the same time, much better provided for in their old age. The reason was, that the natural character of the French peasant was to save, and invest his savings, either in land or some other security which gave an immediate return. In Holland, again, there was not the same difficulty with regard to pauperism as in England, simply because the national habit was to lay by. Indeed, he had been told, that amongst the well-to-do classes a man was considered somewhat of a spendthrift if he did not save about nine-tenths of his income. This habit of saving was proved by the fact that even the peasants were accustomed to wear on festive occasions expensive gold brooches and head ornaments. The same kind of thing might be seen in Austria, but in North Germany, which seemed more allied to England in national character, the same improvidence was manifested. He thought, therefore, that the solution of the difficulty would be found, not so much in providing an elaborate system of annuities, as in encouraging, by every possible means, the habit of laying by and investing these savings in houses, land, or other securities. Building and land societies, therefore, were doing great good; and any method by which small shares in sound undertakings could be brought within the reach of the working classes as investments, as was the case in France, would tend in the same direction. The plan suggested, of not employing persons, or not giving them poor relief, unless they had done something in the way of saving, would not be found practicable, although it sounded very well in theory; and such an involuntary method of applying the system would not tend much to recommend it to Englishmen generally.

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* In five yearly instalments, if 20 others will do the same.

Mr. E. W. Holland said the difference between Mr. Bartley and Mr. Baxter appeared to be one of those fundamental ones which underlie all discussions of this class. It was quite clear that at the outset of any proposals for enabling working men to provide for themselves in old age, there was always this difficulty brought up, that they were not able to do it. The answer to this was, that charity, or poor rates, or whatever supplemented their wages, did not enable them to do it any more, and that whatever men got in this way, external to their own exertions, did not really make them richer, but poorer. He had some acquaintance with the working classes, and it was his decided opinion that only by means of small weekly savings could they ever obtain capital enough to enable them to enter into any of the operations which Mr. Baxter had recommended in preference to government annuities. With regard to frauds on depositors, he certainly thought the rules of the Post-office in this respect reduced the possibility of fraud to a minimum, for the depositor had the amount he paid in put down in a book under his own eye, and had also notice that if he did not receive an acknowledgment from the head-office in so many days he should make inquiries about it. Ignorant persons, of course, were always liable to be imposed upon; but his experience in collecting rents from the working classes had shown him that, even those who could not read or write, knew perfectly well whether he put down 1s. 6d. or 2s. 6d. in their book. One reason why the Post-office system had failed was, because it was not adapted to the class for whom it was intended. It would be as reasonable for a bank or insurance office in the City to be open from 4 to 10 p.m., and expect to do business, as for a Post-office to conduct a large business with the working classes between 10 a.m. and 4 p.m. Then, again, all sorts of difficulties were interposed. A deposit of 2s. 6d. could not be received. The why government clerks should not be able to add up pounds, shillings, and pence, he could not understand. If some of these anomalies were removed, and proper means were taken of making known the advantages offered, he believed a large increase of business would result.

Mr. Geo. Howell said he agreed in many points with the paper of Mr. Bartley, but there were some errors in it which must be obvious to every one who had a practical knowledge of the condition of the working classes. It had been said that working men did not provide for their old age on account of their ignorance and other causes, but he maintained that the first and principal cause was inability. How was it possible for the agricultural labourers of England to lay by anything for old age? If they had anything whatever to spare, it had to be put by for a time of sickness, or when out of work. Then, in the case of labourers in large towns, although many of them earned tolerable wages, as compared with the peasantry, still their employment was so precarious that it was impossible for them to save so much continuously week by week for years. Passing on to the class of skilled artisans, to whom, probably, the statements of Mr. Bartley were especially intended to apply, no doubt their wages did enable them to save something; but, nevertheless, they were not so great as was commonly supposed. He was more intimately acquainted with the building trades than any other, and it was taken for granted that they had good wages, and so they had; but when the question was considered of laying by, week after week, and month after month, for years, so as to entitle the workman to an annuity of £26 a-year, after the lapse of 20 or 30 years, what was the fact? He himself had kept an account for some years of all his earnings, and spreading them over a number of years—about 15—he found that, though his wages had ranged from 36s. to £2 a-week, the average for the whole period, allowing for lost time, &c., only came to about 20s. 9d. A friend of his, a teetotaller, and a very skilful man at his trade, had kept a similar record of every penny he had earned for 22 years, and the average was only 22s. 11d. per week, and, as he was living in London and had to pay high rent, and London prices for provisions, he would ask how was it possible for him to provide for old age, in addition to what he had to contribute to his society—and he was glad Mr. Bartley had something to say in favour of the much-maligned trades unions—for times of sickness and when out of work? It was quite true that working men, as a rule, did not know the value of small beginnings and of small savings, but one great requisite was some means of rendering these savings available in time of sickness or emergency. No doubt it was rather difficult to devise a perfect scheme, but he had paid a great deal of attention to this matter, and had considered it in connection with the great national society to which all ratepayers belonged—the Poor-law—and he had often thought whether it would not be possible to form a gigantic society, which, having plenty of capital, should enable everyone to insure for old age, at a much lower rate than was now paid in poor-rates. If they could apply that amount which people were forced to pay yearly for the support of those who were, to a great extent, made paupers in the way he suggested, there would be enough capital to start a great national insurance company, which should give to every man a right, in time of sickness, or when old age came upon him, not to be called a pauper, but to receive that for which he had paid when he was able to do so. And there was nothing derogatory to a man's independence in receiving that for which he had so paid; he would have as much right to it as to a policy of insurance on which he had duly paid the premiums. He did not know whether such a thing would be practicable, but he had no doubt that there were numbers of capitalists who would be only too glad to take the £11,000,000 a-year, which were now paid in poor-rates, and keep all the poor in the country respectably. Another idea which had occurred to him was, that the system of building societies might advantageously be incorporated with the Post-office savings banks, and this would do good in a variety of ways, besides making a provision for old age. Habits of care and cleanliness would be inculcated, for a man would always take more care of his own house than he would of that of his landlord. He believed too much was made of the amount of money spent by working men in intoxicating drinks, though he knew very well that there was an immense deal of money wasted in that way. When the facts were fairly looked in the face, and particularly when it was remembered that, taking Mr. Dudley Baxter's figures, the amount of money paid in wages yearly, when divided amongst eleven million workers, only gave an average of £36 6s. 6d. per annum each, he would ask how much it was possible to save out of that. Of course some earned much more, and others much less; but these figures were enough to show that what was most wanted was the ability to save, not the means of doing it.

Sir Charles Trevelyan, K.C.B., said it was, unfortunately, but too true that the habit of providence, if it had ever existed amongst the English (and the Anglo-Saxons were taunted on this score by the Normans, whilst the poet Spenser called his countrymen a dispendious people), had now disappeared, and the very idea of laying up a store for the future amongst a large proportion of the people was utterly unknown. Within the last few weeks he had gone through, in company with a committee of Poor-law Guardians, relieving officers, clergymen, district visitors, and sisters of charity, the entire lists of poor in one parish and the greater part of another, and it was hardly possible to find any trace of saving amongst them. If it did exist at all, it was chiefly amongst former domestic servants, and in their case they were soon exhausted. It could not be said that this was owing to want of means, for, particularly in the case of the working population in the north, they had now abundant wages, and could lay by something if they liked. The autumn before last, he, with the secretary of the Charity Organisation Society, made a tour through the coal and iron districts, and made a point of conversing with all the most intelligent men they met with, and the universal testimony was that, with few exceptions, the increased wages did really more harm than good; they were spent in present indulgence—in eating and drinking. He did not say this was altogether to be despised, for the best investment of all was no doubt in bones and sinews; and when he compared the fine stalwart men in the Midland Counties with the unfortunate peasantry in Dorsetshire, Somersetshire, and Devonshire, he could hardly mention what he had said with regard to their spending with disapprobation, much less with contempt. Still there was an enormous sum spent in drinking; and at the West-end of London scenes constantly took place which were a disgrace to civilisation. Surrounding all large establishments, such as gas works and the like, there were always public-houses, showing that even in London where wages were at the lowest money might be saved. What was the cause, then, of this evil? Simply that for generations we had violated the laws of nature. One of the first laws imposed upon our race was that man should live by the sweat of his brow, but the Poor-law entirely exempted the population from this law; and working men actually said, why should they labour and save to make another insurance for themselves when there was already one provided for them by the public. In London, the out-door relief was administered in an indiscriminate manner, which did an immense deal of harm. While the counties, and boroughs, and provinces had been pressing on the vagrant class with the help of the police, these people were driven into London, where they were received with open arms in casual wards and night refuges, which were more mischievous still, because there was some check in the casual wards, but the night refuges were open to everybody. The soup kitchens, again, were open to all, and even the administration of district visitors, admirable as it was in the main, was conducted with a lavishness sufficient to upset all calculations. As to the remedy, it must be the converse of all this; instead of giving local and private charity wholesale and with both hands, it should only be given after the fullest investigation, and in no case without seeing that the person applying for it had done the best for himself or herself. If this were thoroughly done in London, the amount spent in charity of various kinds would so rapidly diminish that it would become practicable to relegate public relief entirely to the indoor system. No doubt the opportunities for saving should be improved to the utmost, but he did not think the national improvidence was owing to the savings bank not being kept open a sufficient number of hours, or to any such cause.

Mr. J. H. Johnson said he had come to a conclusion diametrically opposite to that to which Mr. Bartley had arrived; and he thought that means should be taken, first of all, to enable persons to get a comfortable livelihood in the prime of life, as a preliminary step, before making any insurance for old age. The number of charitable institutions existing, though in one sense we might feel proud of them, were in another sense a disgrace, for every one must deplore the necessity for their existence. Pauperism was increasing, whilst wealth also increased, and he thought the matter ought to be dealt with more comprehensively than was proposed by the Provident Knowledge Society. He went on to complain that the whole social system was an artificial and improper one, and that, if it were otherwise, poverty would not be necessary, but, on the other hand be impossible; but the meeting did not seem inclined to hear how this Utopia, as he himself described it, was to be attained.

Sir J. K. Shuttleworth, Bart., M.P., said he had had experience on both sides of this question. Nearly 40 years ago, he was actively engaged in introducing the new poor-law in districts where wages were at their lowest, and therefore he was acquainted with the phase of the subject to which Mr. Howell had adverted, and at the same time he had the good fortune to live in the same county as the noble Chairman, surrounded by a population receiving the lightest wages, probably, of any class of men in the world; and he could not say that there were not a great portion of those operatives who were not distinguished for their prudence. Within 12 miles of his house, there were at least £700,000 of capital invested in co-operative mills and machinery, by the working classes alone almost, and in Rochdale there was a vast capital employed in co-operative stores. All this originated with the working classes; and one word of caution he would utter was this, that as had been said by Mr. Dudley Baxter, that whatever schemes for the improvement of the labouring class were invented simply by theorists and economists were generally destined to fail. On the other hand, as a young man, very eager to dissolve the connection between the agricultural labourers and the pay-table of the overseers, and to bring about that vast change by which there would be no able-bodied paupers receiving out-door relief, he remembered receiving a rebuke from the chairman of one of the unions with which he was connected himself, an earnest administrator, a fellow of Jesus College, Cambridge, a scholar, and a gentleman in every sense, a thorough Christian, and the rector of his parish. He took him to the cottage of a poor man who had lived a most exemplary life—a cottage consisting of one room, in which he, his wife, and eight children had to live, and from the questions he put, he found that his wages were 7s. a week; and on inquiring further they could not make out that, with all extra sources of income at harvest-time, and otherwise, the family earnings exceeded £22 per annum in the most favourable seasons, How could such a man as that lay by for old age? This question, therefore, was not simply one of providence, but involved the social condition of the working classes generally, which no inculcation of mere economic doctrines could change. Neither could it be changed simply by the exertions of the working classes themselves, although any legislative measures, without a great improvement in intelligence and education, would be equally hopeless. There was, in fact, no single remedy for this unfortunate state of things. After his experience in the way he had mentioned, he had to sit for four days under the harrow of a Committee of the House of Commons, to explain his administration of the New Poor-law, and to answer questions as to the wages received in the district. He had prepared himself beforehand to answer correctly, and he could not say that the average income of a family of several members exceeded £26 a-year. In such cases something more than providence was requisite in order to provide for old age, but no simple and easy method would effect the desired result. Since that time many improvements had taken place, not only in the law of settlement, but also in the facilities for migration to more favourable centres of employment; and he had succeeded in three years in sending ten thousand from the pauperised south to the comparatively wealthy north of England, and twenty or thirty thousand from the eastern counties, under his own immediate supervision, left England for America, where he hoped they were now doing well. He deprecated looking at only one side of the shield; but while he agreed in nearly all that Mr. Howell had said, he must repeat that out of one hundred millions annually spent in intoxicating liquor, probably seventy millions was pure waste. The problem was very complicated, and many matters must be taken into consideration in dealing with it.

Lord Derby said they would probably expect that, as chairman, he should say a word or two with reference to what had passed. The subjects which had been raised were so vast, that with thought and preparation, they might be discussed for four or five hours by anyone, but without it, it was really very difficult to talk concerning them for five minutes. He was afraid there was no resisting the conclusions that various speakers had come to, that in the matter of economy and providence we stood rather low in the scale of European nations. The French were undoubtedly before us. There were no persons in the world more careful and thrify than the peasant farmers. the small tradesmen, and the inhabitants of the towns who made up a large part of the French population. The Swiss were before us; so were the Belgians, the Dutch, and the North Italians; and, but for the very sincere respect which he entertained for any opinion expressed by Mr. Dudley Baxter, he should have inclined to put the North Germans in the same position. He recollected once hearing a foreign gentleman, who interested himself in economical matters, make the remark which, although it was somewhat an exaggeration, was not probably altogether unfounded, that a French family, with an income of £200 a-year would manage to live on what an English family with £200 a-year would throw away. If anybody inquired the cause, or rather the causes, of that state of things, he should never be much perplexed to give the solution. Perhaps there was something in the fact that, from our colonising and commercial habits, from our widely-spread commercial relations with all parts of the world, we had been in the habit, as a nation, of making money faster than our neighbours, and there was always a tendency to spend rapidly that which was easily obtained. Then, again, we had amongst us not an inconsiderable class of artisans who combined a very high development of skill in their special industry with very low general culture. and that was a class of man who spent all he got. He did not save, not because he had any particular objection to the idea of saving, but simply because it did not come into his head to do it. He did not want to rise out of his class. He had maintained his parents, probably, in their old age, and he thought it quite natural that his children, in his old age should maintain him. Perhaps as another explanation, he might add that there was in all classes, though now among a very small minority, a lingering feeling, which had found expression in the room that evening, that there was something mean and selfish in the habit of saving. He had heard that language used by educated men, and no doubt it had an infinitesimal particle of truth in it. But people were very apt to overlook the claims of their neighbours. As another cause, they might observe the unfortunate amount of mischief which had often been locally done by the failure of savings banks, and associations of all kinds in which the savings of poor men were invested. It was quite intolerable for a man, who had perhaps for 20 years pinched himself in laying by for the future, while his neighbour was enjoying himself, to find that he had lost all the pleasure he might have had out of his money, and that he had lost all his money too. Fortunately, under the present management of the Government Savings Bank, no such failure as that was likely to occur; but a single failure of that kind was a lesson of improvidence taught to a whole neighbourhood. He took the principle of the scheme which had been suggested that evening to be, that employers should require those who worked for them to make some provision for their old age and their families; and upon that he had one criticism to offer. He thought it assumed that employers had the command of the market to a greater extent than was actually the case. They could not make a condition of that kind, except in one of several cases. Either they had the command of the market, and therefore could dictate what terms they pleased, which they all knew was not practically the case in this country, except in a few rare instances, or they must be prepared to give those who adopted their scheme a higher rate of wages than generally ruled in the neighbourhood. It was said, that in that case the man was laying by for himself, whereas it was the employer who was laying by for him. Again, the men employed might not be willing to go into a scheme of that kind; and he apprehended, as men's feelings now were, they were not likely to do so, because, as was well known, they disliked interference of any kind with their private affairs. Interference of the kind suggested was not such as would probably recommend itself to their feelings, and no doubt those great associations, which had exercised, in one way or another, so much power, would be extremely jealous of any interposition of the kind on the part of employers, if it were exercised upon a great scale. But whilst he differed as to the remedy, he quite agreed as to the extreme importance of the subject. The creation of provident habits had a national as well as a private interest. Saving men were safe men. The men who made a row, headed mobs, and generally made themselves unpleasant to their neighbours, were for the most part those who had not got a shilling laid by for a rainy day, Economy, like everything else, might be carried to an extreme, but it was not an extreme that we were in any danger of running into in this country. The difficulty was the other way. Dr. Stallard said very truly that what we wanted in these matters was somebody to set the example. That was true; but the misfortune was that when they had got anybody in a neighbourhood who did emphatically set an example in this respect, it would be generally found that he was the most unpopular man living. The question of individual prudence and provision for old age opened the infinitely wider question of the operation of the Poor-law, and of all laws in the nature of poor-laws as they affected the formation of individual character, and as to them, he should say there was no subject upon which they required more to be taught to reason calmly and justly, because, so far as he had observed, it was a question upon which we were perpetually tending to fall into one or two extremes. Sometimes we took a compassionate fit, and many were apt to talk what, in effect, was the very wildest socialism. At another time they took an economic fit, and used language which, if human nature allowed it to be acted upon—and for the most part it did not—would be enough to bring about a revolution in a very short time. The question was an exceedingly difficult one; and, very obviously, the difficulty increased when those who were alive to the importance of the subject, and therefore gave advice, were well off. It was very well to say that men ought to be made more than ever responsible for the way in which they chose to live. If they dealt with the man himself who was in fault, that would be right enough; nobody, he supposed, would feel very much for a man who had been utterly improvident and reckless, and who was brought to dependence and a certain amount of discomfort in his latter days. But the misfortune was—and this was the point upon which all the economic theories broke down—that, generally speaking, the man who was in fault was one person, and the person who suffered another. The man himself was perhaps dead, or in a helpless condition, and did not feel what had come to him. It was not the man himself, but his children, who were not in fault, upon whom the penalty fell. It was very hard, in that case, to say that, because the father had been in fault, therefore they were not to help the children. At the same time, if they looked at the other side of the question, it was clear that if every man had a perfect assurance, that although he made no provision for his family, that family would none the less be made easy and honourable in their circumstances by society in general, there would be almost an end of individual saving. It was not, therefore, an easy problem to solve, and he thought they must rely more upon hope than upon fear. It would not do to tell any man that, if he did not lay by, he or his children would starve, because that was not the case. The proper thing to say was, that if he did lay by his old age would be more comfortable, and his children would be in a higher position than that which he had occupied. Something had been said about the impossibility of expecting the labouring classes in agricultural districts to lay by, and he was afraid he should agree with that. But these men were not the whole, they were not, perhaps, more than a bare majority of the class who were paid by weekly wages, and he did not think anybody who knew what wages were, and what was the position of artisans in manufacturing districts, and in great towns generally, could doubt that they had abundant opportunities, if they pleased, of laying by something out of their income. He feared, however, that, as a rule, this was not done to any considerable extent. The manufactures in the north had almost been coining money during the last year or two, and it might be taken that the average of wages had been higher, and the work also had been more abundantly provided than at any former period within the memory of man. Still, he was afraid that the amount of money which remained at the end of that time in the hands of the workmen was not large. The conclusion at which he had arrived on this subject was but an humble one. He did not think that any schemes, however well devised, would be more than palliatives of the evils which all deplored. The question, after all, was one of national character; Englishmen had always been improvident, and were so still, and this national character could not be changed in a day, though it might be done in a generation or two. All that could be done was to keep public attention fixed on these matters, and give every encouragement that the State or society reasonably and fairly could, to men investing such sums as they were willing to lay by. One fact, which was certainly new to him, had been elicited during the discussion; he referred to what Mr. Baxter had said as to the possibility of frauds being committed upon illiterate persons who deposited money in the Post-office Savings Bank. He had never heard of such a thing before, and if it really occurred in more than some very rare and exceptional cases, the discussion of that evening would have been very useful, if it did no more than call attention to that one abuse. He did not think there was much force in the remark that those who invested in the Post-office savings banks got lower interest than other people. They did get a lower interest, certainly, but they had a better security, better, in fact, than that of the funds; for if he invested in Consols, though he was sure of his interest, he was not sure of the amount of capital which he could draw out in a few years time. It might be greater than he paid if things were prosperous, but it might be very much less if things went badly. At the present time, £100 was worth £92, but if a time of national distress and trouble ensued, it might fall, as at the time of the Crimean War, to £85 or £84, in which case he should lose three years' interest. The man who put his money into the government savings bank, however, though he only got 2½ per cent. interest, could draw it out at any time, and be sure of having the exact sum he had put in. The noble Lord concluded by proposing a cordial vote of thanks to Mr. Bartley, which was carried unanimously.

INDIA COMMITTEE.

A conference was held on Friday, January 26th, Major-General Sir Arthur Cotton, K.C.B., in the chair. The paper read was—

ON THE ROUTE TO WESTERN AND SOUTH-WESTERN CHINA BY THE IRRIWADI AND OTHER RIVERS OF INDIA, AND THE COMMERCIAL ADVANTAGES ATTACHED TO IT.

By Commander F. E. Manners.

India, that gorgeous land, enclosed by magnificent natural boundaries, has, from time immemorial, enjoyed the highest celebrity and elicited the greatest interest of all the countries on the Asiatic Continent, and in considering this in an aggregate, it may well be represented as a compendium of the whole world. We do not here see nature defined under one uniform character or aspect alone; on the contrary, its individual representation leads us to trace a gradual yet complete transition between the most opposite extremes, resulting from its diversity of climate, as well as other numerous and varied physical conditions and combinations peculiar to it; but the whole of its immense superficies is of surpassing richness, beauty, and fertility, through which mighty and majestic rivers flow. The general character of these magnificent rivers, as well as the great advantages to be derived commercially from them in conjunction with the Chinese canals, will form the subject of this paper.

This subject is now beginning to attract considerable attention, even in the Chambers of Commerce, and in dealing with it, my object will be to prove, as the materials permit, how these splendid rivers of India may be developed, in order to keep up our producing power, by opening out, on an extensive scale, by the agency of steamboats and a vast commerce with rich and fertile countries, we are hitherto, comparatively speaking, unacquainted with, and how by their means a direct communication may be effected with west and south-west China. The vast resources of these magnificent rivers are manifest; they are no doubt all, more or less, capable of being made the general highway of commerce with this country, inland India, and south-west China, if proper and efficient means be systematically adopted, by covering them with suitable sea or river steam vessels of a nature in every way adapted for the navigation. Nor is this a difficult question to be arrived at, that is, as to their several navigable conditions, for, little as we are at present acquainted with the upper courses of the other three rivers, as distinct from the Irriwadi, we may reasonably conclude, in fact, I assert there is no doubt on the matter, that, by the application of steam upon these, we should entirely supersede by that means, and more than double, the extensive trade which now exists by native vessels from India and Chinese junks, as well as the land trade.

The actual resources of the Irriwadi, which will stand first for consideration, are even at the present time but little known, or its capabilities appreciated as a great and important highway for a vast trade with this country and China, commensurate with its importance. Since, however, the construction of the Suez Canal, and the recent discovery of the fact that this magnificent river can be safely navigated for nearly 1,000 miles from its mouth, must necessarily very shortly result in the demonstration of its immense value as a trade route, connecting China, Tartary, Yarkand, Tibet, and the great Shan States with this country. Indeed, considering its vast importance in a commercial sense, a fact which I shall endeavour to demonstrate, it is a very singular circumstance that, though ascertained to be navigable, it has never as yet been established as a highway for trade, and its entire resources developed by the agency of steamboats; and it is still more remarkable that its large and valuable tributaries have not, that I am aware, up to the present time, been developed for commerce to the extent their communications and consequent importance demands. I have very recently heard that large steamers from Scotland have made the voyage up to nearly the frontier of China.

A very interesting paper has recently been submitted upon this subject by Major Sladen (the present political agent at Ava), who explored this river to within 40 miles of the Chinese frontier a few months ago. This description I shall make use of, as corroborative of its vast importance as a direct line of communication by steam vessels of proper capacity between this country and west and south-west China.

Major Sladen, in part of his narrative, makes the following pertinent and conclusive remarks:—"With reference," he says, "to a decisive settlement of this question, the Indian government were led, in 1868, to organise and carry out the expedition, *viâ* the Irriwadi and Bhamo, to the Chinese province of Yunan, in contradistinction, so to speak, of the proposed survey by another route from Rangoon to Kian-Hung. In the case of the direct route from Rangoon to Kian-Hung, it had been proposed to lay down a line of communication, either railway, tramway, or ordinary road, over the 400 miles of land journey which intervened between Rangoon and the proposed terminus of the Cambodia. This line of communication would at best be experimental only, and surveys would have to be made, and a new route of trade communication practically established; and so far as no other means existed of establishing overland communication between Burmah and China, even this scheme, involving, as it does, the cost of an expensive line of railway through 400 miles of a difficult and thinly-populated country, was still entitled to reasonable consideration. But when, in opposition to such a scheme, they were able to supply water instead of land carriage, when by water carriage by means of steam navigation on the Irriwadi they were able to reach a navigable point 900 miles from Rangoon, and close to the Chinese frontier, surely it was time, in deciding this question, to cling to the route which promised certainty and success at very little cost. It is very well ascertained by the testimony of Col. Yule, that the only river which could be turned to account for communication with west and south-west China was the Irriwadi. At Bhamo, 900 miles from the sea, and probably 1,000 from its source, the Irriwadi, when full, between its natural banks is four miles in breadth, and during a third part of the year or more it might be navigated with the greatest ease as far as Bahmo by vessels as large as any that ever ascended the Yantze-Kang to Han-Kow from Shanghai. By selecting the Irriwadi as a means of transit for produce to south-western China, and Rangoon as a port of export for such produce, by means of steam navigation the voyage to Europe would be reduced by probably six or ten days, both in distance and duration. In a corresponding degree, the expenses of navigation would be reduced and the risks avoided, and it would do away altogether with the heavy insurance at present in force, by reason of the difficult navigation through the Straits of Malacca and the Chinese Sea, with its attendant uncertainty and risks. Burmah could be made a highway by steam navigation, to tap the resources of south-western China, and I may include other adjacent states." In conclusion, it was his opinion that, however much other influences might prevail, its own solid merits must continue to force this scheme of overland trade with China into conspicuous pre-eminence; and his firm conviction was, that the establishment of trade must inevitably follow, and that, at no distant period, it would develop itself into one of the most compensating achievements of the age we live in. This I have taken as my text.

To carry out this undertaking in the way proposed, by means of a large fleet of sea and river steamers, is most certainly a very important project, only requiring capital with energy to make it the very largest trade in British India, and we perceive no real or actual difficulty in the means proposed of at once establishing it, and extending it as well to any further bounds necessary. Major Sladen is most certainly a most competent judge; and I have no doubt in my own mind, having held to the same opinion for many years, that his view is the true one, viz., that, not only the whole of the river as far as Bhamo, a few miles from the Chinese frontier, is perfectly navigable, but its affluents also. There is also a very important subject to be considered, as the Major has stated, with respect to the actual value of the river as a trade route, viz., that the distance between China and England would be considerably shortened, by probably six to ten days, *viâ* the Irriwadi and Suez Canal, more especially since the Brindisi line is open, as compared with the old route *viâ* the Straits of Malacca and Chinese Sea, to say nothing of the escaping, by this means, the difficult and intricate navigation, with its attendant uncertainty and risks, consequent on those fearful typhoons in that tempestuous ocean. A few remarks are necessary as a preliminary measure before proceeding with this sketch. It will be seen now, from what has already been advanced, that there is no manifest drawback to mar the complete success of this important undertaking. It is, I maintain, a mere question of time and money, as well as enterprise, and if carried out in all its integrity, in the way I propose, cannot fail to prove one of the most magnificent and important commercial movements of the day. It is indeed the great Eastern question of the day, by which a complete revolution as regards our Chinese trade would be accomplished. The development of new worlds, for such we may term the west and south west provinces of China, and the bringing them and their wealth within easy reach of this country, by steam navigation, *viâ* the Irriwadi and Suez Canal, will be the means of turning the stream of life and commerce away from the old route by the Straits of Malacca and Chinese Sea in a new direction, as well as a better and more secure one, and the great benefits that will accrue to commerce, we may add, science, will be more than proportionate. This is another reason why every advance in naval science and engineering always brings substantial benefit to this country, in spite, often, of the official opposition it meets, for every communication by improvement, however effected, or however applied, whether by railroad, by tram-road, by canal, or by river, is almost certain to result in advantage to commerce generally, and is, moreover, a most powerful engine in the hands of a kingdom which maintains the very widest possible circle of communication with India and China. We can only judge between the two routes through the comparison of results by the adoption of the one under review, when it becomes the highway for trade. The route I propose cannot but supersede the old one by the superior advantages it will possess when developed, and both communication and commerce must change from the one to the other. The result, when completed and accomplished, will most certainly evince a very conspicuous illustration of the mental and no less physical energy of those merchants (whoever they may be) who shall cover this magnificent river with appropriate steamers, and by that means develop rich as well as extensive provinces, which must amply repay them for any risk they may have incurred, by conferring a lasting benefit and obligation on those interested in the commerce of this country and China. The south-western and western provinces of China, bordering on the Irriwadi, are, from the geographical reports and other recent sources of information, about the richest portion of that great Empire, as far as mineral wealth and other commodities, which will be shown, are considered. All these provinces are, we well know, connected by a magnificent network of canals, but that subject I shall consider separately—I mean as to their commercial advantages—and from them a vast inland navigation exists, and which comprehends the whole empire.

A few of the principal cities and towns in these rich provinces of China, and in communication by canal probably, and near the Irriwadi, are as follows, though I shall only mention three of them, being sufficient for my purpose, but there are many others of great consequence. These, however, as belonging to the provinces where the most extensive trade is carried on, are necessary to illustrate the subject.

Kye-yang is a large city in the south-west of China, in the province of Kwi-Choo, which contains a population of nearly 6,000,000 inhabitants. There are extensive mines of gold and silver, vermillion, and iron near this city. It is also a great mart of inland trade by land carriage with Burmah. The opium trade, however, is the most important, for in this province the cultivation of the poppy forms one of the chief features of the industry of the inhabitants; but I will refer more to this subject hereafter.

Yunan is another great commercial city in the south-west of China, traversed by the main streams, or by considerable affluents of all the great rivers of further India as well as China, the great Yantze-Kiang flowing near it. It belongs to the province of the same name (population 6,000,000), and is intersected by canals. From authentic reports, it is one of the very richest portions in this part of China, and not very far removed from the Irriwadi, as well as other great rivers of south-east India. It yields gold, silver, and copper in abundance, tin, rubies, sapphires, and other gems, besides a variety of gums, resins, ivory, varnishes, musk, flax, also very beautiful carpets, and the finest horses. This city also has large manufactories of silk fabric and other articles of the most exquisite character, such as porcelain, embroidery, and lacquered wares of superior and exquisite design, with other valuable commodities. Here also is a very extensive opium trade, probably nearly the largest in China. It is very probable there are very extensive tea districts in its neighbourhood. Its chief general industry appears to be the cultivation of the poppy and manufacture of opium, which is of a very superior description.

Chingloo is the chief city in the province Sechuen, population of province 22,000,000. It is traversed by large rivers and intersected by canals. Most of these rivers appear to be tributaries of the Yantz-Kiang. Of this, however, I am by no means certain, for the information we get from this part of China is not of a very reliable character. It produces metals, sugar, silk, woollens, drugs, with various other articles, probably tea. The rich provinces of Shensi, Hopei, Kansa, and Honan are in its vicinity. This splendid city is also a very important mart for trade by land with Siam, Burmah, Laos, Aunan, and other neighbouring states. A very considerable commerce is also carried on between the whole of these provinces, by land, with Bhootan, Kumâon, and Nepaul, the exports of which include borax-salt, silk, woollen goods, and metals, with an infinity of other articles, of which gold and silver may be comprised. There are several other large towns and cities in this part of China, but a full description would entail more space than I have at my disposal. These few are mentioned, however, in order to prove what a magnificent opening there is for an extended commerce by the means of steam navigation on the Irriwadi, and the west and south-west of China, of which at no distant period the result must be a commerce so vast that it is impossible even to realise the idea of its extent, as well as of a character the most important and lucrative possible. All this may be accomplished by the agency of direct steam navigation on the Irriwadi, with depôts on the frontiers, and perhaps also, as I shall show, by some of the other great rivers of India.

It appears, from a report of the consul at Hankow with reference to the above cities, that the various accounts given respecting the opium trade, as connected with west and south-west China, and the particular provinces of the cultivation of the drug, are little known even to merchants. In this department of the empire, and more especially near Yunan, remarkable attention is paid to the cultivation of the poppy; at Sechuen, nearly half the land is already appropriated to its culture. At Yunan itself and Kivichon, though these provinces have lately been invaded by a Mahommedan insurrection, the produce of opium is very considerable; in fact, this is the great opium mart of all China, which is carried in large quantities down the Yantze-Kiang for consumption in other parts of the country. This crop seems till lately to be grown only in west and south-west China. I request particular attention to this fact, but it pays the growers so well that its cultivation increases; and, although the supply of the native drug becomes more plentiful every year, Indian opium, imported in large quantities down the Yantze-Kang, still holds its own, and is highly esteemed. Hankow is the centre of this vast but iniquitous trade. This town is situated midway on the navigable course of the Yantze-Kiang, and in the very heart of the Chinese empire, and is, therefore, from its situation, the great emporium in the interior of the country for opium imported in foreign steamers from India, and again exported to the various provinces in China. A great competition, therefore, naturally exists between the Indian and Chinese drug, but the superiority of the former is admitted, and it is only the poor people and the inhabitants generally of the remote provinces, from which the difficulty of transit shuts out the Indian article, consume the native drug. The quality of the drug, however, grown in Yunan is said to be excellent, nearly, if not quite equal, to the Indian kind, and the adjacent province of Honan is largely supplied with it. The canals of west and south-west China are, no doubt, largely used for its exportation to the more distant provinces. It is, however, a significant fact that Honan is likewise the greatest importer from Hankow, as a centre of the native drug, so that the best native opium would seem, under the most favourable circumstances, to compete successfully with the Indian article. The native drug is only consumed by the poor (who are as much addicted to this detestable habit as the rich).

The opening out for commerce of the west and south-west provinces of China, which must be now seen are probably among the very richest of that great empire, by means of which trade might be established on an extensive scale by the development of the Irriwadi, and the direct agency of steam, presents at once, which must be apprehended, a more extensive market for commerce than I think could be obtained either by land carriage or by the old route. The canal system of China, with its immense ramifications (of larger magnitude it is said than all the rivers of India combined), would actually become a great auxiliary power in our hands for the extension of trade throughout the whole empire, and which could be at once made to flow to the nearest frontier town of China on the Irriwadi, as the development of commerce proceeds more and more every year. The canals occupy an area of about 1,300,000 square miles.

The Irriwadi route being established, and that by the other rivers we shall consider, commercial enterprise would at first begin to extend, and then improve itself; it would, however, take time for any very great extension of trade in the inland parts of the country to become manifest; improvement, however, would rapidly follow towards such extension. I am, however, viewing the matter as having reference to navigable rivers in general, where trade has to be established in a primary sense, but here commerce already exists to a very great extent, and only requires being transferred from land to water carriage by steam navigation. The above remarks would, therefore, scarcely apply to the commercial aspect, as here represented by the proposed route, in consequence of the great and evident facilities afforded by the river and canal system, with also the communications by the great rivers of China themselves, thus affording such material advantages. Commerce, therefore, could at once be established on a vast scale.

China is, however, peculiar to itself, and, while throughout India, land-carriage is preferred, and perhaps encouraged by the British government, to the detriment of water-carriage, the contrary exists as regards China. The roads of China are mere footpaths.

The rapid advancement, within the last fifteen or twenty years, of railway communication in India, is a most significant and remarkable incident. The facilities of communication developed during that period by this great and conductive system have wonderfully progressed, and has extended beyond all comprehension its immense advantages over the ancient mode of transport of goods, thus opening out a rapid and easy means of transit for merchandise and passengers, and leading to the establishment of factories and warehouses in localities where, before this grand institution was established, little trade existed. This movement has advanced with amazing speed, demonstrating that the power of steam in India, especially in Western India, by the iron-horse, has effected the same prodigious advance in inland transit that has resulted in this country; and, as the science of railway locomotion is still progressing and extending, vast resources of India are being developed, the enormous stores of mineral wealth widely enlarged, spread abroad, and made more universally available; in a word, nations are brought into friendly communication by trade, which, before such trade existed, and those facilities provided, had little knowledge of, or communication with each other. Commerce is also ramified and extended, and a general interchange of the productions of industry between people and people effected which, before such means were supplied, was not possible of attainment. Almost the same wonderful effect would be produced by the canals of China and rivers of India in a mighty extension of trade, if developed in the way I propose, and the navigation proclaimed suitable.

Such facts as these speak volumes, which must, indeed, greatly tend to the extension of trade, if what I say is not a dead letter, and would be far more forcibly illustrated by the application of steam-navigation on the Irriwadi and other rivers of India. As to the route proposed by the Irriwadi to west and south-west China, we must expect difficulties with the Chinese; but no doubt in time, by a careful policy, as well as conciliatory mode of proceeding in dealing with them, a favourable change will soon result, and be the means of commerce greatly increasing and extending, as well as flourishing, to the advantage of both countries.

I maintain, therefore, the time has arrived for the energetic action on the part of merchants, with the view of taking advantage of the resources of west and south-west China, by developing the Irriwadi and opening out trade by means of a suitable fleet of steamers on the river.

I must now make a few remarks, though they will scarcely, I fear, be considered relevant with the subject, although they are necessary in order to arrive at a due appreciation of the importance of what I have endeavoured to demonstrate, viz., the value of the Irriwadi as a trade route between India and China and this country.

As the commerce, as established by this country, is altogether free, it must naturally of necessity flow in that direction where the greatest amount of profit can be obtained. I desire to prove that the west and south-west provinces, with their communication by river and canal (thus comprehending, probably, by these valuable auxilaries the very richest portions of that vast empire), must offer, therefore, a superior market for the commerce with England and America, and a more extended medium for a trade by the Irriwadi larger than that which now exists, probably by the Straits of Malacca and Chinese Sea. But it would be useless to attempt to create a monopoly, as there can be none where there would be ample room for almost any amount of commerce, if these magnificent provinces of China were properly developed in the way proposed, and efficiently worked for such a trade as exists, and having factories and warehouses established on the frontier of China by the adequate sea service, and that it does exist we can have no doubt whatever, from what has already been remarked as to the general produce to be obtained. In considering such a trade as capable of being established, we must notice particularly the amount and extent of those provinces and their products, with the rivers, cities, and canals, as well as the populations, which last may be computed perhaps at 100,000,000 in south and south-west China, as also the various and numerous communications with the more distant parts of the empire by such canals and rivers in China.

It is remarkable that a great, and, as we are aware, intelligent nation such as the Chinese, with those valuable and extensive facilities of trade which their magnificent country affords, with its vast rivers, canals, and communitions, should not yet have adopted the appliance of steam, for by this means a vastly more extensive foreign trade might be added to their home trade; and though this could scarcely much improve the productive powers of its national industry and well known prosperity, or perhaps improve to any great extent the value of the manufactured material in China itself, such a foreign trade would at once be established, and it is probable a a great part of this commerce would be carried on in Chinese bottoms, using the appliance of steam to an extent perhaps as great as is now pursued by English vessels of all kinds. This is a large assertion to make. Indeed, by the application of steam on the Irriwadi, rivers and canals of China, it is not too much to assert, under such circumstances, China would become by this means the general and universal feeder of all Europe. By a more extensive steam navigation also they would naturally likewise acquire the art of constructing and using the different machines and scientific appliances made use of in civilized countries, as well as the other well-known improvements in art and science (this in a qualified form now prevails in Japan most extensively). Under their present isolated condition and exclusive system, the result of circumstances, which has been described, as well as their peculiar though inexorable laws, they have no desire as yet of improving themselves, or acquiring those necessary arts and sciences. There seems, however, to be a more forward movement among them lately, and they now appear (if the government would not obstruct) more sensible to the advantages they would derive from such acquirements, for the Chinaman is eminently alive to his own advantage. Though this is somewhat apart from our subject, it may be mentioned that the Chinese are essentially a maritime people, unlike the Indian nation, and though the land trade with China is very extensive, especially on those provinces bordering on the great Burmese Empire and on the Irriwadi, as I have before shown, the maritime commerce is on the whole the most important, and, as a rule, extensive, as well as being the most valuable.

A most able writer upon this comprehensive subject, many years ago, estimated the commercial shipping of China at only about 70,000 tons, and that of Hainan at about 10,000 or 12,000 more, chiefly engaged in trading by junks to Siam, Anam, Japan, and the Asiatic Archipelago. It is, no doubt, however, a fact that this trade, since the construction of the Suez Canal, has greatly increased in native vessels during the last few years, owing to the great increase of trade. But by the general application of steam by the Chinese themselves, the amount of commerce would be still further increased at least one hundredfold, and very much more if the rivers and canals were considered. Numerous junks annually leave Siam in the fine season with sugar, grain, ivory, and other valuable commodities, for the ports of China, and various articles are imported in return from the Asiatic Archipelago, Celebes, and Arru Isles. But I have said enough upon this subject. I merely desire to prove that, if such a profitable, extensive, and probably increasing trade is carried on by means of junks and other sailing vessels, what would the amount be if a large and well-appointed steam service was established, and intended to comprehend at once not only the Irriwadi as a means of import and export with India and west and south-west China, but all those different countries embraced and watered by the ramifications of its tributaries, thus connecting them with this country also by the Suez Canal.

I do maintain there is no difficulty whatever in the matter, and nothing more is necessary than that merchants should be convinced of the possibility of its construction in order to realise its advantages for commerce. We can only assure them that a great mart is open for an extensive trade, without one single obstruction, that distance is shortened, and the dangers of the old route avoided; and this much must be asserted that its time will arrive sooner or later, so that, when this magnificent river is fully developed, trade must inevitably follow, and expand itself into one of the most magnificent and profitable undertakings of the age we live in.

We will now proceed to consider the three other great rivers of India which lead into south-west China. These are the Mekong, the Menam, and the Salween. With reference to their importance as a direct means for developing trade, if not in the western or south-western districts of China, at least in the surrounding inland provinces of India, which is almost of equal importance, I regret my knowledge is very imperfect* respecting them—what I say are mere impressions—my main object being to prove their importance in developing, if not south-west China, at least inland India. Supposing them to be navigable throughout, a fact not yet ascertained, though from their general character, as very similar to the Irriwadi, we may conclude they are so, it may be, perhaps, to a limited extent; there is still no positive confirmation on this point, as regards their upper or more westerly course. There is very little doubt, however, they might be readily developed throughout by river steamers peculiarly adapted for the navigation. For my own part, I am strongly of opinion, based on a 25 years' experience in India, they are all sufficiently navigable by river steamers for trade purposes, and I think native accounts lead to the same conclusion. There has been no survey of them, that I am aware of, since the time of my first entering the Indian Navy, in 1831. We are all aware what surveying meant before that period. My accounts of these rivers are deduced from very uncertain sources; I am not answerable for their correctness.

The Mekong is supposed to be about 2,400 miles in length, traversing Camboja, Laos, and South-Western China. It is a most magnificent river, and almost the very largest in India. Like the Irriwadi, it has many tributaries, and separates by these into numerous arms or channels in its lower course, covering the Siamese and Anamese dominions with a network of ramifications, of which the east and west boundaries are its delta. It divides Anam from Siam. This splendid river could be made a most important highway for commerce, even in so far as its present condition has been ascertained, by means of a large fleet of sea and river steam-vessels, not only with those fertile, rich, and populous inland provinces of India, but very probably with south-west China also. Its numerous tributaries seem of themselves all noble rivers, and there is no doubt these might be developed for trade, if appropriate measures were established. The commerce on the lower part of this river is still carried on by Chinese junks and Indian sailing vessels. This trade seems extensive. Little information has been afforded us, however, respecting its upper or more western course, as, indeed, we may remark of the two others, as to their actual condition for navigation, excepting in so far as their importance must be recognised as an opening for an extensive trade with inland India.

The Menam is a much less extensive river than the Mekong, as to its general character, and though understood to be navigable, according to the native account, for over 300 miles from the mouths, is little used for commerce by steam-vessels. Of its actual navigable condition throughout we know little. It traverses the very centre of Siam, and after a south or south-east course of between 400 or 500 miles, enters the Chinese Sea in the Gulf of Siam. It is, however a very considerable river, about the same size as the Irriwadi, and, according to the generally accepted accounts (as we have little other information otherwise to go by) rises in the high table-land of Yunan, and is probably connected with the great rivers of China in that neighbourhood. In its more westerly course, near China, it is said to be obstructed, more or less, by bars; of this statement, however, we have no positive proof, as this river has never, within my recollection, been perfectly surveyed, nor have we ascertained satisfactorily the whole extent of its course; it may, however, be estimated at about 1,000 miles. It appears to have numerous splendid tributaries, one especially watering the independent kingdom of Laos, and a part of inland India, which is little known, on the confines of south-west China, called Lanchang. On either side of this affluent there appears to be both a richly-wooded and cultivated country, abounding in produce of various descriptions, as well as vast quantities of valuable forest, such as teak, Japan, and sandal-wood trees. The greater part of the river itself waters many large and fertile other districts of inland India, and from which a considerable land trade is carried on. On the whole, imperfect as our description is, for want of information, we may consider it a most magnificent river, and in every respect of equal importance for inland commerce in south-east India as the other adjacent ones. In the annual overflow, which seems common in July and August on most of those large rivers, its waters are said sometimes to rise to a considerable extent, occasioning at times disastrous floods. A great commerce might, without difficulty, be readily established by a service of sea and river steamers adapted for the work, if it were only properly surveyed. Both these rivers would afford great facilities for the extension of trade, and evince what the power of steam has already effected in India; and the same prodigious advancement may also be easily achieved by their development in the way proposed, affording a ready and rapid means for the conveyance of produce from rich and fertile provinces of inland India. This must be obvious to all, especially as a means for developing new markets in hitherto neglected or, comparatively speaking, unknown localities. There is a junction, it is said, between the Menam and Mekong; it has a large delta, and the two principal mouths are very wide. It appears in its higher range to pursue a course more easterly and westerly, up and down. All these rivers seem to subdivide, giving off lateral streams. There is a very large general trade from Bankok with China and this country. The source of this magnificent river is supposed to be 18,000 feet above the sea, intersecting mountains of amazing height in the south-west provinces of China, through which it flows. It is uncertainly reported in one part as bending due south, and it is not improbable in its course it is joined by the Gartobe, the conjoint stream breaking through the mountains of the Himalaya; this, however, is a subject for investigation. I do not vouch for its accuracy, as it is in nowise clearly ascertained. As a rule, the greater part of the more southern country immediately adjacent to its banks, in its delta especially, is, from reports, of high and unvaried fertility, and on which are numerous towns, which it is unnecessary to describe. The name Menam signifies "the mother of waters." The native Siamese are extremely jealous, and averse to its development, and very considerable danger exists to its being made a general highway by us.

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* I have assumed it possibly pretty correct, from the country through which they flow, but that is all, for I am not responsible for inaccuracies.

The Salween is another splendid river, but, like the two former, little known in its upper course. It has its source in Thibet, a region prolific in mighty streams; though it has been but slightly explored, it appears to divide the most western Burmese dominions by tributaries. It has, however, been stated as so long a course as to be almost without any; this, I think, is probably a mistake, by observing the countries it waters. It separates Laos and other independent States generally. This noble river flows, like the Irriwadi, in a southerly direction through the south-west Chinese provinces, and part, as I have said, of the Burmese dominions. It is called the Moulmain river, entering the Gulf of Martaban by a considerable mouth, flows through a widely populated country, and no doubt could be navigated some hundreds of miles from its delta. For the development of inland trade by river steamers, this river would afford a very profitable medium.

All the great rivers enumerated in this sketch are most important channels for opening out commerce by means of steam navigation, either on a large or small scale. If we could only establish the one fact of their being navigable for river steamers, as there is no reason to believe but that they are so, a vast impetus would be given, and the fields of commerce enlarged and extended, by developing the immense resources of inland India, that is the more inland parts of Siam, Assam, Burmah, and Laos.

We have every appliance for the art of transport, whether by sea or land, and in proportion to the perfection of this art will be the extent of commerce. We know well this valuable fact, that an enormous commerce can readily be established by means of steam on these rivers. Why, then, I ask, should it not be accomplished? These rivers must be surveyed thoroughly, and there are some of the most eminent Indian navy surveyors who would accomplish the work, one the greatest living authority and Indian surveyor on these matters, and who, I make no doubt, would undertake the work. I strongly advocate these rivers should be occupied. Two small steamers, well fitted out, and strongly armed, with a few steam launches, would be sufficient for the purpose, and the result to commerce would be incalculable, for even India itself, particularly as regards its inland provinces, leaving out China, has not been half so developed as it might be for commerce; both, in fact, in this respect are in their infancy, and more especially since the construction of the Suez Canal, as almost the universal route for vessels to India and China.

In my opinion, the Irriwadi route must be established sooner or later as the general and universal one. We must not be satisfied with things as they now exist, or be content to travel on in the old ruts; we must see and judge for ourselves, and take nothing for granted until all existing particulars have been properly examined, ascertained, and cleared up.

The deductions to be obtained from the above remarks may be summed up as follows:—

Firstly. The opening out of new provinces never before developed, except by land-carriage traffic, and the establishment of commerce with west and south-west China, Burmah, Pegu, Siam, Anam, and Laos; by the agency of the Irriwaddi, Mikong, Menam, and Suez Canal, by a comprehensive fleet of sea and river steamers, and which might be intended to embrace the Malayan Peninsula, Borneo, the Philippines, Papua, and the whole Indian Archipelago as well—especially as relates to river navigation in those localities, for Papua, Borneo, and even the Malayan Peninsula is full of, I think, undeveloped rivers, in their upper portion.

Secondly. Shortening the distance from, probably, six to 10 days, as compared with the old route, *viâ* the Straits of Malacca and Chinese Sea, and thus avoiding those fearful typhoons in that tempestuous ocean as well as its dangerous navigation. The river being perfectly navigable for suitable steam vessels of proper draught.

Lastly. The great paramount and obvious advantages to be obtained from covering the affluents with steamers, and thus developing the existing trade with inland India on a comprehensive and extensive scale. These tributaries are especially valuable for opening out a commerce by them with inland India, the magnitude of which it is impossible to estimate. These channels might also be made available to connect by steam all the adjacent countries.

Before finally concluding this subject, I may mention that I have not thought it necessary to describe the different shoal banks, bars, or various reaches on the Irriwadi, which, from the survey, I could easily have done. I have never myself personally made the tour of the Irriwadi, but am of opinion, from the various information received, sufficient has been stated to illustrate the subject for the purpose intended; and, indeed, no further conclusions can be arrived at, when we remember, as was stated at the commencement of this paper, that since I penned this sketch vessels of large tonnage from Scotland have actually made the voyage easily up to almost the very frontiers of China, thus at once setting at rest any doubts as to the safety of the navigation.

It is true no institution can remain unchanged in our time if it depends for its stability on the antiquity of its foundation, it must stand or fall by its own intrinsic merits, that is, the goodness of its work, by the social or public advantage to be derived from it. If that be imperfect in any respect, it must amend its internal arrangements, or the spirit of change and improvement will at once demolish it. This principle may be applied in the case before us, that of the old China route, as compared with the one we have been considering as well as recommending, with the advantages and disadvantages incident to both. The former is no longer tenable if a shorter and better has been discovered, and can be substituted in its place, and that such is the case there can be no doubt, after what has been advanced from the testimony adduced of the two above-named officers. There is no question as to the capability of the Irriwadi to be made a great highway for trade with western and south-western China.

The Irriwadi has been occupied for now, I should say, more or less, nearly 50 years by steam on its lower portion, and I think, notwithstanding that fact, it is only this year that the river has been found practically available throughout for the largest vessels to within a few miles of the frontier of China. Why, therefore, have there not been depôts opened, and factories established, on those frontiers, for conducting the vast commerce which would at once be established, and by the rivers and canals extending, as they do, throughout the whole empire of China, and connecting almost every province, such produce would be brought from every part of the empire. The other three rivers mentioned ought to receive also especial attention, as they have not as yet been occupied by us with the view, by river steam navigation, if not by sea, of developing for commerce inland south-east India. This, however, could scarcely be accomplished until their upper courses were carefully surveyed. This survey, if ever undertaken in the proposed way, should be entrusted to those eminent men of the late Indian Navy who have already completed the present magnificent surveys of the Indian and Chinese seas, the Arabian Sea, the Red Sea, and Persian Gulf, with various other harbours and rivers of India.

I would recommend, or rather suggest, the first survey to comprehend the three rivers mentioned, the Mekong, Menam, and Salween, and perhaps the upper sources of Bramhapootra, then the upper parts of the rivers of Borneo and Malayan Peninsula, the survey to extend afterwards to the unknown majestic rivers of Papua. As for myself, I am no surveyor, but think there is one, the greatest living surveyor of the Indian Seas, available. No doubt the Royal Navy possesses the most eminent surveyors; these, however, have no direct experience of India in that department of science; and certainly those who have accomplished already the greatest portion of the Indian work, and which, from experience by very many years of labour, is familiar to them, should finish it. I merely throw these remarks out as suggestions, for if the capacity of the Irriwadi, after being used by steam perhaps 50 years, has only just now, for the first time, in 1871, been ascertained as to its safe navigation throughout, what can we suppose is the case as to the upper portion of the Menam, Mekong, and Salween, and perhaps the Bramhapootra, which have not as yet been occupied, and on which the present trade is pursued, either by land carriage or by boats and junks. I maintain these are very important mercantile questions, and deserving every attention.

In such a survey, it could be made to pay itself by employing merchant vessels for that purpose, in the meantime trading while operations were going on, merely, I mean, having surveyors on board with all necessary appliances.

These are suggestions merely thrown out for what they are worth. At any rate, these rivers ought to be properly and efficiently surveyed at once, and developed for commerce by means of steam, thus superseding the land trade and that now carried on by native vessels and Chinese junks. The inland commerce thus to be obtained from Anam and Siam, as well as Burmah, would be found most extensive as well as compensating.

A discussion followed the reading of the paper, which will be given in a future *Journal.*

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

France.—The *Journal Officiel* of the 19th January, 1872, contains the following decree relative to the representation of French productions at the Exhibition:—

The Minister for Agriculture and Commerce, in virtue of the decrees of the 5th April, 1870, and 30th December, 1871, instituting a commission for the proposal of such measures as would facilitate the participation of France in international exhibitions, and authorising the formation of special committees of admission, selected on the recommendation of the principal commission, and presided over respectively by a member of that commission, has resolved as follows:—

Art. 1.—Special committees of admission to the International Exhibition of 1872 at London are instituted in accordance with the statutes and regulations published by her Britannic Majesty's Commissioners.

Art. 2.—The following are named members of these committees for the various branches of art and industry:—

First Division.—Fine Arts.

Class 1.—*Painting.*—M. Meissonier, Member of the Institute, and of the Principal Commission, President; MM. Daubigny, artist; Maurice Cottier; Fromentin, artist; Cabanel, Member of the Institute; Chenavard, artist; Robert Fleury, Member of the Institute; Bonnat, artist; Paul de Saint-Victor; Viollet-Leduc (Adolphe); Lafenestre, of the Fine Arts Department, Secretary.

Class 2.—*Sculpture.*—M. Guillaume, Member of the Institute, and of the Principal Commission, President; MM. Barye, Member of the Institute; Carrier-Bellener, statuary; Cavelier, Member of the Institute; Paul Dubois, statuary; Guéret, ornament worker; Jouffroy, Member of the Institute; Mène, sculptor; Aimé Millet, statuary; Alexandre, of the Fine Arts Department, Secretary.

Class 3.—*Engraving, Lithography, Photography.*—M. Gerôme, Member of the Institute, and of the Principal Commission, President; MM. Olympe Aguado, photographer; Henriquel Dupon, Member of the Institute; Hamery, engraver; Gaucherel, engraver; Vicomte de Laborde, Member of the Institute, and of the Principal Commission, Mouilleron, lithographer; Jules Jacquemart, engraver; Robert, Professor of Photography at the Ecole des Ponts et Chausées; Des Chapelles, of the Fine Arts Administration, Secretary.

Class 4.—*Architecture.*—M. Lefnel, Member of the Institute, and of the Principal Commission, President; MM. Vandoyer, Member of the Institute, and of the Principal Commission; Abadie, architect; Boësvillwald, architect, Inspector-General of Historic Monuments; Duc, Member of the Institute; Labrouste, Member of the Institute; Laisné, Professor of the National School of Fine Arts; Millet, architect; Lance, architect; Gasnier, head of the Office of Historic Monuments, Secretary.

Class 5.—*Industrial Products exhibited on account of Artistic Merit.*--M. Viollet-Leduc, architect, Member of the Principal Commission, President; MM. Badin, Manager of the Manufactory of Beauvais; Darcel, Manager of the Manufactory of the Gobelins; Anatole Gruyer; De Lajölais, artist (painter); Eugène Lami, artist (painter); Rondelet, embroidery maker, Member of Commission; Steinheil, artist (painter); Williamson, Manager of Mobilier Nationale; Leroux, architect, Secretary.

Class 6.—*Drawings Relating to Industry.*—M. Ferdinand de Lasteyrie, Member of the Institute, and of the Principal Commission, President; MM. Chabal Dussurgey, industrial draughtsman; Jules Diéterle, formerly Assistant-Director of the Manufactory of Sèvres; Denulelé, decorative artist; Gulland, decorative artist; Guichard President of the Central Union of Fine Arts applied to Industry; Cambon, auditor at the Conseil d'Etat, Secretary.

Class 7.—Reproductions from the Antique and from Works of the Middle Ages.—M. Le Baron Alphonse de Rothschild, member of the Principal Commission, President; MM. Le Comte d'Armaillé; Le Comte Clerc; Christofle, manufacturer, Paris; Eugéne Dutuit, Rouen; Ch. Lepec, painter on enamel; Salmson, sculptor; Jacquemart (Albert); Gerspach, of the Fine Arts Administration, Secretary.

Second Division.—Industry.

Class 8.—Cotton and Cotton Goods.—M. Feray d'Essounes, Member of the National Assembly and of the Principal Commission, President; MM. Cordier, member of the National Assembly and of the Principal Commission; Alfred Collin, merchant; Gustave Roy, Member of the Consulting Committee of Arts and Manufactures; Henry Grellow, lace maker; Alcan, professor at the Conservatoire des Arts et Metiers.

Class 9.—Jewellery, Precious Stones.—M. Rouverat, jeweller and dealer in precious stones, Member of the Principal Commission, President; MM. Falize, Aîné, president of the Syndical Chamber; Bapst, dealer in precious stones; Soufflot, jeweller; Boncheron, jeweller and dealer in precious stones; Hémon, plated ware manufacturer; Rouzé, imitation jewellery maker; De Luynes, professor at the Conservatoire des Arts et Metiers; Martial Bernard, jeweller.

Class 10.—Musical Instruments.—M. Le Comte de Chambrun, member of the National Assembly and of the Principal Commission, President; MM. Ambroise Thomas, Director of the Conservatoire de Musique; Wolf, successor to Playel; Schaeffer (Maison Erard); Alard, professor at the Conservatoire; Focillon, director of the Ecole Municipale Colbert; Wolfeld (pianos), Avenue Hudaine; Gaston Plante, Secretary.

Class 11.—Acoustics, Scientific Inventions, and Discoveries—M. Sainte-Claire Deville, member of the Institute and of the Principal Commission, President; MM. Lissajons; Privat-Deschanel; Jamin, Member of the Institute; Debray, examiner at the Ecole Polytechnique, professor of chemistry, director of the Garantie-office at the Mint; Lami, professor at the Ecole Centrale; Troost, professor at the Ecole Normale.

Class 12.—Paper, Bookbinding, Printing.—M. Wolowski, Member of the National Assembly and of the Principal Commission; MM. Lavasseur, Member of the Institute and of the Principal Commission; Alfred Maine, member of the Principal Commission; Claye, type founder; Aimé Girard, professor at the Conservatoire des Arts et Métiers; Paul Dalloz, printer; F. Didot, printer and publisher; Charton; Gautier-Villars, printer; Dethomas, private secretary to the Minister for Agriculture and Commerce, Secretary.

Art 3.—The two Commissioners-General, Messrs. Ozenne and Du Sommerard, named by the above decrees, belong by right to all the committees of admission; they are instructed to convene them, and centralise the working thereof.

Done at Versailles, 17th January, 1872.
The Minister for Agriculture and Commerce,
(Signed) Victor Lefranc.

English Pottery at Berlin.—The following is an extract from the *Berliner Fremden und Anzeigeblatt*, of December 17, 1871. An exhibition of English pottery, originated by the government, is now open daily, free, from eleven to three o'clock, in the Palace Monbijou, and deserves general attention on account of the importance of this extensive collection from an industrial point of view. This collection was brought together for the London International Exhibition of 1871. The London firm of Mortlock distinguishes itself by its beautiful turquoise-blue porcelains. The invention of G. J. Cox, of London, deserves especial notice. It reproduces upon porcelain plants faithfully coloured after nature, although the decorative application of them leaves much to be desired as regards the arrangement. Doulton and Watts, of Lambeth, have contributed a collection of vessels in stone-ware of artistic shape, mostly of an ornamental character. The collection of glazed earthenware from the Bethall works of Maw and Co. excites the admiration of connoisseurs, as well as of the general public, on account of the lustre of the colours and the sharpness of the modelling preserved after the burning. The collection consists chiefly of tesseræ for decorating walls, and of ornamental vases in majolica colours. The great central group of the exhibition is formed by the collection of Minton and Co., of Stoke-upon-Trent. The majolicas of this firm are exemplary as to colour, although they are not always examples of taste as regards the modelling. Their imitations of good old faïence ware deserves especial attention, and likewise their copies of Henri Deux ware. Other singularly interesting productions of this firm are their wall decorations from Persian, Japanese, and Chinese patterns, tesseræ, &c. One of the most remarkable art works of the exhibition is also found among the exhibits of Minton, a representation of a gem, *pâte sur pâte* (white on blue ground), imitating in the most perfect manner the transparency of gems. This imitation is the work of a French modeller, but its perfect technical execution belongs after all to the English makers. The elegant Irish porcelain articles for the decoration of rooms, by M'Birney, are remarkable for the brilliancy of their glazing, which is like that of mother-of-pearl. Copeland and Son, of London, have successfully adopted the technical process of old Sèvres porcelain, with inlaid small gold plates and imitations of small pearls. The celebrated porcelain works of Wedgwood have contributed pieces ornamented with gay and charming groups, which are executed in a wonderfully dexterous manner; they are painted by a French artist, Lessore. The pieces exhibited are the originals, which have been purchased by the Prussian government as patterns, as well as several other of the principal objects. Battam and Son have successfully imitated in porcelain the precious Limoges enamels of the 16th century. The Royal Porcelain Works at Worcester are imitating in their porcelains, in the most excellent manner, the warm yellowish tint of ivory, as well as the rendering of colours upon ivory. The South Kensington Museum has lent a collection of ceramic works of various nations, amongst which the vessels for the use of the peasantry of Spain, Egypt, Persia, Russia, and Switzerland, excite attention, on account of their artistic shapes. The Spanish articles for daily use are particularly interesting for the tradition of classic forms which they show. Amongst the other works, those of Ginori, of Naples, are especially prominent. Portugal and Sweden are represented by majolicas. The English articles for daily use which are intended for the colonies, and are sent to the far east among half-civilized persons, are also remarkable. The exhibition is superintended by Inspector Hesse and Dr. Lessing, and one of these gentlemen is daily to be found in the exhibition-rooms, to give information, from one till two o'clock. The English government is represented by Major de Winton, who also superintends the sale of objects in the interest of the English manufacturers. On Wednesday, the 13th December, their Imperial Highnesses the Crown Prince and the Crown Princess visited the exhibition. In conclusion, the attention of manufacturers, as well as of the general public, is called to this opportunity of becoming acquainted with the pottery of England, so rich in variety, which has developed itself in such a surprising manner since the International Exhibition of 1851 and the foundation of the South Kensington Museum."

The Albert Hall.—At a recent meeting of the Royal Institute of British Architects, Major-General Scott, C.B., read an explanatory paper on the construction of the Albert Hall. The President of the Institute, Mr. Thomas Henry Wyatt, occupied the chair. There was a variety of illustrative diagrams on the walls. General Scott said that at first he hesitated to accept the invitation to read the paper, as he did not wish to appear there in the character of an architect, a title to which he made no pretension. On reflection, however, he felt that he ought not to shrink from contributing his quota to the general stock of information on constructive difficulties and expedients, because he had largely benefited by the advice of members of the society, and was anxious that so novel and gigantic an experiment as the Albert Hall should, in the interest of future design, he freely criticised. As a complete descriptive memoir would take too long a time to read, he intended to confine his attention to such points as exhibited some novelty in practice, or involved some important principle that might be elucidated by discussion. Before doing this, it was necessary to say a few words as to the conditions imposed upon him. The models and drawings of Capt. Fowke were put into his hands as the basis of the design, but they embodied only his first rough ideas on the subject, and what the building would have been if he had lived long enough to mature his design could not be fairly judged of from them. Consequently, he (General Scott) had greater latitude to remodel the work, but did not avail himself of it without ascertaining that others were of his opinion. The data prescribed for his guidance were these:—1. That the building should be of oval form, and accommodate 6,000 or 7,000 persons. 2. That the interior arrangements should consist of an arena, which might be used as a promenade or exhibition, some 10 or 12 rows of seats above the arena arranged in the form of an amphitheatre, two or three tiers of boxes above the amphitheatre seats, and a great gallery open to the interior of the wall, running round the building between the exterior and interior walls, and top lighted. 3. That the entrances and exits should be arranged like the seats on the plan of the old Roman amphitheatre. 4. That the façade should be of red and terra-cotta dressings. 5. That the whole expense should not exceed £175,000. With these instructions he had the advantage of the advice of a committee, consisting of Sir W. Tite, Sir M. Digby Wyatt, Messrs. Fergusson, Fowler, Hawkshaw, and R. Redgrave, R.A. To each of these gentlemen his best thanks were due. At the preliminary meeting of the committee it was suggested that the Greek theatre should be substituted for the Roman amphitheatre as a model. But the general form of the latter was considered a fixed condition, and the existing form of the hall was determined by a careful consideration, experienced opinions, and facts relating to acoustics. Whether another shape would have enabled an audience to hear music better was, of course, a fair question to debate. Owing to a modification of Captain Fowke's plan of the hall, they gained sufficient space to introduce the balcony, by which 2,000 cheap seats had been obtained at the expense of 800 dearer ones. The increased curvature of the sides also had collateral advantages as respected the stability of the roof. The committee advised the change on general, if not on architectural, grounds. Something of the grandeur of Captain Fowke's proposed arcade might have been sacrificed, but this loss, General Scott believed, was compensated by their giving to the arcade a visibly solid wall to stand on, from whatever part of the interior it might be seen. The velarium, while acting as a sun screen, imparted to return waves of sound the desired divergence. It had been assumed by some critics that the velarium was invented to cover a defect disclosed by experience, but its expediency was discussed by the architectural papers at the beginning of 1869, before the roof was fixed. Indeed, the idea of covering a building on the model of the Roman amphitheatre with a velarium was natural enough. A great collateral advantage in point of artificial lighting was gained from the white reflecting surface of the velarium. Large quantities of light were absorbed at night by a dark glass roof. Their reasons for lining the wall with wood were fivefold. It was believed that sound in its utmost purity was heard in still, open air, and this might be due not only to freedom from disturbing reflections but also to the absences of causes interfering with its free transmission, and checking vibrations isochronous with the vibrations of the atmosphere, such as would be interposed by draping the walls. Tiled floors give rise to sharp, irritating reflections of sound. The buildings remarkable for good acoustic properties had all been lined with wood. Among others, there was the celebrated theatre of Parma, in which a low tone of voice could be heard at a distance of 140 feet. A room sufficiently non-resonant for a speaker with ordinary rapidity of utterance, and with modulation of the voice, was too dead for musical purposes, and the resonance from wood was more agreeable than that obtainable from any other material. The corrections of undue resonance was easily accomplished by draping, but it would be costly to impart resonance to a building deficient in this respect. The fact that the most delicate musical sounds were distinctly audible, even at a distance of 186 feet from the performer, was attributable in no small degree to the wooden sound boards with which the hall was lined. Listening for echoes had much to do with those formerly complained of in this building. He was not, of course, speaking of such distinct echo from the roof as was heard in the arena from the Prince of Wales's voice on the opening day. This was occasioned by the reflection of the waves of sound from the convex glass roof, which the velarium was too thin to intercept, and which had been remedied by calendering and filling up of the pores of the cloth of which the velarium consisted. An important modification of the original design had been made in the arrangement of the staircases. It was in the first place intended that the space between the inner and the outer walls should be completely filled with stairs and landings, the one over the other, running spirally round the building, and all having their exit in one common corridor. Instead of this, a plan had been adopted which gave to each staircase or pair of staircases an exit into a separate crush room, thus enabling visitors in different parts of the building to be kept separate. At any time the auditorium could be emptied in a few minutes. A part of the two upper tiers of boxes projected some distance beyond the compartments above them, an arrangement made with the view of adding to the imposing effect which was given by a great number of well-dressed ladies. Perhaps the roof was the most interesting of the constructive features of the building. As it was impossible on this occasion to give this subject the attention it merited, he should not do more than refer to the general principles and considerations on which reliance had been placed for the security of the structure. As in the case of the acoustic properties of the hall, disaster had been predicted on this point. And there was enough in the gigantic nature and novelty of the undertaking to cause some anxiety. In the original plan, the roof was supported by buttresses resting on the two walls of the building; but, to have taken advantage of this means of receiving the thrust, it would have been necessary to accept an unequal division of the bays of the outer wall, for it was manifest that, if the columns supporting the roof in the interior of a structure were arranged in an ellipse, the prolongation of radii through these columns to an outer wall would not equally divide this wall if it were an ellipse parallel to the first one. Means other than buttresses, therefore, had to be devised for securing the wall, which carried the roof against its thrust; and the expedient adopted for this purpose was a wrought-iron wall-plate, of girder shape, resting with its web on the wall, and supporting the ends of the roof principals. At the first blush, there might appear to be danger in trusting to the varying rates of expansion of brickwork and wrought-iron in a continuous girder of nearly 700ft. in length, but it was considered that, even if the expansion of the iron caused an irresistible strain on the brick arches which joined the piers for supporting the roof, the elasticity of the piers would be sufficient to take up the expansion of the wall-plate, and no further damage than minute and probably invisible fractures through the crowns of the arches could result. The next question was how far a girder wall-plate of reasonable weight could be trusted to take the thrust of the roof-load and the strains arising from wind; for, as the plan of the building was elliptical, the thrust of the principals of the roof, owing to the inequality of the weight of roof upon them, would vary with the inequality of the two axes of the ellipse. Contrary to the advice of Mr. Hawkshaw, who counselled the adoption of simple ribs having one member only, but of considerable strength, which should carry a central curb, and rise and fall freely with the variations of temperature, principals like those at the Cannon-street Station, on the trussed girder system, were determined on. The lower member, however, instead of being a simple tie rod of circular section, was made of an inverted T form, to enable it to receive compression as well as to take tension. By uniting, also, both the upper and lower members of these principals in central curbs, which were assisted in keeping their form by tie rods, the principals were enabled to act either as arches or trussed girders, and could better cope with unusual or irregular strains. The stability of this arrangement was probable, for the strain on the wall-plate would not vary correspondingly. But in the event of an unexpected disturbance, the tendency to loss of shape would at once be arrested. Moreover, if weakness existed in a principal, it would, from the polygonal form of the purlins, receive much support before mischief was done, and the especial defect of girders of this form, as respected lateral and sudden strain from wind, had been in great measure obviated, The plastering used on the interior wall perhaps merited some attention. Treated as it had been here, the lime set without slaking. As to warming and ventilating arrangements, they had, in order to preserve a general equality of temperature, divided the coils of hot-water pipe into sections, each of which had its own hot-water generator. By closing the louvres of the up-cast shaft through the centre ring of the roof, the inward draught occasioned by the opening of the doors could be controlled. Many thought that the modelling was too coarse, but delicate treatment was out of character with a building which depended on the sweep of its lines rather than exquisite finish for its effect, and the eye of the painter was generally pleased with the picturesqueness imparted in consequence. In the original design, the exterior of the wall of the picture gallery had its surface broken with decorative panels of geometric design. One suggested that this would give a fine opportunity of introducing a mosaic picture of figures of more than life-size; another, while approving the notion, was in favour of reducing the figures to nearly half life-size. In this conflict of views he (General Scott) adopted a middle course, as an attempt to increase the apparent magnitude of the building by reducing the figures would not succeed with all observers. On the other hand, he saw no reason to reduce the apparent size of the building for the sake of a fine mosaic picture. By the advice of some of the artists who undertook to prepare the designs, the figures were finally made of full heroic size. General Scott, who bore willing testimony to the value of the assistance he had received, then brought his paper to a conclusion.

EXHIBITIONS.

Exhibition Illustrative of the Art of Writing.—The Comte de Bizet-Taillant has opened a very curious exhibition in his hotel in the Rue d'Assas, in Paris. It consists of a very interesting collection of objects used in writing during the past ten centuries, and of the various materials for writing upon, from the papyrus and tablet to the writing paper of modern times, with some curious examples of transitions. The receipts of the exhibition are to be devoted in aid of the wounded in the two sieges. This unique collection should, says a correspondent, if possible, be secured for the coming exhibition at South Kensington, as it would form an interesting feature in the paper and printing group.

The Lyons Exhibition.—On Monday, a committee meeting was held at the Mansion-house, under the presidency of the Lord Mayor, for the purpose of considering the best means to be taken to ensure the proper representation of the United Kingdom at the International Exhibition of Agricultural and Industrial Products and Works of Art, to be held at Lyons, from May to October next. It was announced that the Minister of Agriculture and Commerce, under whose patronage the exhibition was to be held, had promised that the French government would furnish the medals to be awarded by the international juries, and that the committee of organization at Lyons would defray the expenses of the London committee to the extent of 6,000 frs. It was resolved to communicate with the various chambers of commerce in Yorkshire, Lancashire, and elsewhere, and to suggest to the mayors of the cities and towns most interested in Continental trade, the advisability of immediately forming local committees to obtain exhibitors; the manufactures mentioned as being most important being those included in the classes for textile fabrics, agricultural, and other machinery, raw and manufactured products, and food. Arrangements were being entered into for the conveyance of goods to the exhibition at reduced rates by the several railway companies and by vessels from London. The productions exhibited will, it is said, be divided into nine groups, viz.:—First, silk, raw material, machinery, and manufactures; secondly, textile fabrics, clothing and other objects worn on the person; thirdly, furniture and decorative objects for use in dwellings; fourthly, machines, implements, and tools; fifthly, products of the extractive industries; sixthly, alimentation; seventhly, agriculture and horticulture; eighthly, materials and processes of the liberal arts; and lastly, works of art. The articles for exhibition will be received at Lyons during March next, and pictures and other works of art will be admitted free of charge. All possible facilities will be given to the exhibitors for the sale of their productions, but no object exhibited must be withdrawn until after the closing of the exhibition. The offices of the London Committee are at 3, Castle-street, Holborn, and all communications should be addressed to Mr. Edmund Johnson, the honorary secretary.

CORRESPONDENCE.

IMPROVEMENTS IN THE PROCESS OF COINING.

Sir,—Mr. G. F. Ansell, speaking on my paper read on the above subject on the 24th inst., before the Society, stated "that he had invented my system of casting and rolling plates years before, and probably the moulds would be found at the mint," leaving the meeting to understand that they were constructed like mine, with the same intentions as to heating, and the same treatment throughout, in fact, that they were identical.

Although I knew Mr. Ansell was wrong, I hesitated to contradict him categorically, until I had ascertained the facts. The attempt to construct moulds for the casting of plates has frequently been made at the British and foreign mints, and long before Mr. Ansell came to the mint. The old managers had used them, but had failed, for the reasons which I explained in my paper.

My moulds consist of two loose plates, two to four inches thick, with loose side pieces to fit between them, and fastened together by overhanging clamps. The object of having loose plates is that of enabling their faces to be ground smooth. The plates are made thick, so that they should retain the heat for some time, thus enabling the cast to set gradually; and, moreover, my moulds are heated in a furnace to red-heat.

Mr. Ansell's moulds were cast with the rims fixed on, so that they could not be ground and polished. His mould plates were thin (scarcely ⅜ of an inch), so that they could not retain any heat, and they had to be fixed in the usual carriage (instead of being clamped), so that the hot metal ran out of the sides. Still more important was this difference:—My moulds are entirely closed in, having but a small aperture at the top, whilst Mr. Ansell's were entirely open, thus leading to a strong oxidation of the surface of the casts.

Mr. Ansell's moulds were not made red-hot first, for they were merely surrounded for a short time by hot cinders, just as the present bar moulds are; in fact, they were nothing more than broad, flat bars, prepared in the same way as the present casts, and their heating never came to near the red heat, excepting when they became hot through the cast itself, and thus, by rapidly withdrawing the heat of the cast, they made the latter brittle.

My moulds are heated in a furnace to red heat, short only of the proper distance from the melting point of cast-iron, so as to give time for the cast to set very slowly.

The difference will appear still more important when I mention that Mr. Ansell's moulds were only used for silver, never for gold. The paper referred only to the manufacture of the standard gold coin, and Mr. Ansell knows well how great the difference is between the temper and treatment of these two metals.

If the authorities of the mint, aware of Mr. Ansell's attempts and failures in plate-casting, had not at once seen that my process was an entirely novel one, would they have given it a trial, and continue to show their desire to carry out further tests? I leave the public to draw their own conclusions from these matters, trusting that I may be allowed to supplement my reply by this letter.—I am, &c., Ernest Seyd.

THE PATENT OFFICE MUSEUM.

Sir,—I trust you will kindly allow me, through the medium of the *Journal of the Society of Arts*, to say a few words regarding the present condition of the Patent-office Museum at South Kensington, an institution of acknowledged public value and importance, for the foundation of which it is not perhaps generally known that we are indebted to the liberality of Mr. Bennett Woodcroft, F.R.S. To show that the matter I write about is one of very considerable public interest, I may state that since the opening of this museum free daily, on the 12th May, 1858, it has been attended by upwards of 2,253,926 visitors, the number for the week ending the 20th January having been no less than 5,449. Moreover, this museum is, I believe, the only place in London where complete sets of the Commissioners of Patents' publications can be consulted in the evening; hence it is an institution of peculiar value to working men and others requiring to have searches made regarding the novelty of their inventions (in order to avoid the re-patenting of old inventions we are so often told about), but who are otherwise engaged in the day-time, and cannot afford to pay others for searching on their behalf. That the present building is totally inadequate and unsuitable for its purpose; that, consequently, the collection of models and machines is too much overcrowded for classification, or for due inspection by visitors; that very many machines and models of the greatest value, scientifically and historically, are kept back from the public by some of our most eminent engineers and others, for no other reason than the total absence of suitable provision for their exhibition to the public; and that, in a word, the place as it stands is an utter disgrace to this the foremost among the industrial nations of the world—are matters of notoriety, which having formed the subject of inquiry and report by a Select Committee of the House of Commons some years ago, need not now be dwelt upon by me, even did the reasonable limits of a letter justify the attempt. But if those whose business it is to attend to this matter are not prepared to provide a better and sufficiently commodious building for the purposes of the museum, it is surely not too much to ask, on public grounds, that the present "shed" (for I can give it no better name), should at least be made as endurable and useful as circumstances will admit; for although it must ever be impossible to thoroughly examine the machines or models crowded together, and piled one above another as they now are, from sheer want of room, it certainly might be made possible to consult the valuable library the museum contains without having one's attention constantly distracted, and (in the winter time) having to endure severe cold and incessant draughts, involving subsequent attacks of rheumatism or other ailments. The models, machines, and library are all contained in a single room, one end of which is set apart for the books, the entrance door for the public being at the other end, from whence the draughts I refer to arise, and the whole place is supposed to be sufficiently warmed by hot water pipes, from a small boiler which also provides heat for a portion of the South Kensington Museum. As to the effect of these various arrangements, I will let facts speak for themselves, by merely stating that the temperature in the Patent-office Museum and Library has been found to vary in winter between 30° Fahr. and 54° Fahr., which latter was the highest recorded during a period of four months ending March last, according to the thermometer in the museum.

In such low temperatures, aggravated by the incessant severe draughts, every reader at the Patent-office Museum has now to pursue his investigations amidst the din and interruptions arising from other visitors who are moving about in the same room, examining and criticising the models, separated from the library portion only by a single hand-rail. Besides talking aloud, some of the more venturesome of these visitors, every now and then, give rise to a tinkling sound, by operating with their fingers upon the model of a musical instrument, judiciously placed just under the reader's nose, and who must needs be furthermore bothered at intervals with questions about the models and other matters, with which, for the nonce, he has no concern. If a reader can be expected under these conditions to satisfactorily study and clearly analyse the specifications of complex machinery and manufacturing processes, and otherwise to enjoy, to a reasonable extent, the advantages which it is the object of such an institution to provide, then my complaint falls to the ground; but, contrarywise, according to my view of the matter (and I have had to use the library for years past), I venture to think that I have made out a strong case, which will fully justify, as I trust it will secure, the intervention of your influence on behalf of the public, especially as I have reason to believe that the objections complained of as regards the library might be, in a great measure, if not wholly, obviated, by the expenditure of less than £100 out of the enormous surplus of £857,200 now in hand, and which has been taken from inventors, the very class for whose use this library is expressly intended. As to the accuracy in every particular of my statements regarding the present condition of the place, I court the fullest inquiry, and, I may add, that a memorial on the subject, signed by a number of readers, was sent in to the proper authorities some time back, but has had no effect whatever in abating the evils complained of, nor has even the slightest notice been taken of it.—I am, &c.,

W. Lloyd Wise.

Chandos-chambers, Adelphi, W.C., 1st Feb., 1872.

PROCEEDINGS OF INSTITUTIONS.

East Lancashire Union of Institutions.—The following is a summary, for the year 1871, of the work of this union, which comprises 20 institutions and evening schools, containing in the aggregate about 3,000 evening scholars:—During the first half of the year, the organising master was engaged one evening weekly at Burnley Mechanics' Institution, Burnley Church Literary Institution, Bacup Mechanics' Institution, Haslingden Institution, and Padiham Church Evening School. At the present time the work of the organising master in Burnley in regard to the organisation and superintendence of classes for elementary instruction, is confined to the evening schools in association with the Church of England Literary Institution. Three evening schools and one institution have connected themselves with the union during the past year. The spring examination for scholars of evening schools, which are closed after the winter months, was held on Saturday, April 1st, and was attended by 105 candidates, 76 males, and 29 females, of whom 52 males and 15 females were successful in obtaining either a book prize or a certificate of merit or of competency. This examination was held simultaneously at St. Peter's School, Burnley, for the Burnley district, and at St. James's School, Waterfoot, for the Rosendale district. The prizes and certificates were awarded as follows:—Worsthorne evening school, 8 book prizes and 10 certificates; Great Marsden, 11 book prizes and 6 certificates; Padiham national, 4 book prizes and 4 certificates; Habergam, 11 book prizes and 3 certificates; Waterfoot, 2 book prizes and 6 certificates; St. Peter's, Burnley, 4 certificates; and Irwell British, 2 book prizes and 3 certificates. The summer examination was held collectively at Burnley on Saturday, June 17th, and was attended by 133 candidates, 95 males and 38 females, of whom 69 males and 36 females were successful in obtaining either a book prize or a certificate of merit or of competency, the prizes and certificates being awarded as follows:—Bacup Mechanics' Institution, 12 book prizes and 22 certificates; Burnley Mechanics' Institution, 11 book prizes and 5 certificates; Nelson, Lomeshaye, school, 15 book prizes and 10 certificates; Haslingden Institution, 3 book prizes and 8 certificates; Crawshawbooth Mechanics' Institution, 3 book prizes and 3 certificates; Accrington Co-operative Institution, 4 book prizes and 3 certificates; Rawtenstall, 1 book prize and 2 certificates; Newchurch, 2 book prizes and 1 certificate. Of the classes in which the candidates entered for the examination, one was successful in the first class, 5 in the second class, 25 in the third class, first section, and 74 in the third class, second section. The following statement shows the number of candidates annually examined since the first examination of the union in 1857:—20 in 1857, 95 in 1858, 168 in 1859, 167 in 1860, 175 in 1861, 170 in 1862, 141 in 1863, 138 in 1864, 85 in 1865, 123 in 1866, 231 in 1867, 216 in 1868, 226 in 1869, 262 in 1870, aud 237 in 1871. Thus, in the aggregate, about 2,500 candidates have been examined by the union, and nearly 2,000 book prizes and certificates of merit or of competency have been awarded. The annual distribution of prizes and certificates was held on October 21st, 1871, and the meeting was attended by Sir James Kay-Shuttleworth, Bart., president of the union, J. Greenwood, Esq., principal of Owen's College, Manchester, U. J. Kay-Shuttleworth, Esq., M.P., and the Rev. W. J. Kennedy, H.M. Inspector of Schools. Science and art classes are now open in all the principal institutions and evening schools, the subjects taught being inorganic chemistry, animal physiology, applied mechanics, physical geography, geology, mechanical drawing, plane and solid geometry, freehand and model drawing, &c. The special science classes for schoolmasters, taught by Mr. Shore, organising master, are held weekly at Burnley and Bacup, and are attended by 22 certificated teachers.

OBITUARY.

Canon Moseley.—The Rev. Henry Moseley, Canon of Bristol Cathedral, and vicar of Olverston, Gloucestershire, died on Saturday, 26th instant. He was born about the year 1802, and was educated at St. John's College, Cambridge, where he took his bachelor's degree in 1826, coming out a high wrangler. He was ordained in due course, and for some years held the Professorship of Natural Philosophy and Astronomy in King's College, London; and he was one of the first clergymen who were appointed her Majesty's inspectors of schools. In 1853, under Lord Aberdeen's administration, he was nominated, in reward of his services in the cause of national education, to the canonry now vacant by his decease, and a year or two latter was preferred by the Dean and Chapter of Bristol to the living of Olverston. In 1855, he was appointed one of the chaplains to the Queen. The late canon, according to *Crockford's Clerical Directory* was the author of many important works, including a *Treatise on the Mechanical Principles of Engineering and Architecture*, which he published shortly after obtaining the "learned leisure" of his canonry, and which has since been reprinted in Germany and in the United States. He also wrote a *Treatise on Hydrostatics*, &c., and contributed more than one article on "Applied Mathematics" to the *Encyclopœdia Metropolitana*. Besides these larger and more important works, his active pen found opportunities for contributing a variety of scientific papers to the "Transactions" of the Royal Society, of the Cambridge Philosophical Society, &c., and also several reports on various subjects connected with education, which are published in the Minutes of the Committee of the Privy Council on Education. Canon Moseley's name, we may add, was well known in learned circles abroad as well as at home; he was for many years one of the corresponding members of the Institute of France. He was a member of the Society of Arts, having been elected in 1853, and was for some time one of the Society's examiners. He was also a Fellow of the Royal Society, an honorary member of the Literary and Philosophical Society of Manchester, and of the Philosophical Institute of Cornwall, an honorary Fellow of King's College, London, a vice-president of the Society of Naval Architects, a member of the Natural History Society of Brisbane, and formerly of the Council of Military Education.

Arles Dufour.—An obituary notice is in type, and will appear in a future *Journal*.

NOTES ON COMMERCE AND TRADE.

Commercial legislation in France is a present question of considerable importance, and the discussions which are now proceeding at Versailles cannot be regarded by the commercial world of Great Britain, or indeed of Europe, without deep interest, not to say anxiety. The old policy of protection seems to threaten to reassume its mischievous sway over the trade of France and its commerce with the rest of the world. The fact that a special commission of the Assembly has, by a majority of nine of its members out of fifteen, recommended the denunciation of the treaty with England, is sufficiently significant; for although the majority declares that it does not require the re-establishment of the *régime* of protection, but only certain ameliorations, the commercial world knows how narrow are the margins of the tariff of 1866, and how little paring they will bear, and also that, whatever may be the ultimate result, the relations of the two countries will, by the mere fact of the notice of suspension of the treaty, remain for an uncertain time in a dislocated and unsatisfactory condition. Under these circumstances, it is important to regard the state of public opinion in France as coolly as possible. In the first place, we have the assertion of the commission already referred to, that it does not advocate a return to the old protective system; secondly, we have the practical fact before us that, in spite of the *prestige* of M. Thiers, and of all the efforts the Minister of Finance and the other protectionists in the Assembly, the proposal to impose duties on the raw materials of manufacture has been completely defeated, Lyons and five other great manufacturing towns having declared that such duties would be ruinous to trade, and that they would take upon their own shoulders the deficit, between six and seven millions sterling, which the government declared would be the result of the refusal to vote the duties referred to. In addition to the above, it should be known that many of the two thousand leading manufacturers who, in 1866, subscribed for a silver statue of "Industry," to be presented to M. Pouyer-Quertier, the present Minister of Finance, for his exertions in opposing the Liberal commercial views of the then government, are now in opposition to that gentleman; and further, that M. Brame, his most ardent supporter at the period mentioned, declared the other day, in his place in the Assembly, that instead of certain manufacturing towns having been ruined by the commercial treaties in question, they never before were in such a state of prosperity as they are at present. There is no doubt still in France a very strong Protectionist party, but it must be evident to all that, considering the facts detailed above, and the very difficult position of the government and the Assembly at the present moment, the principles of free-trade have not lost supporters in France, but have, on the contrary, after five or six years' experience of modified import duties, won over many of the former supporters of Protection, and some of the prominent leaders of that party. It may, therefore, be inferred that if the present difficulties of France induce the government, wisely or not, to try and obtain increased income by Protectionist means, the best-informed portion of the commercial world are gradually but surely becoming converts to freedom of commerce. It is to be lamented that in another direction the symptoms are not so satisfactory. The government, supported, nay urged, by the shipbuilders and shipowners of Marseilles, Bordeaux, Havre, and other seaports, have been enabled to carry through the Assembly, and that with a very large majority, a Bill for the imposition of surcharges on all foreign flags, or, in other words, the re-enactment of the old navigation laws. Thus, every article arriving in a British or other bottom in a French port will have to bear its part in the surcharges of that port and tonnage dues; even cereals are not exempted; and ships and marine engines imported into France are to pay duties varying from forty to sixty francs per ton. Present circumstances may seem to warrant such enactments, but it is difficult to believe that they will increase the revenue of France, while the new duties cannot be other than obstacles in the way of the commercial progress which, during the last few years, has done so much to increase the friendly intercourse between our neighbours and ourselves.

The advantages of free trade to France are shown by some statistics published in the *Times* respecting her commerce. A comparison is drawn between 1859, the year before the treaty with England, and 1868, the year but one before the war. In the latter, the imports and exports amounted to £324,563,000, an increase of £108,000,000 in nine years; imports being £132,160,000, £66,520,000 more than in 1859; exports £117,000,000, being an increase of £26,360,000. Europe took £30,320,000 more of French produce than in 1859, Africa nearly a million more, Asia and the Pacific half a million more; the French colonies, including Algeria, about a million and a half, and America four millions less. It was only in 1866 that France gave up her Navigation Laws, with the exception of those protecting her coasting trade. Putting fisheries out of the question, it appears that she had half a million more tons of shipping in 1868 than in 1858, and that the total increase would have been much greater but for the decrease of a quarter of a million in the only part of her trade reserved to her own people. Of course, if the shipping of all nations employed in the French foreign and colonial trade be included, the difference in favour of the year 1868 is still more remarkable, for France has now invited her neighbours to share in these portions of her trade, and they have come. Like ourselves, she has been lately substituting steam for sail, and of steam tonnage she possessed, in 1868, 135,259 tons, against 66,587 tons in 1858. If production is to be the test of prosperity, France produced not far from twice as much wine in the six years after 1860 as in the six years before. French imports to the United Kingdom were—of silk manufactures, in 1859, £1,732,928, in 1869, £9,004,291; of lace, £179,374, against £22,364; of leather gloves, £487,775, against £1,202,766; of oil-seed cake, £92,233, against £416,955; and woollen manufactures, £607,609, against £1,586,691. In addition to the above statistics, an important article on "The Commercial Treaty and English Statistics," by M. Theophile Pergeline, has been published in *La Houille*, the organ of the metallurgical interests in France. M. Pergeline shows that whilst in 1856, under the protectionist system, France exported to England 259,000,000 francs worth of merchandise, England sent to France no less than 261,000,000 francs worth, being a difference of 2,000,000 francs against France; whilst under the system of free trade, which Napoleon III. inaugurated, the transactions have always been in favour of France, although, from the vastly-increased trade both ways, England has little to complain of. In 1867, England bought 843,000,000 francs worth of French goods, and sold to France 575,000,000 francs worth, the advantage to France being 268,000,000 francs. In 1868, England bought 847,000,000 francs worth, and sold 588,000,000 francs worth, the advantage to France being 259,000,000 francs; and in 1869, England bought 838,000,000 francs worth, and sold 582,000,000 francs, the advantage in favour of France being 256,000,000 francs.

The acclimatisation of esparto in France is a matter receiving attention. The administration charged with the care of the forests, rivers, &c., have under consideration a plan for the acclimatisation of it in public lands in the south of France. Its cultivation has already been tried in several communes, on ground belonging to the municipal authorities, which had hitherto remained unemployed, and with fair promise of success. The cultivation of the plant is found to cost but little, and great results are expected from the proposed scheme. The importance of this rush to our paper-makers, and its comparative scarcity and cost, were recently laid very clearly before the Society, and the results of the plan for producing it on the waste lands in the south of France will doubtless be looked for with much interest. It is added that the reports of esparto from Algeria represent several millions of francs per annum, and one naturally asks why its development in that colony does not receive more attention. It is not easy to imagine the market overstocked.

At a recent meeting, held at Cannon-street Hotel, London, to discuss the question of our reserve food supplies in the colonies, and to promote the popularisation of tinned Australian meats, it was mentioned by Mr. E. Wilson that, in the Australian and New Zealand colonies there are, at the present time, about 60,000,000 sheep and 5,300,000 cattle. It is calculated that one-fourth of this enormous aggregate should be available annually as surplus stock, to be slain for food. This, at 50 lbs. weight per sheep and 700 lbs. per bullock, would give about 750,000 tons weight of animal food. If this were disposed of in England at 6d. per lb., it would represent a trade of nearly £42,000,000 sterling. Yet, fabulous as these figures may seem, this vast supply would only represent about 1 lb. of meat per head per week of the population of the United Kingdom.

A very important matter to the commercial world is a uniform rate of postage. The *Homeward Mail* asks, "Can any one explain why we should not have a penny overland letter and newspaper post between India and England?" The Post-office makes no general rule that the cost of each letter bag should be paid by the letters contained in it. There is no heavier charge on a letter posted in some northern islet, and destined for an out-of-the-way country village, to which it has first to pass through the London sorting-office, than there is for a letter posted at St. Martin's-le-Grand for delivery in Fleet-street. On the same principle, so long as the entire expenses of the Post-office are paid, there should be a uniform charge. The exceptional rate by the shortest route to India of 1s. for a letter and 4d. for a newspaper, is an injustice. Who connected with India talks of "these days of cheap postage?" And now it is announced that another penny is to be added, because the particular mail service fixed by contract for the next ten years, without regard to changes which have already shown "holes in the work," does not exactly pay. Does the penny newspaper rate to Australia pay? Do half the outlying home postal districts pay? Surely, if the entire Post-office Department is carried on without loss, that is all the country desires, and the margin of profit that is made annually might be distributed in equalising rates. We cannot understand why any one class of her Majesty's subjects should be exposed to ruinous inconvenience by postal rates.

The following statistics of the island of Crete show the exportation from the principal ports last year:—

Olive Oil.

	Tuns.		Value. £
Canea	788	....	35,465
Candia	1,212	....	44,849
Rethysno	250	....	11,200
Total	2,250	....	91,514

Soap.

	Cwts.		Value. £
Canea	43,026	....	50,618
Candia	29,184	....	43,778
Rethysno	4,800	....	6,000
Total	77,010	....	100,396

All the oil from Canea was shipped to England in English and Dutch vessels, and that from Candia was shipped to different ports in Turkey; from Rethysno, 80 tuns were shipped to England, and the rest to Turkey. The whole of the soap, excepting 4,000 cwt. for Austria and Greece, was for the Turkish market. The other articles of export consist of carobs (locust beans), Valemia silk, cotton, cheese, lamb skins, oranges and lemons, wine, honey, and beeswax. None of these articles are exported in large quantities. Their total value scarcely amounted to £100,000. The total exports in 1870 were—From Canea, £124,083; Candia, £136,627; Rethysno, £39,200. This result shows a falling off of about £80,000 in the value of the exports, as compared with 1869. The most striking fact is the large amount of grain and flour imported, value £100,000. This is owing to the late insurrection having stopped agricultural progress. The live stock has to be supplemented by importation; about 1,500 oxen, valued at £9,000, and 6,000 sheep and goats having been imported during the year. The value of the cotton manufactures imported amounted to £170,000, all obtained through houses in Constantinople, Smyrna, and Syria. The value of sugar, coffee, and rice imported was £33,000. The other articles imported consist of tobacco, hides, timber, spirits, petroleum, iron, coal, stock fish, and herrings, and all these articles are valued at £250,000 for the year.

The following report of an American case regarding international trade-marks has been sent by Messrs. Haseltine and Co., patent solicitors:—"An equity suit respecting trade-marks, of international interest, was recently decided in the United States Court for the Washington district. The suit was instituted by David A. Burr, Esq., counsel for Rogers and Sons, the celebrated cutlers of Sheffield, against Philip and Solomons, contractors to the Treasury Department for the supply of Rogers and Sons' cutlery. The plaintiffs alleged that the defendants had supplied counterfeit articles with their trade-mark, and they asked the court to grant an injunction, and claimed heavy damages. The defendants did not deny the sale of imitation articles, or the use of the trade-mark in question, but proved that these articles were manufactured in Prussia by a firm known as Rogers and Sons, who use the trade-mark under a royal license, and that Prussian cutlery bearing this trade-mark, had been extensively imported and sold in the United States for many years, and also that the plaintiffs had not registered the trade-mark as provided by the recent Patent Act. The defendants contended that the suit could not be maintained in view of the above facts. Wylie, J., refused the injunction chiefly on the ground that the plaintiffs had, by their acquiescence in the infringement, waived their right to assistance from the court, and he also stated that the Prussian firm was entitled to the use of the trade-mark where the cutlery was manufactured. The acquiescence of the plaintiffs was presumed, no evidence being offered to show that the trade-mark had been used with the consent or knowledge of the Sheffield firm. The judge did not comment upon the fact that the plaintiffs had not registered their trade-mark, but the registration of trade-marks in the United States is now a matter of the first importance to English manufacturers and merchants, for which provision was made in the Act of last year."

GENERAL NOTES.

Institution of Naval Architects.—The thirteenth annual general meeting of the Institution of Naval Architects will take place on Thursday, Friday, and Saturday, the 21st, 22nd, and 23rd of March next. By permission of the Council of the Society of Arts, the meetings will be held at the House of the Society, John-street, Adelphi, London; morning meetings at 12, and evening meetings on Thursday and Friday at seven. Papers on the principles of naval construction, on practical ship-building, on steam navigation, on the equipment and management of ships for merchandise and for war, will be read at these meetings. Naval architects, ship-builders, naval officers of the Royal and Merchant services, and engineers, who propose to read papers before the institution, are requested to send immediate notice of the subject and title of the paper to the secretary; and it is requested that the paper itself, with illustrative drawings, may be deposited at the offices of the Institution on or before the 20th of February next. Candidates for admission as members or as associates should send in their applications by the same date. The annual subscription of £2 2s. is payable on admission, and becomes due at the commencement of each year. —C. W. Merrifield, hon. secretary, 9, Adelphi-terrace, London, W.C., January 25th, 1872.

Ultramarine.—The ultramarine manufacture, up to the present time, has laboured under two difficulties, first, the uncertainty of producing particular kinds, and second, the quantity of inferior material which is produced, owing to the slightest negligence of the workmen, particularly in the heating. Carl Fürstenau states that he has got rid of both these drawbacks, by fixing the chemical compounds of the two known sorts of ultramarine, the so-called Nuremberg, that, is clear blue, and the alum-holding sort. He then states that, by discovering the right silicates which both contain, and also the limit to which reducing material can be used, he has not only so far increased the variation in temperature in heating that it can easily be held in check by an ordinary workman, but also entirely prevented the formation of other than blue compounds. He has also obtained an increase of twenty seven per cent. in the produce by employing the right proportion and kind of sulphide of soda in the manufacture of the different kinds. Finally he has obtained by this means all dark, clear, strong-coloured, and alum-holding sorts that have come under his notice. The ultramarine is placed in ovens, which contain about 600 pots, or about 28 cwt. of mixture; these are finished in 12 hours. The duration of the manufacture, from the first grinding of the raw material until the packing of the finished ware, is 21 days.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

February 7th.—"On the Forests of England, their Restoration, and Scientific Management." By Thomas Wingfield Webber, Esq., Officiating Deputy Conservator of Forests, Central Province of India.

February 14th.—"On the Study of Economic Botany, and its Claims Educationally and Commercially Considered." By James Collins, Esq., F.B.S. Edin., Curator of the Museum of the Pharmaceutical Society of Great Britain.

February 21st.—

February 28th.—"On Prison Labour, as an Instrument of Punishment, Profit, and Reformation." By F. J. Mouatt, Esq., M.D., late Inspector-General of Prisons in Bengal.

March 6th.—"On the *Goliath* Training Ship." By Capt. Bourchier, R.N.

INDIA CONFERENCES.

February 23rd.—"On India as a Field for Private Enterprise." The Conference will be opened by Frederick Campbell, Esq., of Assam.

CANTOR LECTURES.

The Second Course of Cantor Lectures for the Session will be delivered by the Rev. Arthur Rigg, M.A., on "Mechanism." The first lecture will be given on Monday evening, February 5th, at Eight o'clock.

SYLLABUS.

Lecture I.—Monday, 5th February, 1872.

Structures, Machines, and Mechanism—Equilibrium and Motion—Force and Motion—Kinetics and Kinematics—Various motions required—Classification of Mechanism—Early contrivances.

Lecture II.—Monday, 12th February, 1872.

Motions produced by Rolling—Forms of Wheels—Circular, Elliptic, Logarithmic, and Lobe Wheels—Mangle Wheels—Star Wheels—Examples.

Lecture III.—Monday, 19th February, 1872.

Motions produced by Sliding—Forms of Teeth on Wheels—Teeth for Velocity—Teeth for Power—Cams—Screws—Worm Wheels—Examples.

Lecture IV.—Monday, 26th February, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies — Cam Pullies — Shafts not parallel — High Velocity Cords—Fusees—Illustrations.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links — Cranks — Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lectures. Rev. Arthur Rigg, "On Mechanism."
Social Science Association, 8. Mr. Arthur Arnold, "The Political Enfranchisement of Women."
Royal Institution, 2. General Monthly Meeting.
London Institution, 4. Professor Odling, "Elementary Chemistry."
Royal United Service Institution, 8½. Mr. E. B. de Fonblanque, "The Control Service; with Practical Suggestions for its Improvement, to meet those defects which two years' experience of its working have exhibited."
Victoria Institute, 8. Rev. G. Henslow, "Natural Theology, considered with respect to Modern Philosophy."
Entomological, 7.
British Architects, 8.
Asiatic, 3.
Anthropological, 8. Annual Meeting.

Tues.....Civil Engineers, 8. Discussion "On the Value of Water in India."
Pathological, 8.
Biblical Archæology, 8½. M. Ch. Clermont Ganneau, "On an Inscription in Hebrew or Ancient Phœnician Characters, discovered at Siloam, of the Age of the Kings of Juda."
Zoological, 9.
Royal Institution, 3. Dr. Rutherford, "On the Circulatory and Nervous Systems."

Wed.....**SOCIETY OF ARTS, 8.** Mr. Thomas Wingfield Webber, "On the Forests of England, their Restoration, and Scientific Management."
Geological, 8. 1. M. D. M. d'Orueta, "Further Notes on the Geology of the Neighbourhood of Malaga." Communicated by the President. 2. Prof. A. C. Ramsay, "On the River-courses of England and Wales." 3. Mr. H. Alleyne Nicholson, "Migrations of the Graptolites."
Microscopical, 8. Annual Meeting.
Pharmaceutical, 8.
Royal Society of Literature, 4½.
Obstetrical, 8.
Science and Art Department (South Kensington Museum), 2½. Professor Guthrie, "Elementary Physics and Chemistry."

Thurs...London Institution, 7½.
Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."

Fri.......Astronomical, 3. Annual Meeting.
Royal Institution, 9. Prof. Humphry, "On Sleep."
Quekett Club, 8.

Sat.......Royal Institution, 3. Mr. Donne, "On the Theatre in Shakespeare's Time."
Royal Botanic, 3¾.
Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."

Journal of the Society of Arts.

No. 1,003. Vol. XX.

FRIDAY, FEBRUARY 9, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

H.R.H. THE PRESIDENT.

The following reply has been received from the Home Secretary :—

Whitehall, 2nd February, 1872.

Sir,—I have had the honor to lay before the Queen the loyal and dutiful address of the Society for the Encouragement of Arts, Manufactures, and Commerce, on the occasion of the illness of His Royal Highness the Prince of Wales.

I have to inform you that her Majesty was pleased to receive the address very graciously.

I am, Sir,
Your obedient servant,
H. A. Bruce.

P. Le Neve Foster, Esq., Secretary to the
Society for the Encouragement of Arts, &c.,
John-street, Adelphi, W.C.

FOOD COMMITTEE.

The Committee have had before them some further specimens of Bancroft's desiccated meats, from Queensland. It consists of meat deprived of a certain amount of water, by five pounds of fresh meat being reduced, by a simple drying process, to one pound. It is ground to a powder, and, with no mixture of any other ingredient, is put into tins, not air-tight, but simply covered with an ordinary lid. The Committee can speak confidently of its keeping qualities, the specimens which they have had before them being part of the original consignment sent to this country in 1867. It is in excellent condition, just as good as when originally sent over. It contains all the constituents of the meat, and is well adapted for the making of soups, beef-tea, potted meats, hashes, curries, &c., &c. In flavour it is agreeable, and its nutritious qualities have been favourably certified to the Committee by Dr. A. S. Taylor, to whom it was sent for examination. The Committee would gladly see it introduced into the trade as a general article of food, believing it a valuable addition to the food resources of the kingdom.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

NINTH ORDINARY MEETING.

Wednesday, February 7, 1872; Sir Antonio Brady in the chair.

The following candidates were proposed for election as members of the Society :—

Connolly, George, 69, Cornhill, E.C.
Crowe, W. Leedham, 24, Cornwall-road, Westbourne-park, W.
Cutler, Samuel, Providence Iron Works, Millwall, E.
Dickinson, Arthur John, Tar and Chemical Works, Trundley-lane, Deptford, E.
Fair, John, Argentine Consulate, 6, Great Winchester-buildings, E.C.
Field, Lieut.-Col. George Thomas, R.A., Royal Arsenal, Woolwich, S.E.
Gilbert, Sir John, Vanbrugh-park, Blackheath, S.E.
Green, Frederick, 19, Onslow-gardens, S.W.
Holland, Samuel, M.P., Glanwilliam, Merionethshire.
Hudson, Hubert E., Battle, Sussex.
Ord, George Rice, Streatham Hill, S.W.
Pearson, John, Mayor of Liverpool.
Walton, Charles, Manor-house, East Acton, W.

AND AS HONORARY CORRESPONDING MEMBER.

Wiszniewski, Prince Adam, 12, Rue de Beaune, Paris.

The following candidates were balloted for and duly elected members of the Society :—

His Royal Highness the Duke of Edinburgh, K.G., Clarence-house, St. James's, S.W.
Cowper, Charles, 3, Westminster-chambers, Victoria-street, S.W.
Dicksee, Rev. Samuel J. C., D.D., Malden-college, New Malden, Surrey.
Fennessy, Rodney J., 39, Old Broad-street, E.C.
Ginner, Samuel G., M.D., 166, Lambeth-walk, S.E.
Griffiths, John George, 119, King Henry's-road, N.W.
Kennedy, Thomas P., 62, Milton-road, Stoke Newington, N.
Nelson, E. M., 43, Little Britain, E.C.
Rothschild, Baroness Meyer de, 107, Piccadilly, W., and Mentmore, Leighton Buzzard.
Samuelson, Henry B., M.P., 69, Prince's-gate, W.
Sanderson, George, 75, Sloane-street, S.W.
Saw, Samuel, Upper Park-street, Greenwich.

The paper read was :—

THE FORESTS OF ENGLAND: THEIR RESTORATION AND SCIENTIFIC MANAGEMENT.

By Thomas Wingfield Webber, Esq.

(Officiating Deputy-Conservator of Forests, Central Provinces of India).

About 200 years ago, it may be remembered that England awoke to the fact, from the pressure of circumstances, that her oak forests were nearly exhausted. Evelyn, the then champion of forestry, spent his life to restore the provision for wooden walls, which has resulted in the almost forest-clad appearance of English country scenery at the present day. The country has now been moved to the perception, not that wood is exhausted, but that the time-honoured forests of England, names connected with the origin of her greatness, have become almost lost to the country, absorbed into private property, or destroyed. Epping, Sherwood, Hainhault, and other ancient woodlands exist but in name only, and the characteristic haunts of the once almost sylvan, and still chase-loving, people of England are not to be found. The craving for happy hunting-grounds, doubtless coeval with the age when men lived by the chase of animals, is an early instinct of the human race, as the catching of mice is of the cat, and hunting of the hound. This instinct still breaks out in various forms. The rich can indulge their appetite, by preserving game, and travelling. In the hard-wrought brain of the working race which has built up English capital, there still exists the long-suppressed instinct. In it are visions of happiness, of wandering free in the primeval forest, away from the haunts of men, where nature reigns supreme, and nothing meets the eye, long dimmed by smoke and brick walls, but the trees, and the green grass, and the blue sky; and no sound falls on the ear, dulled by the eternal whirr of wheels, but the note of the wild bird and animal, and the murmur of the running stream, and rustle of leaves. The sentiments inspired, like the Divine institution of the Sabbath, are ennobling, and preventative of lower influences to which the poor are subject. The working man may dream, indeed, of the forests of old England, but he will not find them —this, at least, is the public impression—and, were he to search for them, the warning shout of the keeper might chance to be an unpleasant awakener, and not conducive to his gaining the benefit expected from his country recreation. The last and most beautiful, the really wild New Forest, was about being disafforested at the beginning of the last session, and a Bill is probably now preparing on the subject. Whether the impression is correct that the forests do not exist remains to be seen. This has caused the forest question to be raised. It is one which concerns, not the working-man only, but all the people of England, and it deserves to be considered in a broad light. It is connected with another question, the production of timber, and is, perhaps, capable of a collective and coeval solution. Both questions have arisen in other countries, and it is well to see how they are settled. The latter question appears at first view not so pressing, but is, perhaps, more so. We no longer fear want of timber, for we now rely on iron walls, and on coals for fuel; so we forget that timber, like coal, is not inexhaustible. To those who have watched the timber question there are, as about coal, ominous clouds in the horizon. Most people are not aware, and why should they be, seeing timber plentiful, and many excellent sorts pouring into the English market, that during the last thirty years clearing of forests has progressed to an enormous extent on the American continent, whence our principal supply comes. There the finest timber trees are looked on as encumbrance to the soil; and tracts of forest are taken up to be cleared and burnt away. The enormous trees of untold centuries' growth are felled, never perhaps in the world's history to be replaced.

Complaints are even now coming that fire-wood is getting scarce in Canada, and that California, the very beehive of industry in the timber trade, is no longer productive. All the sea-board and river-side forests are felled, and the saw-mills are standing still, as the transport of logs from inland forests would cost more than bringing them from England by sea. The great hardwood forests of the Guianas are in a similar plight, and yet no thought of forest conservation has entered the head of Transatlantic governments.

In India, it is notorious that the magnificent teak and sal forests have become exhausted in this very generation, and most of the members of the Indian Board remember the clearing effected by annual contracts given by government.

The lamentable effect of timber having once been allowed to become scarce, in a country dependent on wood for firing, has been observed by those acquainted with the western States of Central India, which has resulted in a total change of climate, whereby the once forest-clad and populous scenes of the Ramayana, famous in Indian writings, have become the most arid wastes, with scarce a particle of vegetation.

It is only within a few years that the Indian Forest Department was set on foot by the same government, and systematic forest restoration begun—even planting resorted to; but this was not brought about till timber had to be imported from Norway for Indian railway purposes. When trees are standing plentifully on the ground, they are thought of little value, and where cutting goes on, the demand (which should keep pace with the rate of growth, not with the rate of felling) is soon out-stripped, the market gets over-stocked, and timber a drug, a drug, moreover, which deteriorates more rapidly when felled than it improves when kept standing. Thus it is that so many irreparable mistakes have been made as to the value of trees in the forest, which people are apt to put down at what they will fetch when felled. A just estimate only can be formed by taking into consideration first, what the trees would be worth when all the other trees, the felling of which gluts the market, are gone; secondly, what they will grow to in a given number of years. A striking instance of over-estimating, as well as under-estimating, is familiar to foresters in this country from the same cause. The most extensive larch forest of Blair Athol was planted by the then Duke of Athol on an estimate made from the price of larch timber, about the beginning of this century. According to it, in 70 years the profit to be made amounted to something fabulous. The result was that, in course of time, cutting commenced, and the large quantity of larch thrown into the market, brought its price down to a mere trifle. Then came a most reckless cutting and selling off of the worthless commodity, which, had it been held judiciously, might, when a few years later the railroad came through the Highlands, have all realised its normal value.

It is only 22 years since the oak plantations, made at great expense of national energy, in 1810 to 1830, in Dean, New Forest, and other royal forests, were mostly condemned by an economical Parliament to be cleared. A committee of practical forest valuators, however, reported that the nine forests in question would be worth, to stand, £10,109,183 sterling, if left till mature, or till a hundred years old, whereas the value of the timber to sell was then only £1,859,864 at the then price, not reckoning how much the price might go down when the market was full. The actual outlay for roads, clearing and fencing the land prior, to letting it for farms, with buildings, about 44,400 acres in all, at £13 per acre, would be about £580,000, and then it would not let for more than an average of 11s. per acre. It was thus made plain that clearing would have been a mistake. These valuable plantations were not cut down.*

The lovers of forest economy will turn with pleasure from such pictures to the country which, from its most ancient experience in the use of forests, and its proper estimate of their worth, is now the practical school of systematic forestry, Germany. The historical Hyrcanian Forest, which once covered half the Continent, appeared once as inexhaustible, and was as impenetrable as the Canadian back-woods. Centuries of experience have, however, taught the Germans the necessity of the strictest conservation, and a regular and beautiful rotation exists for all kinds of trees, whereby a certain portion is annually cut down and renewed. The supply is thus always equal to the demand, and the quality and means of transport are under command. An enormous quantity is constantly produced of useful timber, which, in the form of articles of commerce, finds its way to every part of the world. The demand for fire-wood is supplied, and a reserve, 100 times greater than the yearly production, is kept on the ground. What private planting has done in England, government supervision has more efficiently performed in Germany, and the once nearly exhausted forests are now in a position to supply much more than the country itself at a fair profit.

It has been found necessary to place even the private and corporate forests, and common lands entirely under

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Appendix to 26th Report of Commons, Woods, and Forests, 1249, Page 78.

government forest supervisors. Experience has shown the ultimate advantage derived both by those and by the State. The system works with great success, and the utmost harmony prevails. The people are not liable to be deprived of the advantages of having a forest near them, by the caprice of some private owner clearing off or enclosing, and the State has the advantage of securing a regular supply of timber for all future, besides the utmost economy being exercised in providing for the wants of the people. Visitors to the State forests in Germany are struck by the enormous and uniform crops on the land, and the extraordinary straightness of the timber, and freedom from knots, so that the white deal, which in other countries is scarcely valued, is here capable of being split with a knife into the finest slices, and is utilised in a hundred ways. There are in some places two crops on the same land, as the oak and the beech; the former is nursed up tall and straight, for planking purposes, and the latter is used for firewood, and its close foliage is found to protect the oak, and its leaves to fertilise the soil for the oak. All this is done on the most far-seeing, well-proved, principles, and its continued success must answer for the correctness of the system. Many large cities and villages, in many parts, have their own forests attached, where every man, no matter how poor, has a right to go and enjoy his portion of fresh air and innocent recreation on feast-days and Sundays, and the beauties of the forest scene. He is not permitted, however, to damage the timber, and is willingly amenable to the regulations he knows are for his good. A visitor to the city of Hanover can get an insight into how this is done, by a walk of half-an-hour from the most crowded part of the town, into the corporate Forest of Eilen Ried. He will find himself in the solitude of dense and seemingly endless woodlands, with the most magnificent timber and young trees everywhere and of every age. There is no sign of the neighbourhood of a large city; the ground is not bare and scald, as near our large towns, and the underwood is not damaged and rendered hideous by being broken. He can enjoy himself thoroughly. Yet, out of this wood, quantities of fine timber are annually cut, of length and regularity like what we have to bring from Vancouver's Island at enormous expense. To detail the excellencies of State forest management in Germany would be instructive, but the results of such details would show what has been tried there has not been found wanting, and is quite applicable to the State forests of England.

Now that some change is contemplated in the latter, it might be wise to take example by the success of Germany.[*] Warnings of coal running short have been sounded, and there are signs of scarcity of timber. In this go-a-head age we are working into the bowels of the earth for stones of fossil timber, which other influences have accumulated in countless ages gone by; but there is a difference between growing grain and working into other people's granaries. When those stores are exhausted, it may prove most calamitous to England at a time not very remote.

It may be well to consider the wisdom of growing timber for the future, even on the little waste land our over-peopled island can boast. It may be well to look round us, and see how many articles of our daily use are made still, not of iron, but of wood, brought many thousand miles, and to calculate what we should do were the supply of it and of coal to diminish even a little. Our ships are said to be made of iron, but there is still no diminution in the importation of timber for planking. It is true there is no demand for compass timber, once required for ribs of ships, from the crooked arms of oaks, but straight logs are in demand, and dark English oak of 400 years' growth is scarcely to be got. These facts would lead to the following conclusions:—

In the coming legislation regarding forests, which every newspaper and every speech, and even the sermons of our bishops, speak of as desirable, the double question should be borne in mind,—to preserve the character of the forests for public recreation, and at the same time to grow timber for the use of the country, as a reserve in case of war, or foreign supply being exhausted, and to study the German system as a well-tried and successful one.

I should go out of my province were I to do more than touch on the difficulties of the question regarding the property of the Crown in the forests. It is certain that property has been administered in a loose way, as much of it has disappeared apparently. Sherwood Forest, and other pieces of Crown forest without number, have been quietly sold to private persons; and if such positive alienation was possible, the property question ought to be easy of solution. The British Parliament, to all intents and purposes, has long since purchased the royal forests, by settling the Civil List on the Crown in lieu of them. It only remains to complete the bargain with the Crown, and purchase them for good. We are blessed with a sovereign whose desire has been ever to promote the well-being of the people, especially the poorer classes. The providential restoration of the next in succession makes it more simple to cut off the entail. The Royal Family has long since relinquished the keeping of game in these forests, and retaining them in name only is no great advantage to the Royal person or her descendants. Windsor would, of course, remain as it is, the most beautiful and best kept people's park in the world.

There is a further point of minor importance to be borne in mind, viz., the separating of the State question of providing recreation forests for the people, and that of providing grass, and firewood, and other pickings for the commoners who live near the forests, and the great landowners, who hitherto have supplemented their parks by common grazing, to the infinite detriment of the forests, and the terrible destruction of the timber. It may be found that the late outcry against disafforesting and enclosing New Forest was raised for the private ends of these persons, not for the public good. It is these people who are damaging the old timber, and cutting off the surface of the soil in the New Forest; and it is to the shiftless practice of turbary, for which in these days of good coal there is no excuse, that the scald and barren appearance of those beautiful woodlands are due. It is they who are burning up the beautiful beech trees, which nature placed with the oak to be its nourisher and congener, at the rate of 380 large trees a-year; and what is more exquisite in the forest than nature's mixing of the sturdy oak and the graceful beech. Its presence is more than ever needed, now that the growth of kneed and crooked oak for ribs of ships is not desirable. The straight-grained and tall planking oak is now what is required, and it is high time to study thoroughly the German system of growing them, mixed with the beech, in the oak soils, larch and the Scotch, Douglas, or other pine being the crop for the light soils. The mixing of hard and soft woods of many kinds, which do not grow naturally together, and usually kill one another, should be avoided, and a result agreeable to the eye and according to nature, as seen in the Hanoverian Eilen Ried, might be arrived at, which would at the same time produce the highest economical results. It has been stated that enclosure for planting in the New Forest means cutting away of all the old and picturesque trees. This is exactly opposed to the German system, which would best apply, called "Group Culture—Horstweiser Betnieb," as practised in wild forests where the old trees are left standing to scatter seed. Reproduction is mostly natural and inexpensive.

I should, in so strongly advocating the German system, ask those interested to peruse for themselves such works as "Stumpff's Hand-book of Forestry,"[*] or other German works, to visit the oak and beech forests of the Spessart and the Deister, and the pine forests of the Hartz and Shwartz wald and Thuringer wald, and converse with the forest officials there, and, above all, to study a rotation scheme, or Forest Stock Book, called a "Forst Wirthshafts Plan." Then a decision would be arrived at as to the merit of the German system. I should, at the same time, having visited some of the royal forests, beg to express my most unqualified admiration of the excellence of the management of the oak plantations, up to the present time, of which there are many thousand acres in New Forest, Dean, and Windsor, and other places. The planting and rearing of this magnificent reserve of thriving oak has been most economical and successful, and its value may prove untold. The age of the trees is now a fitting one to introduce the German system of planting beech as underwood to the oak. By it the desired change of method may be brought about, whereby a tree with straight-grained timber shall be produced with the per-centage of branch wood to stem reduced to a minimum. The modern appliance of timber points to this as the desideratum of the day. The necessity of this alteration in English forest management is not the least important phase of the question just now forcing itself on the public notice.[†]

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[*] No mention is made of the forests of France, which are doubtless not less worthy of imitation, because the German system is perhaps the most comprehensive, and applicable to England from similarity of climate.

The necessities of each country have produced a peculiar excellence in certain kinds of culture. Thus, England has out-paced most countries in scientific agriculture; Germany has, on the other hand, brought the science of forestry to great perfection. When I say the science of forestry, I would speak of a far different thing from the practice of arboriculture and the management of private plantations, which is, doubtless, well understood in England. I would take much higher ground. This is a comprehensive system of cropping the land for the production of sufficient timber to supply continually the demand of an entire nation, the growth of which occupies more than a man's life, and the rotation of which is counted by centuries. I maintain that this is not properly understood in England. Almost the only forest scheme I have met with in English writing was one proposed by Lord Glenbervy, the Royal Commissioner of Woods and Forests, in the report for 1808. His idea was to plant 100,000 acres with oak, at 1,000 acres yearly, and cut an equal quantity, believing 100 years to be the mature age of the oak. The idea was disregarded as too theoretic to be capable of practice. Precisely similar schemes are now in full course of operation in Germany with the greatest success. The rotation period for oak, however, is more like 240 years than 100. The rotation of crops, brought to such a nicety by the agriculturists of England and Scotland, were once thought to be too theoretic for practice likewise. I have also seen a pamphlet, published in 1834, by Mr. Adam, of Blair Adam, in Scotland,[‡] also proposing a scheme of rotation for his plantations; but, it is needless to remark, that a rotation covering the natural lives of two or three generations was not likely to be carried out by private enterprise. It is thus that Germany excels England in forestry. It is the country, not of private enterprise, but of government enterprise; but we may learn a lesson from that highly theoretic and yet practical people. It is well understood in England, as elsewhere, that, to carry on a commercial undertaking, careful accounts and a periodical stock-taking are the ground-work and basis of successful management, or management at all; for without these every move would be hap-hazard. It is, I believe, true that stock-taking in forest culture in this country, as a basis of operations, is ignored or misunderstood. In India, a country whose forests are all-important and of vast area, scientific management is now being introduced, and a system of account is in operation under government; the stock returns, however, are filled up periodically with a detail of the felled timber, while the standing timber, the real stock, is not shown in the accounts at all, nor the annual production, that is, the growth of timber on the trees, called in Germany "zuwachs." The very essence of the science is left out in the accounts, and nothing whatsoever is known of the real state of the crop. The balance-sheet shows only what timber is being felled and what cut down, and is thus no balance-sheet at all in the legitimate forest sense.[*] The greatest mistakes are made in felling what ought to be left to grow, and forest officers, from neglecting the true principles, as Lord Glenbervy did, because they were too theoretic, become destroyers instead of preservers of the forest, and mere lumberers of timber instead of practisers of a beautiful and highly-important science.

It may be mentioned that the far-seeing point of view indicated in the science of forestry is one to which the field of private enterprise is inimical, as individuals have too great an inducement in the matter of temporary gain to cutting down half-grown crops which they could never live to reap at maturity. Therefore forestry must be taken up by government, and every encouragement given by government, if the science is to have fair play. This country labours under a great disadvantage, in the fact that the laws would seem to ignore one of the first principles, that the legitimate yearly production of land under forest is the number of cubic feet of timber laid on the stems of the trees during the season, which in Germany is known to within a few feet per acre. Our government, instead of encouraging, virtually puts an almost prohibitive penalty on the correct practice of forestry, in the shape of a succession duty, not on the production of the land for the season (as in other crops) but on the actual standing timber, which has taken centuries, perhaps, to grow, and has paid the same duty perhaps several times before, though the owner has gained nothing by it. If the inheritors, as frequently happens, succeed one another quickly, the whole value of the centuries' crop may have to be paid to government. This seems an erroneous view for the government to take, even on the ground of increasing the revenue, as, if this penalty did not exist to discourage forest culture by private enterprise, there would be a larger and more regular production of timber in forests, by which the loss would be amply refunded to the revenue when the timber was mature and fit to cut, in the form of income-tax. It may seem not so important to encourage the practice of forestry in England now, but we must remember that it is not so long since, that the greatest want of timber was felt, which will surely (when American forests are cut down) come again. The want is even now felt. How is it that, if timber is required for roofing purposes, long and straight English-grown pine and deals are scarcely to be got; in fact, anything straight and free from knots must be got from Norway or America. The larch and pine from English plantations is all too coarse and sappy for any work but hurdle making, cart making, or rough sleepers.

It is the received opinion that Norway pine is a different kind of timber from the English, and that such will not grow in England. This is a grave error. The soil and climate of England and Scotland are just as suitable for the growth of planking and roofing timber as that of Norway or America, and the *Pinus sylvestris*, or the common Scotch fir, is precisely the same as the famous Memel pine of North Europe, and is just as capable of producing straight, sound, and highly valuable roofing timber, if grown in the proper manner. This anyone may see who visits the Scotch fir forests of Lord Mansfield, near Perth. The difference is, that what comes from abroad is grown in masses, tall and straight, as nature intended, and is one hundred years old or more, whereas what is grown in England is usually reared in a mixed plantation, thinned out over much, and on a wrong principle, till the wind gets in, and kills half the trees. The crop is then cut, when the trees are only forty to fifty years old, only one-third of their full size, and prematurely failing. The timber is so coarse-grained (from too rapid growth) and too knotty (from having too branchy a head) to be of any use except as described before, and the growing of pines and deals, the most useful of all timbers, is pronounced to be a failure. There are thousands of acres of waste land in this country still, which can never grow corn with profit. Now is the time to put in a crop which, when American forests are cleared (perhaps one hundred years hence) will pay cent. per cent. The very clearing of those forests in America, which are generally put under grain, will make it less necessary for England to grow corn, and render timber in England more valuable, as being on the spot. To say that American forests can never become exhausted is a dangerous fallacy. Unless an equal quantity be replanted it must be so, and it is equally certain that replanting is not thought of in America. The time for systematic planting is now, while timber is to be got. When forests are exhausted, it will then be a hundred years too late.

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[*] "Stumpf, Waldbau," published at Aschaffenberg, Bavaria.

[†] The writer has ventured to press it among the other bearings of the subject, in consequence of impressions formed during survey of extensive natural forests in the Himalayas, where the hand of man has never interfered, which has convinced him that the system of natural selection advocated in Germany, or allowing young trees to effect their own thinning to a certain extent, is the correct one to obtain the most vigorous crop on the ground, as well as the greatest amount of close and straight-grained timber.

[‡] "Woods of Succession and Selection," by Mr. Adam, of Blair Adam.

[*] Forest surveyors or valuators of the crop were appointed in the north-west provinces of India, at the suggestion of Dr. Brandis, the able Inspector-General of Forests, but these appointments have since been abolished as not necessary.

Let this, therefore, be an opportunity to remodel the laws bearing, in every point of view, on the royal and other forests.

Before closing, I wish distinctly to assure all those who fear that scientific forestry ignores the picturesque, that this is not the case. Science endeavours to follow nature, and I have seen enough of the principal natural forest of an unenclosed country to be able to state that nothing can be more picturesque. When the seed has fallen we usually find masses of young trees, of equal age, growing up thickly together, protecting one another, and being drawn up straight and tall, to form, when matured, those useful straight stems, free from knots, which make the best timber. Thinning is performed by nature on a system of natural selection, the tallest and most vigorous trees gaining the upper hand, and killing the weaker ones. This is precisely the German system. Again, we find contrasting beautifully with the dense shade of the thicket group the solitary or twin stems of the ancient giants, which have stood for ages in the glade or open wood-land. These are the parent trees of the Germans, in their group culture left to scatter seed on the ground for reproduction. There is every variety of picturesque form and size in a correct and natural forest. The English ideal plantation, consisting of well-branched and thinned-out trees, standing at equal distances, like cabbages in a garden, insufficiently sheltered by one another, is not the correct ideal of a scientific forest, as found in Germany, or ever seen in a natural forest. The system is one of masses and groups, which is most picturesque, and after nature.

Enough has been said to bring about at least some inquiry into the different systems, which may result in a settlement of their merits. It may be concluded that England, which has brought agriculture to such perfection, would do the same for forest culture.

I would further draw the public attention to a misnomer, which has led to some false notions on the question. It is the word "disafforesting." This is an old term, used when portions of the open forests or chases were enclosed for planting, so as to keep out the cattle and deer from the young trees. The enclosed part was said to be "disafforested." Now, this is the very part which, in strict language, is afforested, or thrown out of waste or common land into forest proper. In Germany, a certain portion is usually given over to the commoners, whose rights must be attended to, and they are fenced out from the forest, which is thus preserved from injury for the benefit of the nation and for the growth of timber. It is not the people's enjoyment which is inimical to the improvement of the forest, but the interest of the commoners, who want to have, not their share only, but all the forest, and the general public must be careful to separate their interest from those of the commoners, who are the real damagers and encroachers on the forest. Let the royal forests be afforested and preserved for the use of the people and the scientific production of timber, and the misnomer will cease to exist.

There is one more point which needs a few words—it is the question of enclosures. There is no doubt that the taking up of waste, or common land, for cultivation, which goes on in all countries at a pace proportionate to the increase of population, has reached a very extreme degree in England.

I believe that, two centuries ago, one-third of English soil was common land. Now, the proportion is very small. The public is naturally alarmed lest the enclosure of the royal forests should result in their exclusion from the enjoyment of their rights. They must carefully distinguish, however, between enclosure effected by private parties for private objects, and those effected by the State for public purposes, of which forest conservation is a very important one, and which itself would be a security against private encroachment. Eight out of nine, I believe, of the royal forests have been thus enclosed, and further encroachment effectually stopped. If Epping had been treated in a similar way, it would not now be found to be private instead of public property. New Forest only remains, and it is for the interest of the people that the right of the nation to it should be permanently secured, which a disafforesting, or rather an afforesting, Act would effect. The cry against its enclosure was not got up by the people who frequent it for innocent enjoyment, but by the commoners, who wish not only to come in themselves, but to drive all their cattle in too. Their grazing rights must certainly be regarded, but not at the cost of the public interest and the preservation of the beautiful trees, which the cattle destroy. If the public only understand its own interests, it will see that the royal forests enclosure and management by the State is the safeguard of the people, and it is to the excellent management of her Majesty's woods and forests hitherto that the people are indebted for having eight out of the nine royal forests besides Windsor now reserved and demarcated. There is nothing inconsistent with forest rules in free and perfect liberty being given to every British subject to wander at large and enjoy himself; and, what is more, I believe the royal forests have always been free to the people.

Finally, the opportunity is a fitting one to consider, from every point of view, the most useful reforms which can be made, whereby the forests of Old England may be restored to their pristine glory and beauty, and the people may have the fullest benefit from them. It is hoped that they may be no longer remembered as the scenes of the exclusive enjoyment of the rich, and that they may become the characteristic haunt of the forest-loving people, and at the same time a type no longer of luxury and waste, but of the most useful and economical culture. This may be brought about, and the scheme may be further extended, till every town shall have its forest in the highest stage of development, both for use and enjoyment.

DISCUSSION.

Mr. Botly said he had listened with much pleasure to the paper, with which he cordially agreed in almost every particular. He knew something of the New Forest, and in a paper read before the British Association, alluded to the fact that many of the poorer inhabitants of that district depended almost entirely upon their forestal rights, in the matter of feeding pigs and turning out ponies, for their livelihood. These rights, therefore, required attention, but he believed they would not interfere with the proper management of the forest. With respect to the advisability of planting, he believed nothing paid better in the long run, if judiciously done; and he remembered hearing an old farmer observe that, if the north and north-eastern borders of an exposed district were planted with belts of timber, it would vastly improve the remaining land. Although a landowner himself, he did not agree with the remarks on the succession duty, for he believed the land did not by any means bear an undue share of taxation. Government should, in his opinion, do everything to encourage the growth of timber by private enterprise, rather than undertake it themselves.

Mr. Eyre (one of her Majesty's Commissioners for the New Forest) said the inhabitants of the New Forest were so anxious to preserve the existing timber that strong representations had been made to the Treasury to prevent the cutting of any ornamental trees, and this had had a very good effect. Some 20 years ago, the Queen gave up the right to keep deer in the forest, in consideration of being allowed to enclose 10,000 acres for planting, and he was sorry to say that the planting of this land had seriously diminished the amount now available for the growth of oak timber. The governing body consisted of four verderers, four commissioners appointed by the Crown, of whom he was one, and two of the Commissioners of Woods and Forests, and encroachments for any purpose were steadily opposed. The practice of planting beech was introduced by William of Orange, in 1700, though the oldest trees in the forest were known as King John's oaks. Four hundred years as the age of an oak was not by any means excessive, therefore, and certainly 200 years was much under the mark. Those planted in 1700 were now only fit for thinning purposes, not for the Navy. The surveyor had the power now of selecting what trees he chose, as also of rejecting them afterwards if not sound, which sometimes proved to be the case, so that not unfrequently the forest lost ornamental trees, which the Navy did not gain. The rights of the commoners must be respected, and if the whole of the waste land were planted, they would be in some cases completely ruined. The practice of turbary had been alluded to, but under due restrictions it was not so detrimental to the growth of timber as was supposed, being exercised principally in places not suited to the growth of trees, and the cutter being obliged, under heavy penalties, to leave two turves for each one he took. Still, he believed those rights were at present excessive. He himself held a farm, to which was attached the right of cutting 10,000 turves annually, and when the same thing was claimed by numerous holders throughout the district, it was certainly a serious matter. It was difficult to know how to deal with these rights, which were of the utmost importance to the poor, coal being expensive and difficult of access. It must be borne in mind that the forest rights were strictly limited, the Crown having the right to exclude altogether the commoners' cattle during the winter months. This was not strictly carried out now there were no deer, and it was one of the matters which they were endeavouring to arrange. An association had been formed for the purpose of resisting any encroachments on the forestal rights, and it had already proved of great service. Both the county members, though they differed in politics, agreed in their wish to keep up the forest, and considered its great importance in a national point of view, and also as a place of recreation for the inhabitants of Southampton, who visited it in crowds during the summer months. He hoped it would long be preserved in all its beauty.

Mr. Andrew Murray said the only point on which he ventured to differ with Mr. Webber was, when he seemed to absolutely surrender his judgment in admiration of the German system. In this he could not wholly go with him; but as it was a matter which would require facts to support any adverse statement, he could treat it better in a letter. He might say, however, that we in England had long possessed the good parts of the German system, and did not desire to adopt the other ones. No doubt the large timber was very fine in Germany when you came to it, but it was very scarce; for, taking the railway from one end of the kingdom to the other, they went through wood not older than from 60 to 70 years of age. Their system set out with endeavouring to get the greatest possible amount of timber out of the soil in a certain period; and part of the system was, that there should be a crop every 60 or 70 years. This he did not hold good for history. With regard to the succession duty on timber, no one objected to paying a fair taxation for his property, but he did object to the method at present followed, by which it was levied over and over again on capital, instead of upon the annual value.

Mr. Botly begged leave to add that it was elicited in a Committee of Supply, in 1870, that the net income to the Crown from the 63,000 acres of the New Forest was under £1,767 per annum.

Lieut.-Col. Wragge said he believed there was a deficit of £200 in 1871.

The Rev. F. Hastings said there was a good deal of spoliation going on in Epping Forest. He had taken a ride round Hainhault, to see the recreation-ground, and could not find it, yet that forest was taken by Act of Parliament; in fact Epping Forest was in danger altogether of being taken by commoners and lords of manors, for both were to blame; but he trusted that action would be taken speedily, so that it would be preserved to the mass of the people.

Mr. Wm. Shakespeare Smith was very glad that this subject had come before the Society of Arts at this juncture of affairs, and it was quite true, as stated by Mr. Webber, that it was a question which concerned the whole public, though the forest of Epping in particular was of the greatest importance to the working man at the East-end of London. Up to about six years ago he had been able to roam through it in all directions, but now he found he was confined to the high-road, and treated as a trespasser if he left it, and liable to be dragged before the very men who possessed it, for the lords of the manor were very well represented on the Essex county bench. The custom of turbary was very well known, of course, but was there any lawyer who would say that a lord of a manor was entitled to take what quantity of soil he liked, and enter into contracts with nurserymen for all the turf from Epping Forest, so as to convert large tracts of ground into a swamp. The custom of turbary was to cut turf to be used on the manors, not to be sold off it. Possibly many gentlemen present did not know Epping Forest, and that there were still five miles of it open, though within the last four years ten square miles had been appropriated. Though the rights of the freeholders and the Crown's rights, possibly, had been provided for, the public rights had not been compensated, and he contended that the Crown's right was the people's right. He was very glad to see Sir A. Brady in the chair, as he had done so much public service in this matter, and he hoped he would yet do more as verderer of Epping Forest. Some few months ago, a question arose with regard to the land reclaimed from the river with public rights, and it was then asserted that it belonged to the Crown, and that the persons upon the spot had no right whatever; but now they were told that the Crown's rights existing over Epping Forest first were worth anything, and that, in fact, a deer was worth more than a man.

Admiral Ommanney hoped this subject would take much deeper root, and excite much more attention than it had done yet, for it was of the utmost importance to a maritime nation. Though iron was now used for ships, no one could say what might be the case 50 years hence, and, looking to other countries, Spain, for instance, where the denudation of forests had gone on to such an extent that the people were in serious straits for want of fuel, it was evidently of great importance that the subject of forests should receive due attention.

Mr. Clutton said no resident in London could object to Epping Forest being kept open for the use of the Londoners, but at the same time it should not be forgotten that the soil of Epping Forest as much belonged to the lord of the manors as any man's private house did, and it must not be forgotten that there were certain owners having rights over that soil. In some places the lords of the manors had purchased the Crown's rights and the timber, and the soil in those parts belonged as much to them as his hat did to him. He did not say it was always politic to push those rights to the extreme of excluding the public, but if the public wanted to possess these rights, they ought to pay for them, and not take them by force. A good deal had been said about the New Forest, and, as he knew something about that also, he might say that the plantations there were almost the best in the kingdom. There were none better managed for the purpose for which they were planted. He believed there were now only two forests, the Forest of Dean and the New Forest, in each of which there were about 20,000 acres planted. Mr. Eyre had referred to the Act known as the "Deer Removal Act," under which the Crown had given up its right to keep deer, in consideration of a right to enclose 10,000 acres, with certain reservations as to fence months, and it was now complained that they were enclosing too much; but the Crown had as much right to the soil there as lords of the manors had to the soil of Epping Forest. For many years there had been a continual conflict between the Crown and commoners in all these forests, and by degrees commoners were acquiring greater rights than they ever possessed before. In early days, they had the right to turn their cattle into the King's Forest, in return, as he believed, for the damage done by the deer trespassing on the adjoining land; but of late years, the commoners' rights had encroached upon the Crown, which was originally to keep as many deer as could be kept alive. Under the Act referring to the New Forest, the Crown was prevented from making an enclosure of less than 300 acres, and this Act was passed with the consent of both members for the county, and of several noblemen who had rights in the forest; and, besides that, under a former Act, by which a portion was sold to the railway for £12,000, which was devoted to the purpose of improving the forest, it was provided that this money should be employed in draining, and that none of the land so drained should ever be enclosed. Now, this had been so carried out that it was very difficult to enclose 300 acres on account of the lines of drainage. It had the practical effect of keeping all the better lands open for the benefit of the commoners. Now that the Crown's rights were being carried out, the cry was raised that the forest was being spoilt. He, however, quite agreed with Mr. Webber that planting would do no harm to any one. There was no doubt that the New Forest might be made exceedingly beautiful if Parliament thought fit. Twenty years ago, they were only allowed to plant timber fit for the navy, but this was not the case now, and there was no restriction as to what timber should be planted, so that the requirements of the soil and situation could be considered.

Mr. Frederick Young said they had had a very pro-[illegible] opinion with regard to the rights of lords of manors in Epping Forest, but he must say that it differed to a considerable extent from the opinion which was very strongly held by many persons also entitled to speak on the subject, and he was one of those who was very glad indeed that the whole question was now relegated to the Court of Chancery, and that it would be decided by that tribunal. He had taken considerable interest in this question on public grounds, particularly on account of the great importance which he attached to the existence of open spaces near large towns; and he must confess he thought the paper was one which had thrown considerable light on the part some were taking with regard to this question, because it showed that it was of the greatest possible importance to the country at large that large tracts of land should be preserved, not only for public recreation and enjoyment, but for the purpose of supplying that most important article of consumption—timber. In fact, unless this were looked to, they would be simply killing the goose with the golden eggs, exhausting a valuable material without looking to the wants of succeeding generations. It was a difficult question, no doubt, in a country so thickly populated as England, and there was a desire on the part of many persons to possess what they called waste lands for themselves for other purposes. It was therefore very necessary that the public should bear in mind that, for their own sakes, one of the best appropriations of large quantities of waste land might be to use it for the cultivation of timber. He would add that he had always advocated the principle that, if any private right were required by the public, they should be properly paid for.

Mr. Le Neve Foster (the Secretary) said it was not his custom often to trouble the meetings with any observations of his own, on the subjects which came before them; but on the present occasion, as an old conveyancing counsel, who in former days was familiar with those questions of land tenure, he begged leave to say a few words. He fully endorsed all that Mr. John Clutton had said as regarded the legal rights affecting these cases. Whilst he (Mr. Le Neve Foster) fully admitted the great importance of preserving the open spaces in and round London, and in the neighbourhood of large cities and towns, for the health and recreation of the public, he wished to correct a very common notion, that the public, *qua* the public, had any right whatever over them. The lords of manors and their commoners, whether as freehold or copyhold tenants or otherwise, alone had legal rights; and if the public desired to preserve these spaces, they must purchase them. It was a very wide-spread delusion—but not the less a delusion—that because these spaces were called commons, they were the common property of the public. He wished emphatically to say that such was not the case. He did not mean to say that there might not be exceptions to the broad rule which he had laid down, but in all these cases the exceptions must be proved against the *primâ facie* rights of the lords and commoners.

Mr. W. S. Smith asked what the Secretary would estimate the value of the lord of the manor's right at, supposing him to possess the fee simple of the land and the Crown rights also?

The Secretary said he was not a valuer.

Mr. W. S. Smith said he had understood they were estimated at one-sixteenth.

Mr. Clutton said this was a mistake. He had enclosed part of a private forest, of which he had the right of soil and timber, and had got four-fifths of the value, with the consent of the commoners.

Mr. Dickenson desired to say a words on behalf of the public, whose rights seemed to be ignored altogether by conveyancers, lords of manors, and commissioners. It had been said that a sheep was not a trespasser on a common, but a human being was, and that he had no right there. If this were law, he did not think it was common sense. If the public walked in a particular track for a certain number of years, they acquired a right of way; but because they strayed all over the common, it was held that they acquired no such right, but were simply trespassers. This did not seem just, and he hoped a different decision would be come to. He understood that in Germany the forests were open to the public; but in England, when the Royal forests were enclosed, no one could walk in them, except by obtaining a key, as a favour, from the gentlemen who had the charge of them. He knew this was the case, at any rate, in the Forest of Dean.

Mr. Cooke said the law, as laid down by the Secretary, was quite correct, according to Blackstone, who referred to the subject in the second volume of his Commentaries.

The Rev. J. Hastings said no mention had been yet made of the fact that the Corporation of London, which had rights over Epping Forest, was willing to give them up to the public. It appeared that those who had no land were born in a country to which they did not really belong, and in which they had no right, except on sufferance. The question was being mooted, who gave the lords of manors their rights?

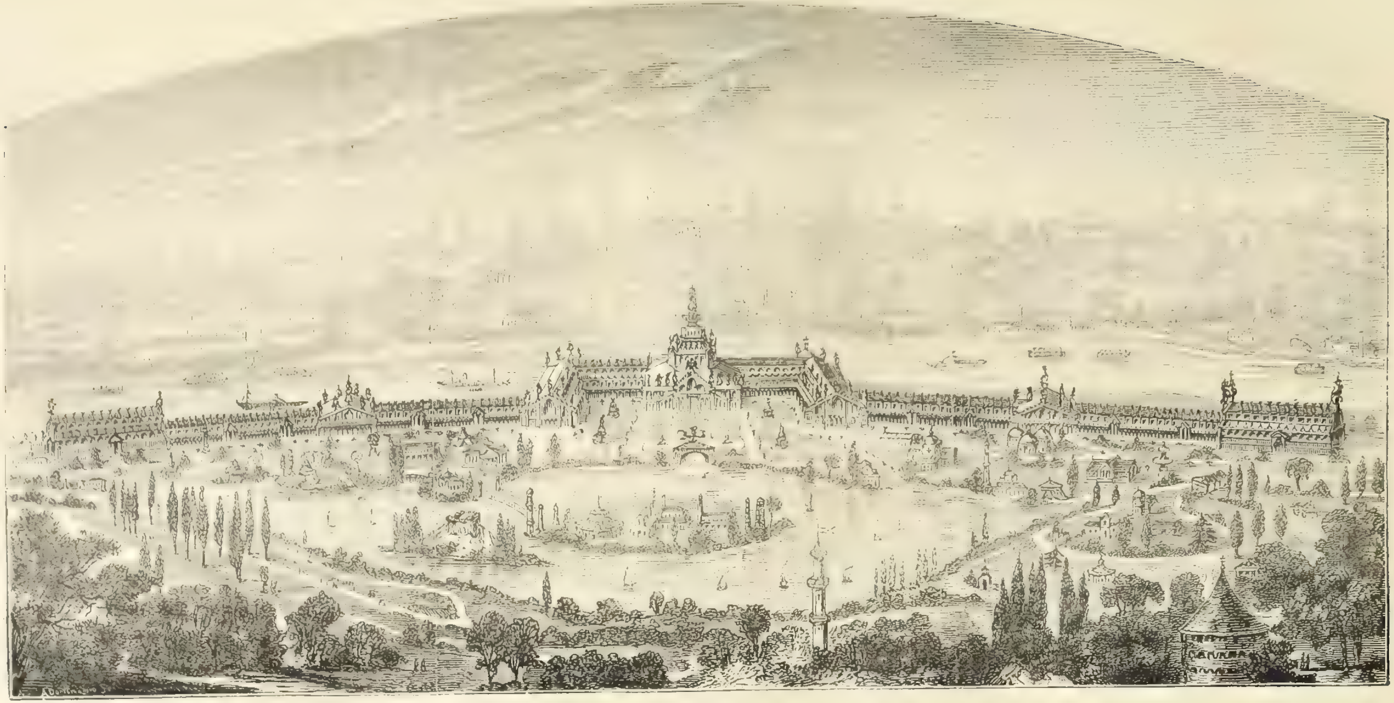
The Chairman said the lords of manors in Epping Forest—and they were numerous—held their rights from the Crown, subject to certain trusts and duties; and to the rights, not only of the commoners, but of all the freeholders. He had in his hand a statement put forth by Colonel Palmer, who was, until recently, the only verderer, in which he said that none of the rights in the manors in question had been forfeited. The fact was, that after the Verderers' Courts had been suppressed by the lords of the manors, who prevented the Queen's writ issuing, and kept the courts in abeyance for seventeen years, when they were re-established, presentments were made on oath, as had recently been done, of encroachments. As soon as this was done recently, the lords went to the Court of Queen's Bench, to restrain the Verderers' Court as obsolete. But it was quite different in 1842. In was an axiom in law, that if you challenged a man's title, he had a right to sit upon his title-deeds, and you must show that you had a better right; but it was not so in the Verderers' Court. There the lord of a manor who claimed rights was bound to show he had them; and when, in 1843, Colonel Palmer put these powers in force, the lords of manors petitioned to be allowed to pull down the fences, which they had put up in error, and they remained down to the present day. Now they seemed to take a different view, because some of them had bought the Crown-rights for £4 an acre, which they were selling at £500 or £1,000 an acre. It became a serious question, which would have to be settled in Parliament, what those rights really were, because they were all lovers of order, and did not desire that any man's rights should be infringed. What they protested against was, enclosure, without law or any pretence of it. During the twenty years that the Court of Verderers was kept in abeyance, some 12,000 acres had been enclosed without any authority whatever, and in these days, when the whole question of land tenure was being raised and insisted on by the working classes, it became a very serious matter to see that at any rate no irregularities should be permitted. If these enclosures went on, there would be no space left on which the people could take air and exercise, except on the public highways, which would undoubtedly be a great public misfortune. It did not follow because the lord of the manor had the right in the soil, that others did not have a right in the surface. He claimed the right, as a freeholder, to send his horse or cow wherever there was any grazing land, but the fact was it had all been filched away; there was no grazing land left. Turbary had been referred to, but he doubted the right of any one to take away the whole soil, and render the land desolate, as was the case at Wanstead, where pits were left in some cases 15 or 20 feet deep, in one of which two children were recently drowned. If private rights were required to be surrendered for the public benefit, no doubt they should be compensated; but it was of the utmost importance that all who valued law and order should be careful to give the lower orders all the rights they could justly claim, and it was essential to the safety of the country that these heart-burnings and antagonistic feelings should be put a stop to. On one occasion he sat for two hours, listening to presentments on oath of unlawful enclosures; but the next morning he was served with a writ from the Court of Queen's Bench, forbidding any further proceedings until the case had been argued out. He understood that very large sums of money had been subscribed for the purpose of suppressing the Verderers' Court, but he believed it would be rather difficult to suppress a court supported by public opinion, and which was the appointed guardian of the rights and liberties of the people. The oath taken by a verderer was a most solemn one; by it he engaged to do justice to the rights of the poor as well as the rich and the Crown, and the rights of the poor came first. It was the ground of their authority that they should protect the poor, and he did not think any minister would be very popular who brought in a measure for disfranchising a court which stood up for the rights of the people. If his tongue were not tied, he could say a good deal on the legal aspect of the question; and he did not think that though a deputation had been informed that "a deer was better than a man," that such a statement would be repeated publicly. It was an unfortunate expression, which he hoped would be looked upon as a *lapsus linguæ*. He concluded by moving a cordial vote of thanks to Mr. Webber, which was carried unanimously.

Mr. Webber briefly responded, and the meeting separated.

INDIA COMMITTEE.

A conference was held on Friday evening, January 26th, Major-General Sir Arthur Cotton, K.C.S.I., in the chair, when a paper on "The Route to Western and South-Western China by the Irriwadi and other Rivers of India, and the Commercial Advantages attached to it," was read by Commander F. E. Manners. (See *Journal*, p. 200.) A discussion followed the reading of the paper, which was as follows:—

Col. Laurie observed that, as one who had spent a good many years of his life in Burmah, at the time of the second Burmese war, and as one who had written a good deal on the subject, he could endorse the views so admirably set forth by Capt. Manners. He had never heard the subject so lucidly explained as on the present occasion; and, therefore, it was a matter for deep regret that there had not been a larger attendance to listen to so admirable a lecture. It only showed that the remark of Professor Fawcett, in a recent speech at Brighton, was too true, viz., that the apathy of the English public, in respect to Indian topics, is perfectly lamentable. Col. Laurie added that, about a year and a half ago, in publishing a pamphlet, he had occasion to touch upon the subject now brought forward by Capt. Manners, viz., the route through Burmah to China; and he might be permitted to remark that, as Lord Mayo is at present at Rangoon, his attention will most probably be drawn to the subject, and it is not at all unlikely, from news which has recently come to hand, that the merchants of that port will press upon the Viceroy the consideration of this scheme for the introduction of trade with China, for there is not the slightest doubt that the adoption of this route will be of vast benefit to the commerce of Eng-



LYONS:—View of the Exhibition Buildings, Park and Lake.

land. Col. Laurie subsequently, at the request of the Chairman, handed in some extracts from the pamphlet to which he had alluded, which will be published in a future *Journal*.

Mr. Hyde Clarke asked the lecturer whether, by his statements that Kye-yang, Yunan, and other towns, "contain populations of 6,000,000," the number of inhabitants in the provinces in which those cities are situate was meant?

Capt. Manners intimated that this was the case.

Mr. Hyde Clarke thought it remarkable that towns so distant as Yunan and Chingloo should be able to carry on a trade with countries so comparatively remote as Nepaul and Bhootan.

Captain Manners observed that the trade was conducted by land-carriage—by caravans principally. The distance was certainly very great; and although it was authoritatively stated that an extensive trade was carried on between the two places named by Mr. Hyde Clarke, yet he had had no means of ascertaining personally the real extent of it.

Mr. Hyde Clarke presumed the caravans followed the upper valleys of the rivers?

Captain Manners replied affirmatively.

Mr. Hyde Clarke added, that it certainly appeared extraordinary that the Chinese should be able to supply Kumâon, when it is so near British territory.

The Chairman said that, in the year 1825, he navigated the Irriwadi in a steamer, so that it is now 47 years since the first steamer ran up that noble river; and it has taken all that long interval of time to bring them up to the point of discussing the advisability of navigating it. It is a most magnificent river, navigable for 1,000 miles as easily as can be desired, and opening out a vast interior, which would bring English commercial enterprise within a moderate distance of the vast river communication of the empire of China. The point which it is now necessary to ascertain is, how far the communication may be improved between the Yantze-Kiang and the Irriwadi, for if we can once get upon the former an immense portion of the richest districts of China will be open to us. The only difficulty is the 150 or 200 miles of intermediate land-carriage between these two rivers. What is the height which would have to be surmounted at this point has not yet been ascertained; and no doubt a considerable obstacle has arisen in the shape of the recent Mahommedan revolution, which is reported as having occurred in those regions. The French expedition, which went as far as Tale-efoo, on the lake, which is within 20 or 30 miles of the Yantze-Kiang, on the high land that drains down to Camboja, was in imminent danger. The Mahommedan rule had just been established, and it was a great question whether the explorer should be allowed to escape with his life. He was, however, compelled to leave the following morning. This state of affairs would, no doubt, form a great difficulty in getting upon the Yantze-Kiang. An expedition had gone up the Yantze at least as far as the native boats would take them, which was probably within 150 miles of the highest navigable point. What is greatly in favour of this route of communication is, the great progress which has been made in the construction of river steamers. On the Godavery, steamers have been placed which run 10 miles an hour, and draw only 17 inches of water; and, as there is little doubt that even this can be improved upon, there is no telling how far the rivers of India will prove navigable. But the main point is to complete the communication between the Irriwadi and the Brahmapootra; and the intermediate space has recently been surveyed by a gentleman, who says the watershed is about 2,500 feet above the level of the sea, and the distance between the two rivers is about 100 miles. This would leave a distance of about 200 miles of land-carriage between the Irriwadi and the Yantze-Kiang, to complete the communication of India with China. A large portion of the trade of south-western China would naturally flow down the Irriwadi, but there would be a tenfold traffic into the valley of the Brahmapootra and the Ganges, bringing Calcutta in direct communication with the vast interior of China. It is a national object to open this line of communication, giving us a private entrance into China; for we can but faintly conceive of the vast traffic which might be induced by facile communication between India and China; and therefore it should be a government duty to complete the exploration of the communication between the two great countries. He should mention that the land-carriage is the grand obstacle to commerce everywhere, but upon the water it is not impossible to carry merchandise many thousands of miles. The great mass of traffic must, therefore, be conducted by water, or else not at all. Now, if by means of the Brahmapootra and the Irriwadi we can come within a moderate distance of China—that is, with 100 or 200 miles of land-carriage—it becomes quite within compass of a vast traffic in numerous highly-important articles of commerce. In America, it has been clearly ascertained that the great mass of the traffic of the country goes by means of the St. Lawrence, the Erie Canal, and the Mississippi, and only a comparatively small portion of the goods can bear the cost of 1,000 miles of land-carriage. The great object in seeking traffic between India and China is, to get as near as possible by water into immediate communication, by means of the different river systems. An exploring expedition should ascend the Irriwadi, Salween, and the Yantze-Kiang, and these parties should try to communicate with each other, for the purpose of ascertaining what really lies between. The inland provinces of China are known to be exceedingly rich in minerals, and they would prove of immense value to England, for the value of the mineral products of those provinces is probably unappreciated by the natives at anything approaching their real value. He earnestly wished the government would take the matter up, and he should like the Society of Arts to form a deputation, to press the matter upon the attention of the Secretary of State for India, in order that a really effective expedition might be formed, divided into three portions, to ascend each of the three rivers he had named, but under one able and energetic command, such as would be found in the person of Mr. Cooper. It is a curious and suggestive thing that he should be the first of the men now living who had ascended the Irriwadi in a steamer, and yet, although nearly 50 years had elapsed, they are still discussing the matter, instead of developing an extensive commerce by means of the stream. A more magnificent river for navigation he had never seen. They were greatly indebted to Captain Manners for bringing the matter so clearly before them, and he had great pleasure in proposing a vote of thanks to him.

Mr. Hyde Clarke observed that he felt it a duty to second the proposition which had been made by the distinguished chairman, because they had not only heard a valuable address, but one which it was to be hoped would issue in a practical result. It had been his duty on several previous occasions, when Indian matters formed the topics for consideration, to call attention to the fact, that their influence is by no means restricted to the numbers who attend these meetings, but that, in point of fact, the speakers address an immense audience by means of the Society's *Journal*. Moreover, the influence of the Society would, no doubt, in the future, operate, as it has done in the past, to bring these subjects before the Secretary of State for India, and the result would not improbably be his acquiescence in, or at least his consideration of the suggestions made from time to time. As a practical commercial man, he felt deeply interested in the suggestions which had been made regarding the opening up of communications with China by an Indian route, and he thought the subject might be considered under two heads—first of all, with regard to the general development of these river systems; and, secondly, as to the question of opening the trade with south-western China. The opener of the discussion (Captain Manners) had not been, perhaps, sufficiently careful to distinguish between these two portions of his subject, which are really quite distinct and independent of each other. It is clear that the Salween and the Irriwadi can be developed by mere navigation, and if that is true, it ought to be done by all means, whether China is accessible by this route or not. With regard to the development of trade with south-western China by this route, let it be done by all means if possible; but, meantime, there cannot be a doubt that the navigation of these Indian rivers is of great importance, and is capable of thorough and comparatively easy realisation. As Captain Manners has truly said, we may look forward, under such circumstances, to the development of new worlds of trade in south-western China; and, in fact, it is by this constant development of new sources of trade that Britain, Western Europe, and the United States are becoming enriched. A case in point is offered by the development of the countries bordering upon the Pacific Ocean, which, a few years ago, were thinly peopled and barbarous as those described by Captain Manners; and, consequently, if we do but apply ourselves to the development of these latter, more benefit will accrue to England than when her merchants engaged their capital in the advancement of California and the countries of South America, because in the case of the Indian route to China, although we may have to deal with wild tribes, yet we have as our goal a vast and industrious population producing the most valuable articles of commerce. Hence a far greater incentive to exertion and enterprise is afforded than was the case in California and the South American States. So far from the Mussulman uprisal on the south-western frontier of China being a disadvantagous circumstance in connection with this scheme at the present moment, it might very probably prove far otherwise, and result in the greatest benefit; for the Chinese government has shown very little disposition to allow any communication between the south-west of China and India; and indeed, if the Chinese government had so willed it, a complete and thorough means of transit would probably have long since been opened. Now, that these new Mussulman kingdoms have been set up, their very necessities will act as a strong inducement to them to open a trade; and though we may fail in obtaining the great advantages which have been described by Capt. Manners as likely to result from our gaining access to the whole population of China, yet it will be a great thing if, in the meantime, we can obtain access to some 20 or 30 millions of people in the neighbourhood of our own possessions, because hitherto the products of these countries have had to be carried down from long distances to seaports of China, very remote from European markets; whereas, if we succeed in obtaining that diversion to which allusion has been made, we shall provide a shorter route and a far cheaper one, and shall have the produce brought to Calcutta or Rangoon, where there are large English mercantile bodies. The cost of conveyance from the Chinese ports would thus be saved, and we should be able to avail ourselves of the Suez Canal. The distinguished Chairman pointed out how short is the space which has to be overcome by some improved means of communication which will bring into union so vast a population. Captain Manners alluded to the thin population of the intermediate countries as offering one of the chief difficulties, by forbidding the hope of productive revenue arising from local traffic, but this should not deter from making any preliminary movement, and it should not be forgotten that this reflection did not prevent the attempt in the cases adduced in America, which have proved perfectly successful. It is very often said by some political economists that everything should be left to private enterprise, but these forget that the present are not the days when undertakings of this kind can be left solely to fortuitous action of occasional enterprise, which must always be uncertain, irregular, and isolated. Besides, the men of commerce have many other calls for their capital and time. Other governments, having far less resources, but with more anxiety in the public interest, have not scrupled to undertake preliminary works, and they have been qualified to appear before our own public, and to obtain large amounts of English capital for projects of infinitely less inherent value than that we are at present discussing, or than many others which affect our commerce and our national interests. The Russian government does not hesitate to aid in a similar way, to direct Russian enterprise to the sources of profitable commerce and trade; and his connection with the Council of Foreign Bondholders daily pressed on him the results of the neglect and indifference or apathy of the English government in respect to matters of this kind; and, it might also be added, that large sums of money are constantly being taken from the English market for undertakings in thinly-populated countries. But the other day a large sum of money was raised for Bolivia, and in this we have an example apt to the purpose, for in Bolivia it is proposed to do something closely resembling what the chairman has urged. They propose to navigate a feeder of the Amazon, passing through a country without population, and to lay down a railway of 150 miles, for the purpose of overcoming natural obstacles in the way of development of their internal commercial communication. And what is the government which came into the English market, and pledged its credit and its resources for the purpose of obtaining the capital for this undertaking, which will be carried out by Americans with English money? The population of Bolivia consists of a few hundred thousands of Indians, wild and tame; but they can carry out an enterprise of this kind, which a great government like that of India or England is unable or unwilling to effect. How is it that the government of Bolivia was able to secure this confidence of the English capitalists? Because, in the first instance, they spent a small sum of money in carrying out the preliminary inquiries, similar to those which had been recommended by the practical experience of the chairman. Many other examples of the same kind might be adduced, and when the energy of these small governments, of countries which can hardly be called civilised, is considered, a strong contrast is afforded by the supineness of our own government. In connection with steam navigation, the States of Columbia have placed a fleet of steamers upon the river Magdalena, and are thus developing an enormous commerce; and example after example rises to the mind where the judicious enterprise of governments has resulted in the best effects. To say nothing of what has been done in respect of the Orinoco, in Venezuela, attention might be called to the Murray, in our own territory, and many other instances might be mentioned where work of this kind had been effected in regard to rivers which have narrower channels, and which presented far greater natural obstacles than the work which is now under discussion. Look at the River Niger, in the wilds of Africa, amongst a savage population. There a great field of enterprise has been opened by judicious action on the part of the government, who had it carefully surveyed by one of their own vessels, and by placing a gun-boat there, they have ensured the safety of the trade. It is useless for private enterprise to enter upon such a work as this without the support and encouragement of the government; and, at the same time it is not asked that the government should undertake the management of the commerce itself. It should, however, do what other governments are doing, by instituting the preliminary inquiries, and giving the necessary guarantees to secure the raising of the necessary capital· They find an indemnity for the nominal risk they incur by the increase of the customs revenue, the improvement of the land-tax, and the increased prosperity of the country. When we consider these facts, and reflect that there is no difficulty in obtaining money for any useful undertaking, and when we are reminded that India is absolutely cramped for the want of capital in its commerce, it is utterly deplorable that the government does not assume a different attitude in regard to matters of this kind. Capt. Manners, in referring to New Guinea, has called the attention of the Society to a subject of great importance, although he has not mentioned what is known to some, viz., that in New Guinea there are gold formations of a wonderful extent. It has been stated to him by persons who have seen the gold formation—the auriferous quartz—a foot in width, such as has not been seen in any other country, and corroborative evidence has been adduced which places the existence of gold in remarkable quantities in that island almost beyond a doubt. Here is another matter in which the government might give assistance of vital importance to private enterprise; for the natives of New Guinea conceive such a violent attachment to any stranger that visits their shores as to make it exceedingly doubtful whether he can ever leave the island alive; and snakes are so numerous that they are said to swim out a distance of two miles from the shore. In conclusion, Mr. Hyde Clarke said that he trusted the gallant chairman would feel it his duty to bring before the India Committee and the Society the propriety of forming a deputation to wait upon the Secretary of State for India, for the purpose of requesting him to direct a survey of the rivers which Captain Manners had indicated. The cooperation of the East India Association and the chambers of commerce might be sought in the matter, and thus a practical issue might be obtained from the suggestions which had been given by the distinguished Chairman and in the very valuable paper they had just heard.

The Chairman said he did not think they could have had a speech more thoroughly to the point than the one they had just heard. Only conceive that the insignificent state of Bolivia is able to procure English capital for the opening out of a comparatively insignificant country, while no such funds are available for making a railway to join the communications between the Irriwadi and the Yantze-Kiang; and that this is due to the government taking no action in the matter, and will not use its influence to start it. It is a wonderful thing that in relation to such immensely important matters as these the government of a great country like England can be so extremely neglectful. He earnestly wished that something could be done, and thought the suggestion to organise a deputation to the Duke of Argyll an excellent one; and if this could not be undertaken by the Society of Arts, no doubt the East India Association would willingly accept the duty. The expense of the exploration of these rivers would be very trifling, for all that would be necessary would be three small river steamers, which should commuicate with each other. Merchants cannot be expected to venture on the trade with China by this route until something of the kind had been done by the government; for there must be political operation. which merchants cannot carry out, and, consequently. there is hardly a case of this sort in which the protection of the State is not needed. Once fairly started, however, they must trust British merchants to carry it on.

The suggestion that a deputation should wait upon the Secretary of State for India having been generally accepted,

Captain Manners briefly acknowledged the vote of thanks, and added that it is very possible that there are affluents of the Irriwadi which, if they do not join the Yantze-Kiang, will be found to join some of the neighbouring rivers.

EXHIBITIONS.

LYONS UNIVERSAL EXHIBITION.

On May 1st, as announced in the last *Journal*, an International Exhibition will be opened in Lyons, under the patronage of the Minister of Agriculture and Commerce. For the purpose of enabling British exhibitors to take part in the exhibition, a committee has been formed, consisting of the following gentlemen:—The Rt. Hon. the Lord Mayor (Chairman), Geo. Anderson, Esq., M.P.; H. W. F. Bolckow, M.P.; Sir Antonio Brady; Alexander Brogden, Esq., M.P.; Charles Candy, Esq.; David Chadwick, Esq., M.P.; Edwin Chadwick, Esq., C.B.; Hyde Clarke, Esq., D.C.L.; Ernest Corbiere, Esq.; Thomas Dickins, Esq., J.P. (President of the Silk Supply Association); Richard Durant, Esq.; H. W. Eaton, Esq.; M.P., P. Le Neve Foster, Esq., M.A.; E. T. Gourley, Esq., M.P.; C. W. Hoskyns, Esq., M.P.; W. Johnston, Esq., M.P.; R. Leeds, Esq.; E. P. Lintilhac, Esq. (Messrs. Dufour Brothers); Sir Louis Mallet; R. J. Mann, Esq., M.D.; T. McClure, Esq., M.P.; A. J. Mundella, Esq., M.P.; Donald Nicoll, Esq.; John Pender, Esq.; C. S. Read, Esq., M.P.; Charles Reed, Esq., M.P.; Col. Sir W. A. Rose, Ald.; T. Salt, Jun., Esq., M.P.; Gilbert Sanders, Esq.; and Edmund Johnson, Esq., Commissaire-délégué and Hon. Sec., 3, Castle-street, Holborn, London.

General Regulations.

Article 1.—An Universal International Exhibition of Agricultural and Industrial Products and Works of Art will be opened at Lyons on the 1st of May, and closed on the 31st of October, 1872.

The exhibition will be held in closed galleries and in an open space adjoining. The building is constructed on land furnished by the city of Lyons, and known as the Parc de la Tête d'Or.

The Prefect of the Rhone is the honorary President of the exhibition; the Mayor of Lyons, the honorary President of the Committee of Organisation; the Director of the exhibition, M. A. Tharel, the acting President of the Committee.

Article 2.—Foreign countries have been invited to form committees for the examination, selection, and transmission of the products of their countrymen. Special commissioners are accredited to such committees.

Article 3.—Applications from intending British exhibitors for allotments of space should be made at the earliest possible moment, and in all cases before the 15th February, 1872, addressed to Mr. Edmund Johnson, Hon. Secretary of the London Committee, 3, Castle-street, Holborn, London.

Article 4.—Spirits, alcohol, oils, and essences, corrosive salts, and generally all bodies easily inflammable, or of a nature likely to cause fire, must be contained in strong and well-closed vessels; the proprietors of such products must, moreover, conform to special regulations relating to them.

Article 5.—The productions exhibited will be divided into nine groups and seventy-three classes, in accordance with the subjoined programme.

Countries, districts, or towns having any special industry, may, by permission, exhibit collectively in any of the groups. Colonies, in like manner, may make collective exhibitions of their productions.

Article 6.—Articles for exhibition will be received at the building from the 1st of March to the 1st of April, 1872, inclusive. Heavy and cumbrous objects, and those which require considerable work for their installation, should arrive by the 15th of March at latest. Extra time may be allowed for manufactured goods which might suffer from being packed for too long a time, on condition that all the arrangements for their exhibition are previously made. Such extra time cannot in any case extend beyond the 15th of April; after that day all productions whatever will be rigorously refused, and the space forfeited.

Article 7.—The package and transport of the productions sent to and returned from the exhibition will be at the charge of the exhibitors, who will be duly informed of the arrangements entered into with the several railway companies.

Article 8.—All packages, in order to ensure their admission duty free, must bear the printed official labels that will be furnished to exhibitors.

Article 9.—The space occupied in the exhibition will be subject to the following charges:—Indoor department, floor space, 25s. per superficial yard; wall space, 8s. 6d. per superficial yard. Out-door department, 5s. per superficial yard; with right of erecting roofs, sheds, kiosques, &c., 12s. 6d. per yard. Pictures and other works of art will be admitted without charge. Books, memoirs, &c., will be charged at the rate of five francs each volume or example. The book-shelves and fittings required will be furnished without charge. Special regulations will be issued concerning agricultural products.

Article 10.—All stands, glass-cases, decorations, and inscriptions to be at the charge of the exhibitors, and in conformity with the general regulations.

Article 11.—Exhibitors desirous of showing goods or other objects of great weight or volume, or which require foundations or special constructions, must furnish full particulars with their applications for space.

In the case of machines requiring steam-power, fountains, and hydraulic machinery and apparatus, notice must be given of the quantity and pressure of steam or water required. The price and conditions upon which water, steam and gas will be supplied to exhibitors will be duly notified.

Article 12.—The direction will take all necessary precautions to preserve the objects exhibited from injury, but will not take upon itself the responsibility of damage from fire or otherwise. All risks and perils remain with the exhibitors, who, however, can effect insurances. The direction will take care that the products exhibited shall be watched over by numerous and active officials, but will not be responsible for any thefts or losses that may occur.

Article 13.—The exhibitors are at liberty to appoint special or other agents, but all such nominations will have to be officially confirmed, and personal cards of admission will then be granted. The acceptance of agents on the part of the direction will not imply any recommendation, nor, on the other hand, any surveillance or interference whatever between the exhibitor and his representative.

Article 14.—Current trade prices may be attached to the articles exhibited during the exhibition; but the direction reserves to itself the right of verifying the truthfulness of the quotations, and, in case of deception, to exclude the exhibitor from competition.

All possible facilities will be given to exhibitors for the sale of their productions; but no object exhibited must be withdrawn until after the closing of the exhibition.

Article 15.—Exhibitors will receive personal cards of admission, which can neither be lent nor given to other parties under pain of being withdrawn; and that without prejudice to any subsequent legal action that may be taken.

Article 16.—Foreign productions are admitted provisionally, and consequently, if unsold, are not liable to Customs duty.

Article 17.—The organisation of the police within the building is placed under the authority of the director. The regulations for such service will be published and placarded at the opening of the exhibition.

Article 18.—The examination and appreciation of the articles exhibited will be confided to a mixed jury, one-half to be elected by the exhibitors, and the other half to be nominated by the administration. A Special Committee in connection with the awards will in due time publish all necessary regulations.

Article 19.—The number of jurors to be appointed will be in proportion to the number of exhibitors, foreign as well as French; and any nominations not made in due time will be filled up officially.

Article 20.—Each jury may appoint associates or experts, whose particular knowledge of a speciality may aid the jury in its labours, such associates to have only a consultative power, and not to take part in the action of the jury, except with regard to the special class of objects for which they are nominated.

Article 21.—The titular members of juries are *hors concours* in all classes of the exhibition; and the associates in those classes only in which they are called to act.

Article 22.—An official catalogue of the exhibition will be duly published.

Article 23.—Conferences and lectures may be given during the exhibition, and every facility will be afforded for their organisation.

Article 24.—The administration reserves the right of the production of general views of the exhibition.

Article 25.—Immediately after the closing of the exhibition, the exhibitors must proceed to the repacking and removal of their contributions and fittings.

These operations must be terminated before the 15th of December, 1872; after that date, all contributions, packages, fittings, &c., which may not have been removed by the exhibitors or their agents, will be stored at the cost and risk of the exhibitors.

Such objects as are still unclaimed on the 30th June, 1873, will be sold by public auction, and the net proceeds applied towards a fund for the relief of invalid workmen.

The exhibition will consist of nine divisions or groups, as follows:—The production of silk and silken fabrics, silk fabrics, textile fabrics, furniture, &c. Machinery, industrial products, both raw and manufactured, articles of food, agricultural and horticultural appliances, materials and provision of the liberal arts and fine arts. These again are sub-divided into sections and classes, as follows:—

Group 1.—Silk—Raw Material, Machinery, and Manufactures.

Section 1.—Production of Silk.—Class 1. Apparatus of magnaneries—Different methods of hatching, warming, and general management in Japan, China, Cochin-China, and in Europe. Modes of ventilation; nets, trays, cells, &c. Magnaneries exhibited in work—Methods of rearing in Japan, China, India, &c.; European methods; rearing in the open-air; collections of cocoons of all countries. Publications and documents on silkworm diseases. Preparation of the seed; Japanese systems, cards, and papers; European systems. Parasites of the Bengal, Japanese, and other cocoons; diagnoses of the moth and seed; implements; microscopic views. Apparatus for preserving, packing, and conveying seed. Class 2. Destruction of the chrysalis—Primitive methods of suffocation; suffocation by steam; mixed system, by steam and warm air, and by warm air alone. Cocoon cases. Apparatus for the management of cocoons. Sorting of cocoons. Description and specimens of defective cocoons. Class 3. Spinning—Primitive apparatus for spinning on long silk reels, as in China, Cochin-China, Russia, Persia, Spain, and Turkey; European processes of silk reeling by steam, systems *chambon*, *tavelle*, &c.; counting apparatus; small implements used in silk-spinning. Class 4. Raw silk from silk-producing countries. Class 5. Minor products—Double and pierced cocoons; knubs, waste, &c.; systems of ungumming and swelling, carding and spinning machines, &c. Class 6. Silk-throwing—Primitive, Chinese, Cochin-Chinese, and other Asiatic throwing apparatus; round Piedmontese throwing mills; French and English throwing mills; spools, presses, and other accessories. Class 7. Wrought silk of all countries—Inferior products, floss silk, &c. Class 8. Testing machines for raw and wrought silk — Provers, scales, serimeters, &c.; conditioning apparatus, and all other implements, &c., used in the testing of silk.

Section 2. *Production of Silk Fabrics.*—Class 9. Apparatus and utensils used in silk dyeing. Class 10. Apparatus and processes of reeling, warping, doubling, winding, &c. Class 11. Weaving and knitting machines and apparatus—Looms and apparatus of all kinds for hand and power; plain and figured weaving; jacquard and embroidery apparatus; circular knitting machines, for stockings, gloves, &c.; glazing by hand and machine; shuttles, reeds, and all accessories used in silk weaving. Class 12. Apparatus and processes for dressing, watering, calendering, glazing, goffering, folding, and measuring silk fabrics.

Section 3. *Silk Fabrics.*—Class 13. Plain silks, black and coloured; taffetas, satins, Pekins, &c. Class 14—Figured silks of all kinds for ladies' dresses. Class 15—Waistcoat pieces, plain and figured; neckties; made-up goods; parasols and umbrellas; silk handkerchiefs, plain and figured; silk for hats, bonnets, &c. Class 16—Velvets for ladies dresses, plain and figured; plush; terries and fancy velvets. Class 17. Furniture silk—Gold, silver, and silk fabrics for religious vestments, &c.; Oriental fabrics, worked with gold, silver, &c. Class 18. Embroidery; hosiery; ribbons and trimmings. Class 19. Silk shawls.

Group II.—Textile Fabrics (Silk excepted) Clothing, and other Objects worn on the Person.

Class 20. Cotton yarns, threads and tissues, &c. Class 21. Flaxen and hempen yarns, threads, and tissues. Class 22. Yarns and fabrics of combed wool. Class 23. Yarns and fabrics of carded wool. Class 24. Substitutes for the articles enumerated in the four preceding classes. Class 25. Shawls — Pure or mixed woollen shawls; cashmere shawls. Class 26. Lace, net, embroidery, and trimmings (silk excepted)—Hand and machine made; crochet and tambour work; embroidery, tapestry, &c., worked by hand. Class 27. Hosiery and made-up linen —Hosiery of cotton, flax, wool, cashmere, &c.; linen for ladies, gentlemen, and children; baby linen; made-up flannels and other woollens; stays; neckties; gloves; gaiters. Class 28. Apparel, clothing, &c., for both sexes, of all kinds. Class 29. Perfumery. Class 30. Skins and furs of all kinds, real or false. Collections of natural objects.

Group III.—Furniture and Decorative Objects for Use in Dwellings.

Class 31. Furniture, upholstery, and decorative work —Carpets, upholstery, and decorative objects; furniture stuffs of all kinds (silks excepted); fibre carpets and mats; leather for furniture and hangings; floor and waxed cloths; kamptulicon; wire gauze. Class 32. Paper-hangings in all varieties; blinds, printed and painted. Class 33. Porcelain, earthenware, and glass. Class 34. Gold and silversmiths' work, cutlery, jewellery, &c. Class 35. Bronzes and other artistic castings, and repoussé work. Class 36. Clock and watchwork, chronometers. Class 37. Apparatus and processes for heating and lighting. Class 38. Morocco work, fancy articles, and basket work.

Group IV.—Machines, Implements, and Tools.

Class 39. Machinery and apparatus in general, including gas. hot-air, and compressed air-engines; electro-magnetic engines; windmills; aërostatic apparatus. Class 40. Machine tools, &c. — Machinery, implements, and processes employed in workshops generally. Class 41. Implements and processes of mining and metallurgy; implements used in the cultivation of fields and forests. Class 42. Apparatus and processes used on farms, and in the preparation of food; apparatus used in chemistry, pharmacy, and tanning. Class 43. Agricultural machines and implements. Class 44. Machinery and processes used in the manufacture of fabrics (silk excepted) for spinning, weaving, rope-making, &c. Class 45. Machinery and processes for making-up clothing—Sewing, stitching, trimming, and embroidering machines; machines for closing, binding, and cutting-out stuffs and leather; machines for nailing and screwing boots and shoes. Class 46. Machinery and processes of civil engineering, public works, and architecture, including models and plans of or for workmen's dwellings characterised by cheapness, combined with the conditions necessary for health and comfort. Class 47. Machinery and processes used in paper-making, paper-staining, and printing, including apparatus for printing paper-hangings and fabrics; for bleaching, colouring, and dressing papers and tissues; for paper-making by hand and machine; type-founding and stereotyping; letter-press, copper-plate, lithographic, and other printing presses and machines. Class 48. Workman's class—Articles of all kinds produced by men working on their own account, with or without the aid of their families or apprentices; machines and processes illustrative of work executed at home; work specially illustrating the skill, intelligence, and taste of the workman. Class 49. Means of locomotion and navigation. Class 50. Arms of all kinds; apparatus used in hunting and fishing; military and sporting arms; traps and snares; lines, hooks, harpoons, nets, fishing tackle, and baits; sporting equipments. A large lake being comprised in the exhibition, experiments connected with vessels and apparatus will be tried thereon.

Group V. — Products (Raw and Manufactured) of the Extractive Industries.

Class 51. Mining and metallurgy; forestry. Class 52. Drugs, and chemical and pharmaceutical products. Class 53. Leather and skins.

Group VI.—Alimentation.

Class 54. Cereals and other edible farinaceous products, with their derivatives—Wheat, rye, barley, maize, &c.; pearl barley, groats, &c., and various feculæ; mixed farinaceous products; macaroni, vermicelli, &c.; bread, substitutes for bread, and pastry. Class 55. Fatty substances used as food—Fats, oils, milk, butter, cheese, and eggs of all kinds. Class 56. Meat and fish—Meat, fresh, salted, and preserved in oil; crustacea and shell-fish. Class 57. Vegetables and fruit of all kinds, in their natural state, and preserved without sugar; compressed and prepared forage. Class 58. Condiments and stimulants—Sugar; confectionery; tea and coffee; spices; cocoa and chocolate; preserved fruits; liqueurs, &c. Class 59. Fermented drinks—Ordinary and choice wines; cider, beer, and spirits.

Group VII.—Agriculture and Horticulture.

Class 60. Specimens of agricultural and rural establishments; modes of culture and distribution of crops; drainage, irrigation, &c.—Plans and models of rural buildings; machines and implements for ploughing, sowing, mowing, and reaping; and also for preparing and preserving agricultural produce; portable engines; horse-gear, and agricultural implements generally; organic and mineral manures; apparatus for chemical and physical analysis of the soil; systems for replanting and cultivating forests, tools, and instruments employed; mill-stones, rough and worked. Class 61. Glass-houses, and utensils and tools used in horticulture and in the decoration of parks and gardens. Class 62. Products—Vegetables, fruit trees, seeds, saplings of forest trees, hot-house and other ornamental plants and flowers. (As this class includes products which require renewal, it will be the object of special competitions, of which due notice will be given to the exhibitors).

Group VIII. — Materials and Processes of the Liberal Arts.

Class 63. Printing and books; lithographic drawings;

engravings; decorative paintings, &c.; carved and engraved work; drawings and models, executed by mechanical processes; moulded work; stationery and paper manufactures; bookbinding; artists' materials. Class 64. Drawing and modelling applied to the common arts. Class 65. Photographic proofs and apparatus. Class 66. Musical instruments and accessories. Class 67. Medical and surgical instruments and apparatus.—Special apparatus for veterinary anatomy; appliances for baths and hydropathy; gymnasia and hygienic apparatus. Class 68. Mathematical and other instruments.—Instruments for topography, geometry, surveying, geodesy, astronomy, &c.; philosophical meteorological, and optical instruments; monies, weights, and measures; maps and apparatus for geography and cosmography; educational publications and appliances for the teaching of science. Class 69. Apparatus and models for primary instruction—Models and drawing copies; systems of teaching singing; works of pupils; libraries and appliances for the instruction of adults in the workshop, common schools, at home, or in special classes; collections of objects; publications, documents, &c., for promoting the development and extension of co-operative societies.

Group IX.—Works of Art.

Class 70. Oil paintings on canvas, panels, &c.; water-colour and other drawings. Class 71. Sculpture and die-sinking. Class 72. Architectural designs and models. Class 73. Engraving and lithography.

The Exhibition being universal, products not specified in the above classification will be exhibited in the group and class to which they respectively belong by their origin or their application. Exhibitors whose contributions belong to various classes must make a separate application for each class, stating the space required therein.

All communications from intending exhibitors should be addressed to Mr. Edmund Johnson, Honorary Secretary to the London Committee, 3, Castle-street, Holborn.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Durbar Jewellery.—The Rajahs of the Bombay Presidency have consented to the exhibition of their durbar or state jewellery. As this jewellery is not only of great value, but of marvellous workmanship, and has never before been exhibited in this manner, the collection will possess great and historical interest.

Musical Pitch.—The Society of Arts will exhibit the various forks showing the musical pitch in use in Continental countries. These forks were collected during the labours of the Committee of the Society which was appointed for the purpose of establishing, if possible, a uniform musical pitch.

Cotton.—Different varieties of growing plants, from the various countries in which the raw material is produced, have been obtained, and will be exhibited in connection with the staple industry of the Exhibition of 1872.

Typography.—In addition to the "Walter" printing-machine, on which the *Times* is now printed, and on which the *Mail* will be printed three times a week in the presence of the public, the type-composing and distributing machine, that has been in operation at the *Times* office for a considerable time, will also be shown at the Exhibition of 1872.

Musical Publications.—The rules for the International Exhibition of 1872 provide as follows with regard to the musical arrangements:—Her Majesty's Commissioners will appoint a committee to select for performance in the Royal Albert-hall new compositions of merit which may have been published before the 1st March, 1872. They are, therefore, desirous of receiving from the musical academies and schools of this and foreign countries the names of musical compositions of all kinds, which are considered by them of sufficient merit to be worthy of performance in the Royal Albert-hall during the International Exhibition of 1872. The works should be the productions of living composers, published before the 1st March, 1872, and may be of a vocal or instrumental character, such as oratorios, cantatas, sonatas, overtures, glees, songs, dance music, &c. It is requested that the information may be supplied on or before the 31st March, 1872.

Rules for the Reception of British Exhibits.—The entrances for the reception of goods other than those in the Fine Arts division will be as follows:—1. East entrance, in Exhibition-road. 2. West entrance, in Prince Albert's-road. 3. South entrance, in Exhibition-road. All objects must be delivered at the building, at the entrances specified, and on the days named:—On Friday, March 1st, machinery for jewellery (east entrance); on Friday, March 1st, machinery for paper and cotton (west entrance); on Saturday, March 2nd, scientific inventions (west entrance); on Monday, March 4th, cotton (west entrance); on Tuesday, March 5th, acoustic apparatus (south entrance); on Wednesday, March 6th, paper, stationery, and printing (south entrance); on Saturday, March 9th, reproductions (east entrance); on Tuesday, March 12th, tapestries, carpets, and embroideries (east entrance); on Thursday, March 14th, designs for decorative manufactures (east entrance); on Friday, March 15th, furniture, &c. (west entrance); on Monday, March 18th, stained glass (west entrance); on Monday, March 25th, musical instruments (east entrance); on Thursday, April 4th, jewellery (east entrance). All objects must be delivered to the officers appointed to receive them, unpacked and ready for immediate inspection, and free from all charges for carriage, &c. The only exception to this rule will be in the case of machinery, which may be sent in cases, but must be unpacked by exhibitors. Packing cases of exhibitors of machinery must be removed from the buildings as soon as the goods are unpacked. To every object a label, duly filled in, must be securely attached. The number on this label must correspond with the number of the object on the delivery-order. It is recommended that labels be attached to objects by wire. Delivery-orders, duly filled in, must be sent in with the exhibits. These forms must contain a complete list of all objects submitted for exhibition, and the numbers in the first column must correspond with the numbers on the labels. The doors will be opened at eight a.m. daily, and will remain open until four p.m., except for one hour, viz., from twelve to one o'clock. The various labels and forms may be obtained at the offices of the Commissioners.

Russian Electrotypes.—With regard to these electrotypes in the Exhibition of 1871, there are at present two different processes, the one producing the engraving direct, the other the galvano-plastic deposit. In the first process, a polished metal plate, sheltered from the light, is covered with a coat of bitumen. This coat, which is sensitive to light, is covered by a photographic positive on glass, and then exposed to the action of light. In order that the positive may adhere uniformly to the sensitive surface, the collodion is detached from the glass in the following manner:—The sensitised plate is placed in a bath of glycerine, and after having considerably strengthened the position with sublimate (mer. cor.) and sulphate of carbon, the collodion is detached by rubbing round the edges, when it floats upon the glycerine. The glycerine is then withdrawn through a hole below, and the coat of collodion adheres firmly to the surface of the sensitised metal plate. The exposure to light lasts from five to ten minutes, according to the weather; afterwards the plate is washed over, by means of a tuft of cotton-wool or a brush, with a mixture of oil of naphtha and essence of lavender; this mixture acts very slightly upon the parts of the plate which have been affected by the light, but easily removes those portions protected by the shadows of the positive. The picture then makes its appearance, and when it has attained the required distinctness, the plate is washed, and exposed to the action of the galvanic current, which, acting upon the parts of the plate exposed to view, attacks the metal, and thus produces an indentation resembling engraving (copper-plate). The plate is printed from in the ordinary manner. This process is suitable for line drawings. By substituting a lithographic stone for the metal plate, and a weak solution of nitric and acetic acids for the galvanic mordant, a photograph on stone is obtained. In the second process, to a solution of gelatine in hot water is added bichromate of potash or ammonia. This solution is poured upon a glass and allowed to dry in the dark. When dry, this sensitised plate is placed under a positive or a negative (as the case may be) and exposed to the action of light for from one to twenty minutes; it is then washed in the dark room with cold water. This removes the bichromate not decomposed by the light in the parts protected by the shadows of the negative, and causes the gelatine in those parts of the plate to swell; but on the portions affected by the light, and where the bichromate is decomposed, the water has no effect, and the gelatine does not swell. In the half-tones, the gelatine swells in proportion as it loses the bichromate, thus producing a relief. This relief is utilised for electrotyping, either by washing it with a solution of tannin, and then blackleading it, after which a galvano-plastic deposit is formed upon the relief in the ordinary manner, or the plate may be washed with a solution of sulphate of iron, and a mould made upon it, which will serve as a matrix for the galvano-plastic deposit. This process is good for half-tints. Printing ink may be applied to the relief directly by means of a printing roller; the unswollen gelatine *i.e.* that which was affected by the light, receives the ink, while the swollen gelatine rejects it. By these means most magnificent pictures can be printed, with all the half-tones, direct from the coating of glycerine.

CORRESPONDENCE.

IMPROVEMENTS IN THE PROCESS OF COINING.

Sir,—In your *Journal* of Friday last, Mr. E. Seyd has detailed with some accuracy my early experiments on moulds for thin, broad plates of silver; he has not yet had time to find the same kind of moulds made with a neck (closed, as he calls it), and secured by clamps, and which moulds were heated to redness by a charcoal fire, such fire being maintained while the fluid metal was poured into the moulds; they, however, exist, and the results obtained by them are recorded, and are therefore indisputable. I would observe that the planing of moulds is an unnecessary expense.—I am, &c.,

George F. Ansell,
Author of the "Royal Mint."

INDUSTRIAL PROVIDENCE FOR OLD AGE AS A NATIONAL QUESTION.

Sir,—As an old member of the Society of Arts, too old, I regret to say, to attend evening meetings, may I hope for space in your *Journal* to offer a few remarks upon Mr. Bartley's interesting paper, and the interesting discussion which followed it.

Mr. Bartley, and the speakers who took part in the discussion of his paper—even those who differed with him in other respects—were all agreed that providence or economy was indispensable, both for individual and national well-being; and the purport of Mr. Bartley's paper was to direct attention to some of the means or arrangements by which economy might be facilitated and encouraged.

The principal obstacles, as it was contended, in the present state of society, sure to obstruct, if not altogether to thwart, Mr. Bartley's well-meant schemes for the improvement of his countrymen, are (1) want of money out of which to save; and (2) want of disposition to save, or to forego present indulgence for the sake of a greater future advantage.

It cannot be denied that these two most formidable difficulties do actually, at the present time, stand in the way both of saving and of persuading others to save. But to acknowledge difficulties does not imply that we intend to succumb to them. We should rather be stimulated to meet, if possible to conquer them; otherwise, all schemes which presuppose their removal must be abandoned, or at least suspended, till that removal has been accomplished.

While we are all agreed in wishing to diminish the extent and mitigate the bitterness of the poverty which prevails among us, we must not forget that our country is one of the wealthiest, if not the most wealthy, of the earth; and wealth is the creation of industry, intelligence, and skill, and other industrial virtues, pre-eminent among which is economy. There must, therefore, be very many of the inhabitants of this country richly endowed with these good industrial qualities, while too many, alas! are sadly deficient in them. Surely, then, the duty imposed upon us is to leave no efforts untried, in order to elevate the industrially defective, and consequently poverty-stricken, to a higher level in attainments and conduct. I would on no account favour the notion that this duty is easy of performance. I believe it will prove most difficult, but not insuperable. Indeed, there is much to inspire us with hope, if not with confidence.

It is but yesterday, as it were, that public opinion seemed to awaken to a sense of its long neglect, in providing that no child shall be debarred from education. As a people, we are still groping, struggling, and wrangling how best to carry out the beneficent purpose of the legislature. Let the intelligent among us unite in aiding the legislature, not only to extend education to all, but to make sure that education shall mean instruction in the conditions of individual and national well-being, and cultivation of habits (economy among them) which will make compliance with those conditions, so indispensable for future security, an equally indispensable item in present enjoyment.—I am, &c.,

William Ellis.

6, Lancaster-terrace, Regent's-park,
5th February, 1872.

INDIAN FORESTS AND INDIAN RAILWAYS.

Sir,—In the letter which you favoured me by inserting in your *Journal* of the 22nd ultimo, on the above subject, I stated that I would reply, in the pages of your *Journal*, to the remarks made by the various gentlemen who favoured me with their views in discussing my paper, and I will do so *seriatim*, in a few short letters.

The first speaker was Mr. Charles Horne, who brought prominently to notice the many difficulties to be contended with, in the endeavour to cover the nudity of the land with its natural clothing, and he offered the following practical suggestion as a probable mode of effecting such a desirable restoration, viz:—"The offering of a small reward for the planting of trees would, he was convinced, be very beneficial. Every villager would gladly plant a few trees round his house, and these would grow to fine timber." But such has failed in Bombay, and in considering this conviction, he must permit me to refer him to his previous remark that:—"It may sound very easy to lay down 3 or 4 acres of plantation; but, speaking from his own experience in India, only a comparatively small proportion of the saplings arrive at maturity."

This same result seems very general all over India, from a variety of causes, such as an excess of moisture, or a deficiency thereof; an unsuitability of soil, locality, or aspect, a scorching heat, the absence of sufficient shade till the young plants are established, the trespassing of cattle, who trample and eat down the young shoots and leaves in the absence of sufficient pastures, or when such are parched up by heat; the baneful system of "kumri" cultivation, by firing the trees to grow crops on their ashes; and also by the wilful destruction and wholesale plunder of some ill-disposed natives themselves.

I would also point out that the subject of my paper was not the provision of natural timber, but that of firewood, as a fuel for railway and other requirements, a want which, coupled with dear transport, is causing so much distress in the Madras Presidency, to which locality I, for the present, am confining my remarks.

Now, the opinions of such gentlemen as are in a position to form a valuable conclusion upon the suggestions offered by Mr. Horne, tend to quite a contrary solution, for nearly all the collectors of the various districts of Madras are agreed as to the fact that it is hopeless to expect that private enterprise will provide a sufficiency of wood fuel to meet the present emergency, and that government must therefore take the matter in hand itself; and they assign many reasons for thinking so, among others, that there are so many more preferable modes for the investment of capital, which realises 12 per cent. on loan, and that the returns from planting trees present too deferred a prospect for men of small capital, who cannot afford to wait the requisite time for a profitable return of outlay; and, moreover, waste land has been freely offered to the general public of Madras for a protracted period, free of all assessments for 20 years, if they would only plant such with a certain number of trees per acre, and even permitting them to cultivate the land between such trees free of all charge during such 20 years of tree-culture, but without any satisfactory results. They take up, in many cases, the waste land, but do not perform the agreement as far as the growth of trees is concerned; therefore, no reliance whatever can be placed upon such a source of supply. The only way in which private enterprise could be turned to account in the provision of firewood for Madras, would be by men of large capital, or a public company, coming forward to find the requisite funds for such distant returns; but then, again, they would look for a considerable profit, and this would not cheapen fuel for the railways; neither can government grow firewood cheaply under their present system, or under their future programme, as far as I have seen it sketched out; but the railways will find to their cost that wood-fuel will be delivered to them only at enhanced prices, and that is the reason why I am so desirous that my proposals for the use of peat should be properly considered, in the interests of economy; and there is not the slightest doubt that it would provide them with a cheap locomotive fuel, and an immediate supply, which is so much needed by them.

Mr. Horne further observes that:—"It is exceedingly difficult to find a single acre of land unclaimed for settling or for plantation purposes. This is another weighty reason why the splendid peat reserves that Madras undoubtedly has should be turned to account, instead of being neglected as at present. With regard to Mr. Horne's remarks, that "it was fair to note that when the Forest Department sold rights for cutting brushwood, they were exceedingly careful that timber should not be cut," I would observe that I had not stated that the Forest Department had sold any rights whatever, and that the fact of their strictly preserving the timber would not produce a supply of firewood in any way, as they could not afford to fell valuable timber to supply fuel; it is to the brushwood itself, that Mr. Horne says they sold the right of cutting, that we must look for a supply of firewood.

I am much obliged to Mr. Horne for his different remarks, as they all so ably support the proposals I have made, towards looking for another source from which to supply the present pressing demand for fuel in the Madras presidency, in which there is plenty of peat.—I am, &c.,

A. Romaine Wragge, Lieut.-Colonel.

Old Charlton, 6th January, 1872.

P.S.—In Madras, nearly ten years ago, the system of planting trees for boundary marks of fields and holdings, in lieu of stones or earthen mounds, was tried in the Godavery and Kistna districts, and failed, for the ryots could not be induced to water or look after the young trees when first planted, and in almost every case they died. Again, another cause is the physical unsuitability of certain districts for the growth of trees. In Bellary, for instance, the government, in 1825, commenced planting topes, and a yearly allowance was granted for the purpose. The result of 28 years' operations was the rearing of 197,913 trees, at an aggregate cost (exclusive of interest) of 193,603 rupees (£19,360 6s.), the annual return being 1,908 rupees (£190 16s.), or less than one per cent! It is not surprising, therefore, that planting is not a favourite speculation in Bellary, and such a sample cannot possibly be instrumental in leading any person whatever to invest in such an undertaking, especially when you bear in mind that money on loan realises 12 per cent. in Madras. Why, then, should persons invest in topes at 1 per cent., when, moreover, they may be greatly injured in various ways, and plundered wholesale by the dishonest. It is true that many Casuarina plantations are now being formed in the neighbourhood of the town of Madras, but why is this? Simply the cupidity of individuals has been very likely excited by the present high price of fuel there, and hoping to realise a large income from it. But this sort of planting would in no way benefit the railways, so as to enable them to carry the locked up merchandise at a cheaper rate. What they require is a cheap fuel such as I have suggested; it is the only remedy, and, though it has been treated with a very prolonged neglect, it must be resorted to, after many more large sums have been recklessly squandered. A. R. W.

SUGGESTIONS FOR A RE-CONSTRUCTION OF THE THEORY OF LIGHT.

By W. Cave Thomas, Esq.

"The nature of light," says Sir John Herschel, "has always been involved in considerable doubt and mystery," and the theory, even at this present time, has not reached that ultimate result which for ever precludes suggestion. Nevertheless, in England, any attempt to clear it from its entanglements is regarded by many as profane, rash, and presumptuous. The science is under "the shadow of a great name," and must not be touched. The dispensers of scientific instruction have, it is true, in the course of a century, been reluctantly brought to tolerate an hypothesis which Newton rejected; but it has been, in many instances, accepted with as little insight as to its real bearing on the science of colour, that the language of the corpuscular hypothesis and many of the notions properly belonging to it have been transferred and incongruously grafted on the new "stock." I cannot, therefore, do better than preface these suggestions with the guarded language of Herschel, which shows that the theory of light is by no means that complete and exact science which some of the "neophytes of the gate" would have us believe. With regard to the refraction of light by the prism, which is commonly supposed to be the best understood fact in the undulatory theory, he says, "it has not been fully successful in accounting for what may be considered the chief of all optical facts, the production of colours in the ordinary refraction of light by a prism, of which the theory of Newton gives a complete and elegant explanation;" and again, "this which has often been urged in objection to it, remains still, if not quite unanswered, at least only imperfectly removed;" and, in reference to the mathematical theory of vibratory and undulatory motions in general, he states that, "it is one of the utmost intricacy, and, in spite of every exertion on the part of the most expert geometers, continues to this day to give continual occasion for fresh researches, while phenomena are continually presenting themselves which show how far we are from being able to deduce all the particulars, even of cases comparatively simple, by any direct reasoning from first principles. And we, moreover, learn from Brewster, "that difference of colour is not an infallible test of difference of refrangibility."

The theory of the harmony of colour, however, forms a complete section of the subject in itself, and its consideration is as much, if not more, the province of the painter than the physicist, and is equally, if not more, within the painter's means of experimental inquiry. It is upon this portion of the subject, therefore, that my attention has been chiefly concentrated. Much which is here set down upon other points must be considered as tentative, and because it either appeared to me to be a warrantable suggestion or a logical deduction from an accepted position.

1. Primary position of the undulatory theory. Light is a sensation produced by vibratory action. There is no matter of light.

Note.—As the ordinary modes of force are adequate to produce luminous sensations, wave action does not appear to be absolutely essential. For instance, pressure in the corner of the eye, a blow, coughing, congestion of the vessels of the eye, &c., give rise to sensation of light and colour.

Particles of light are not supposed to travel from the sun to the earth, as in the Newtonian hypothesis, but wave action, to be communicated to intervening matter by solar action, the waves producing the sensation, being the last of a series between the object and eye.

2. Waves of different periodicity produce different sensations of colour.

Note.—But it cannot, therefore, be said that every wave period produces its special sensation in the healthy eye; for it will elsewhere be shown that the same period may produce different sensations under different relative conditions.

3. Colour is not a property of the waves or undulations themselves, nor of the particles of matter undulating, nor of the external object, but a condition or affection of the sentient eye, produced or excited in the nerves by undulatory action. Light in all its phases, therefore, is only a condition of the inner being, a sensation of which the external correlate is vibratory matter.

Note.—These facts have only hitherto been recognised in a vague and slovenly way, nor have they been pushed to their logical consequences. The language in popular use upon the subject has, therefore, been very incorrect and misleading, as sensations can by no possibility be transferred from the eye to external objects; it is absurd to speak of colours being "absorbed," "reflected," "refracted," &c. But if we cannot speak of sensations being absorbed, reflected, and refracted, we may of wave action being reflected and refracted, but surely not absorbed. It may be transferred and dissipated, as other kinds of force.

Since colours are but sensations, there can be no secondary colours, except in respect of succession, and the order of succession is a matter of will. Sensations cannot be mixed. The ocular spectrum of what is commonly called a primary, is a secondary; of what is commonly called a secondary, a primary; showing that each is equally a simple and unmixed sensation, a prime. If it be affirmed that two sensations are distinguishable in a secondary, they must be distinct sensations still, or they could not be distinguished; if, on the contrary, we assume that the united action of two wave periods simply produces a sensation distinct from the other two, that must be unmixed, and a prime. "One of the most interesting facts relating to the phenomena of vision is, that the impression of different colours on corresponding identical spots of the true retina does not give rise, as a general rule, to an intermediate sensation, but one of the colours predominates in part, or in the whole extent of the field of vision, and the impression made on the other retina is only perceived in spots, where the first is wanting. Sometimes one colour predominates, sometimes the other—sometimes one is seen as a cloud on the ground of the other, or they alternately obliterate one another. If long continued, the intermediate sensation may ensue, but not for any length of time." A sensation is a state or condition of the sentient. The same part of the sentient cannot be in two different conditions of the same kind at one and the same moment. We cannot experience 50° and 20° of temperature in the same portion of our bodies at once. And we have to recollect that the modulations which produce the sensations of light are only the *avant-couriers* from some intense source of heat, those more delicate and rapidly communicated vibrations which cannot be detected by the common nerves of feeling. Still, heat and light are merely different effects on the sentient produced by one and the same cause, the difference of colour, as the difference of temperature, being a difference of degree and not of kind.

4. The sensation of whiteness, or of white light, is supposed to be produced by the simultaneous action of waves of every periodicity on the same elementary portions of the retina.

Note.—Newton thought there were seven primary colours; then it was decided that there were only three, and that these three were adequate to the production, not only of all the colours in nature, but of white light. And during this period, embracing the present time, these three primaries, with their secondaries, have been verbally muffled about as if sensations had objective existence, and we have been favoured with the edifying intelligence that three colour-sensations produce all the colours in nature. From other sources, we learn that the prismatic spectrum is produced by an infinite number of wave periods, every one of which is undecomposable, and therefore a prime. In speaking of wave action, we have to recollect that this is simply a mode of force—a certain kind of mechanical action. Now, if several forces act simultaneously on one point, the effect on that point is the result of the sum of those several forces, which are then, to all intents and purposes, one force. If waves of every periodicity occur in a right line, or in one and the same chain of particles, they could not act simultaneously at every joint in that chain. Even if it be supposed possible for waves of different periods to act simultaneously on one chain of particles without interference, they could only act in succession on the retina. What is the effect of waves of different periods acting simultaneously on a monochord? If the various periodicities which are said to constitute the sensation of white light do not act in one line upon one unbroken chain of contiguous particles, they must be communicated side by side in separate and distinct lines, as rags of force popularly conceived; in this case, the order of the grouping would have to be determined, and they could only be made to act simultaneously on one point by artificial means.

5. The study of the theory of light then naturally divides into two parts:—1st, that of the sensations of light; and 2ndly, that of the mechanical production of those sensations on the dynamics of undulatory action.

Note.—The study of the first is more easily prosecuted than that of the second, for to obtain a scientific knowledge of the former we have but to experiment upon our own eyes. This is why it was possible for the greatest colourists to exist before and independently of any physical theory being propounded; but the study of the latter, the dynamics of waves, in reference to the production of the sensations of light, has to be commenced with an assumption, and experiments to be conducted with delicate and costly instruments.

6. The physical or mechanical action of waves forming the second part of the subject, requires a more searching investigation than it has yet received, and, unfortunately, the study has hitherto been clogged by a certain vague attribution of colour to the waves themselves; but, now that the consideration of the wave is emancipate from the consideration of the sensation, we may prosecute this position of the subject as an independent study, and note how one wave may interfere with and modify another. The following, by analogy, may suggest somewhat for consideration:—"The sound of one body may, under certain conditions, excite in another insulated elastic body, not merely resonance, but also a new production of sound; the sound emitted by the body thus secondarily thrown into sonorous vibration being in this case the note peculiar to itself, and different from that produced by the body primarily affected. Stretched strings will reciprocate the sounds of other bodies by the notes for which their degree of tension fits them. For this to occur, it appears to be necessary, not merely that the sonorous body secondarily affected be very elastic and bounded by free surfaces, but also that the number of the vibrations in the note which it is adapted to yield should bear a simple numerical relation to those of the original sound. Finally, an elastic sonorous body of definite extent may, under certain conditions, even modify this pitch of the sound yielded by the body primarily thrown into sonorous vibration, the vibrating of each reciprocally influencing those of the other, so as to give rise to undulations which differ from those proper to either separately.

7. If there be no secondary or mixed sensations, every sensation is a simple, unmixed prime. It may yet be urged that there are secondary or mixed wave periods. Now, if two waves of different periodicity can really be mixed, the result can be no other than an intermediate and distinct wave period, one of that infinite series of wave periods, producing all the various sensations of the spectrum. But it is affirmed that every simple wave period producing the spectrum is undecomposable—is a prime. Now, the sensations of the spectrum include both what are called primaries and secondaries; therefore, all the secondary sensations in the spectrum are simple sensations, produced by primes, undecomposable periods. These secondaries, however, may be simulated by the combination of two different prismatic wave periods, but in this case they are again resolvable.

8. The law of compensation is essentially the same throughout the cosmos. Any kind of phenomenon fluctuating in infinite gradation between limits presents a series of terms, of which one-half is in excess, the other in defect of a mean; and there will be, for every term in excess, another in defect, the sum of which will equal the maximum limit; or, in other words, there will be a series of corresponding and compensating pairs within those limits, of which the sums, taken two and two together, will be equal. This applied to the gamut of wave periods, would imply that there is a series of periods in that gamut, which, combined two and two, would compensate one another, and produce the sensation of whiteness, or of white light, as confirmed by ocular experiment, and the series of pairs of dioptric colours producing white light in chromatic polarisation. The explanation commonly given of the ocular spectra, or accidental colours, has two bearings:—

1st. It attributes the sequent sensation, or spectrum, to insensibility of the retina to the initial sensation, and, consequently its susceptibility to the remaining and compensating constituents of white light, as that is commonly understood.*

2nd. The truth of the explanation commonly given being taken for granted, the phenomena of the ocular spectra have been regarded as confirmations of the popular conception of the constitution of white light. Now, if the first position be untenable, that conception loses what has hitherto been considered a very important testimony to its truth. Let us, then, first, consider the doctrine of insensibility, which pales before the following facts:—Insensibility in the nervous system is that state which most nearly approaches paralysis or death of the part affected, that state, in fact, in which a remedial reaction can only take place after a considerable lapse of time. When any portion of the nervous system is reduced to a state of insensibility, it is dead, as the term implies, to all sensation whatever; but instead of such a state of the retina as this, we have a counterbalancing activity in precisely the same spot, as a very precaution of nature to preserve its delicate organisation from the injury which would ensue on repeated reduction to insensibility. It is probably, too, by this rapid reaction, that the irradiation of action producing sensations of colour is prevented, and the images of objects maintained clear and well-defined upon the retina. This irradiation, under certain conditions, does sometimes occur. Although this doctrine of insensibility may appear to receive some colourable support from the fact that vivid initial sensations are succeeded by dark ocular spectra, it is totally inadequate to explain why dark initial sensations should be replaced by vivid, more luminous spectra, as the retina in this case, so far from being insensible, is evidently more susceptible and vivacious in the very same spot. The German physicists had discerned, more than twenty years since, the inadequacy of the explanation commonly offered, but without suggesting any new hypothesis. But of this remarkable liberation of contraries in the phenomena of the ocular spectra, my theory of compensation would appear to furnish a perfectly consistent and satisfactory explanation. But not only is the doctrine of insensibility fallacious, but the notion that these spectra exist elsewhere than in the sentient eye; for they may be experienced if the eyes be turned into a perfectly dark cavity, whilst they should not if the old-fashioned explanation were the true one—nay, more, are experienced if the eyes be perfectly enveloped against all external light, clearly demonstrating that this class of phenomena is entirely due to a change of condition in the part primarily affected, and not to any action from without, though external action may modify them. Therefore the phenomena of the ocular spectra in no wise tend to confirm the popular notion respecting the constitution of white light. Again, if we receive a mitigated but tolerably vivid sensation of the image of the sun on the retina, say on a misty morning, or at eventide, we shall find that an ocular spectrum, which appears dark when our eyes are turned towards the sky, will, if they be closed, appear luminous, and change to various colours, although we may open them again within a brief space of time, and find that the former appearance, the dark ocular spectrum, will re-appear, which shows, not only that the dark spectrum which obtained when our eyes were first turned towards the sky, and which is usually attributed to insensibility of the retina in that spot, becomes a vividly luminous sensation if the eyes be closed, but also that a sensation may be changed by a difference in the condition of its surroundings in the field of the retina. Analogous sensations are experienced in other affections of sense under changed relativity.

There is another fact which I have observed, and requires further notice, viz., the movement of spectra in the field of the retina.

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* We must confess this has always appeared to us a rather Hibernian mode of nature to produce greater susceptibility by insensibility. This class of phenomena, too, be it remembered, are commonly treated of as if they were external and objective.

9. Another phenomenon which may prove of importance in reconsidering the theory of light is, that we become oblivious to the general tone, or key, of the undulations which are exciting the various sensations of colour, unless a portion of the retina be affected with sensations in another tone or key. Thus, if we look for any length of time through what are commonly, but erroneously, called either green, red, blue, or other coloured media, we become, after a time, unconscious of the tone, which for the time being is a common condition, which seems to indicate that the sensation of whiteness is a consequence of a common basic proportion underlying all the wave periods. If artists paint by what is erroneously called yellow light, yellow appears white; if by blue, blue appears white; if by red, red appears white, &c. Therefore it is that a picture will never produce the impression the artist intends under other conditions than those in which it was painted, unless executed for another condition with this foreknowledge. The exact and correct statement of this fact is very difficult; it will be sufficient for the present if I have succeeded in indicating it.

10. To what extent is the periodicity of an undulation modifiable? The difference in wave periods are only proportional differences; all the wave periods, therefore, are only differentations of one species of force. This brings the constitution of the gamut of colour into closer analogy with that of music, but renders worthless many former ingenious attempts to reconcile the two harmonies, by the triads of primaries and secondaries of the old-fashioned theories.

PUBLIC ARCHITECTURE.

The *Times* has published the following letter, showing the right which the public ought to exercise in the taste of public buildings, which are always in sight, to please and educate, or to disgust and degrade:—

Sir,—Do the public and Parliament realise the fact that, at the present time, more than £2,000,000 sterling is pledged to the erection of public buildings, the architecture of which has been decided in the most absurd and hap-hazardous fashion? Never has the violation of common sense, in the determination of what our public buildings are to be, been so conspicuous as at the present time. To mention only great public buildings, arrangements are made, or being made, for building the Law Courts, the public offices in Downing-street, the National Gallery, the South Kensington Museum, the Natural History Museum, and the Post-office. The plans for the War-office and Admiralty are being considered, Heaven only knows how, or by whom.

I am not going to say anything about styles of architecture, or to express any preference for imitating Greek or Roman temples, Gothic cathedrals or castles, Renaissance palaces, or any new and eclectic mixture of all these styles; but I ask for a little space to prove the utter want of system, control, and responsibility which now prevails. The words which Mr. Gladstone used, in reply to Mr. Ayrton (*mirabile dictu*) in 1860 are still as applicable as then. There is still a "lamentable and deplorable state of our whole arrangements with regard to the management of public works. Vacillation, uncertainty, costliness, extravagance, meanness, and all the conflicting vices that could be enumerated are united in our present system. There is a total want of authority to direct and guide."

We have a First Commissioner of Works, who is sometimes in the Cabinet and sometimes not. He takes his orders from the Treasury, which by fits and starts lets him have his own way. If by chance the Chancellor of the Exchequer is a great connoisseur of architecture, or thinks himself so, then there arises a little friction between these functionaries, but the Treasury is the constitutional authority for finance, and if it goes into architecture it steps beyond its province. Theoretically, the First Commissioner for Public Works is a minister accountable directly to Parliament; he is not chosen, and ought not to be chosen, for any professional qualifications. His business is to be responsible to Parliament for the administration of a proper system. But the working of the present "no system" is to permit the First Commissioner for the time being to indulge in any whims of his own. At one one time, it may be "costliness and extravagance," as Mr. Gladstone says. He may be succeeded by a minister who acts with "vacillation and uncertainty," and then may come a minister to whom Mr. Gladstone would impute "meanness." During the reign of Lord John Manners, the public were threatened with a period of Gothic buildings. The public offices in Downing-street were designed as Gothic, and the harlequin wand of Lord Palmerston (not, by the way, First Commissioner of Works, but First Lord of the Treasury) turned them into what was intended to be Italian renaissance. The building for the University of London was actually begun as a Gothic building, and it, too, turned into an Italian one. Just the opposite occurred with Captain Fowke's designs for the Natural History Museums. He obtained, by unanimous consent, the first prize in an open competition for an Italian building. He dies; Mr. Cowper Temple, with delightful innocency, puts the execution of it into the hands of a Gothic architect. Lord John Manners re-appears in his favourite character as First Commissioner, and puts aside the design chosen by a public competition for one in a style of Gothic which it is difficult to characterise, and approved by no one but himself. Some people call the style Byzantine, and others Norman. It is said that Mr. Ayrton is going to be responsible for the execution of it, if Parliament allow him. It is supposed that the present Chancellor of the Exchequer is the architectural authority for the Law Courts, having once recommended the House of Commons to adopt the style of Inigo Jones.

Is there no cure for this? Is it beyond the administrative capacity of this country to find one? I think not. In a constitutional country like our own we cannot have any Pope in architecture; but it does not follow that we are to have public buildings inflicted upon us by such a system as I have described in the words of Mr. Gladstone. I submit that the cure can be found in the watchfulness and expression of an enlightened public opinion acting upon Parliament and the government of the day. I have shown that the responsibility of the First Commissioner of the day lasts only for a little time, and then passes on to a successor, while the administration of public buildings is continuous. Even in the administration there is no continuity of the same individuals to act. Within four years, the permanent adviser of the First Commissioner has been changed three times, and he has been an architect competing in practice with his fellow architects, an architectural author, and a Royal Engineer.

But, although the public has to pay for ugly, unscientific buildings, produced by "vacillation, uncertainty, costliness, extravagance, meanness," and to have its taste corrupted by them, the public has no real voice at all in the work. At this very moment, what does the public know of the outside of the Law Courts, which it will see daily, and future ages will have to look upon for centuries? It was at the fag-end of last session only that plans were put up in the library of the House of Commons, which jaded members would not look at. The architectural newspapers have published woodcuts. But these two modes of publication are wholly insufficient. Parliament should insist, before the elevation is commenced, upon having a model upon the same scale as Wren's model of St. Paul's. We are going to spend at least £750,000 on these courts. A proper model only can show what we are to get for our money.

At the very last possible day of last session £30,000 were voted on account of £350,000, the estimated cost of a Natural History Museum. Some half-dozen members of the House of Commons, remaining in town to pass the Appropriation Act, were just able to obtain a glimpse of the designs for this museum in the library of the House of Commons, and this is all the public know of that architectural scheme. But in this, as in a former case, a model should be made and exhibited before the structure is begun. Many thousands of pounds are being spent upon public buildings in Downing-street, of which the public has not an idea. The works at the National Gallery are a mystery.

While the internal arrangements of a public building may be determined by those who have to use it, and may be considered to come within strict official routine, the outside is a property in which every passer-by is interested. Let the First Commissioner of the day have the undivided responsibility for the economy and fitness of the inside of a public building; but as respects the outside, let him have the advice of a permanent council, whose report should be submitted to the First Commissioner, and by him laid before Parliament, with his observations. Let this permanent council consist of three architects—one named by the government, one named by the Royal Academy, and one named by the Institute of British Architects; of three artists named by the government—one a painter, one a sculptor, and one a decorative artist; together with three laymen—one being a member of the House of Lords, and another a member of the House of Commons; in all nine persons. To insure responsible attendance to the duty, let this council be paid. A very moderate proportion on an expenditure of three millions spent on public buildings, say a farthing in the pound, would amply suffice. This council would act as a jury, to give a verdict on behalf of the public, and the First Commissioner would be the judge, to adopt it or to give good reasons for refusing it.

The operation of this plan would be as follows:—The planning of the building, its adaptation to site, its cost, and its execution, would rest upon the sole responsibility of the First Commissioner of Works. He would get the plans, either through his own office, or through an architect, or by public competition. The plans, with a sufficient model, would be laid before the Permanent Council of Taste. Their report would be made and published, and the model and plans exhibited to the public. The First Commissioner would then report to the treasury, and the cost of the proposed building would be submitted to Parliament. By this means the caprices of the past ten years, with their "extravagance, vacillation, and meanness," would be prevented. Parliament would be made fully aware for what it has to vote public money, and the public would have its proper voice of authority and the means of expressing its opinion on buildings which are always to be before its eyes, to gratify or disgust them.

Sexaginta.

February 3, 1872.

NOTES ON ART.

It was expected that the late events in France would have thrown a large number of works of art into the market, and that the sales at the great auction mart of the Rue Drouot, in Paris, would have been unusually numerous and important; such, however has not been the case. There have been many sales, but not of large collections. The season is, however, yet young, and as the prices obtained at past sales have generally been good, and in some few cases very high, it is probable that a considerable number of works of art will still come under the auctioneer's hammer. In fact, the *Moniteur des Arts*, the special organ of artists and connoisseurs, contains a long list of sales for the present and coming months. The most important of these is the sale of the collections of the Brothers Péreire, which is appointed to take place on the 6th, 7th, 8th, and 9th of of March, in the Gallery of the Boulevard des Italiens, formerly the property of Lord Henry Seymour. This arrangement will allow of the whole of the pictures being exhibited at once, and for several days previous to the sale, so that connoisseurs will have unusual opportunities of judging of the works. The number of the pictures is only 181, but the quality is unusually high; MM. Péreire bought largely, and did not confine themselves to any one or more schools; they were among the most prominent purchasers at the sales of the Mecklenburg, Patureau, Rhoné, Piérard, Demidoff, Northwick, Pembroke, and other collections; they purchased also a large gallery in Spain, and many fine pictures that had belonged to the late Louis Philippe. The 181 works now about to be sold are the cream of all those purchases; the larger works from Spain and elsewhere were given to the churches and public galleries in the provinces; the less important works were sold by auction in 1868; those which are now offered to the public are the choicest of the whole, and nearly all easel pictures. In addition to the catalogue, which is published, there will appear, after the mode that has prevailed for some years in Paris, another, illustrated with about fifty etchings, by the most eminent artists in that style. The sale will commence with the modern pictures, which amount to fifty-five in number, and include, amongst other remarkable works, "The Flight into Egypt," by Decamps; "The Miracle of Saint Benoit," and "Henry IV. confiding the Regency to Marie de Médicis," after Rubens; and the portrait of a young man, after Raphael, by Eugène Delacroix; four pictures by Delaroche, including "Mary Magdalene at the House of Simon," and "Marie Antoinette after her Condemnation;" the "Pifferari at Rome," by Gérôme; "Œdipus and the Sphinx," and "Saint Symphorien" (a drawing), by Ingres; "The Flute Player" and "After Breakfast," by Meissonier; works by Léopold Robert, Robert-Fleury, Rousseau; "Flowers" and "Fruits," by Saint-Jean; "Margaret at the Fountain" and "The Convalescent Mother," by Ary Scheffer; and one of Verboeckhoven's admirable landscapes with animals. The next division includes twenty works of the French school of the eighteenth century, amongst which are three fine pictures by Boucher; a fine Claude; two by Fragonard; "The Madeleine," by Mignard; four works by Pater; and "The Youth of Bacchus," by Nicolas Poussin. Of the fifteen pictures of the Spanish school, the most important are, the "Vision of Sainte Rosalie and Sainte Rose," by Murillo; the "Infanta of Spain," by Velasquez; and "Christ on the Cross," by Moya. The works of the Italian school are only ten in number, including "Calvary," by Fra Angelico; "The Queen of Sheba at the feet of Solomon," by Tintoretto; a portrait of Léonora d'Este, by Luini; and others by Boticcelli, Caffi, Carpaccio, Diziani, and Farelli. The German school is only represented by five works, by Amberger, Dietich, Elzheimer, Mengs, and Plazer. The remaining seventy-six pictures belong to the Flemish and Dutch schools, and are of great excellence. They include three works by Berchem; a portrait of "Henrietta of England," by Vandyke; three by Holbein; as many by Mieris; four by A. Van Ostade; the portrait of Juste Lipse, by Rembrandt; "Apollo and Midias," by Rubens; five by Ruysdaël; four by Teniers, "The Temptation of St. Anthony," "The Game at Tric-trac," "The Players at Bowls," and "The Tabagie," or Smoking-room; four by the Van der Veldes; the famous "Horse Market," and two others, by Wouvermans; and many other admirable works. The Péreire sale cannot fail to attract buyers and connoisseurs from all parts of the world.

The sale is also announced, for the 19th inst., of the collection of the late Baron de Frétaigne, which only counts sixty-five works, but many of which will attract special attention in England. Amongst others, an easel picture, by Rosa Bonheur; a "View of the Seine at Rouen," by Bonnington; a collection of seven works, by Decamps; three easel pictures by Delacroix, Arab groups; eight works by Diaz; three charming gems by Meissonier, "The Two Van der Veldes," "The Young Man Reading," and "The Young Man at his Studies," with a sketch for the last named; "Medora," by Ary Scheffer; four fine examples of Trojan; and "The Malaria" and "The Cervarolles," by Hébert.

An interesting and instructive exhibition is now open at the Ecole des Beaux Arts, in Paris, consisting of the plans and drawings of the late celebrated architect, M. Félix Duban, to whom a monument is about to be raised by subscription. In addition to the more practical and technical works, the collection includes many charming studies and souvenirs of Rome, Pompeii, Athens, and a number of highly interesting drawings of portions of the old royal chateaux of France. The exhibition is a grand memorial of the genius of one architect, and presents an admirable study for others. The loss of such an artist at the present moment is a severe one to Paris, so many of whose monuments have to be rebuilt. Of these, the most important is the Hôtel de Ville, which several commissions, and subsequently the Municipal Council, have decided shall be rebuilt on the same site. Some questions of general artistic importance have arisen during the discussion; in the first place, the building which now stands in ruins was designed for a more contracted open space than that which now surrounds it, and consequently its relative importance and appearance have been diminished and dwarfed by the change. This is what often happens to old buildings, when the streets and squares around them are altered; and it is a fact too often overlooked, considering that proportion is the soul of architecture; secondly, the soil has arisen around the old edifice to the height of several feet, so that the whole requires to be raised. The total cost of reconstruction is estimated at nearly a million sterling, and the foundations and some other remaining portions, variously, £80,000 to £400,000. A commission has, therefore, been appointed to revise the latter estimates, and afterwards the Municipal Council will decide whether the edifice is to be reconstructed precisely on the former plan and site or in a modified form.

The theatre of the Porte Saint Martin is to be rebuilt, it is said, in classic style, with a grand pediment supported by eight enormous columns. A most extraordinary proposal, with respect to theatres, is made in connection with the completion of the immense new Place of the Château d'Eau. Before the construction of the new boulevards in that part of the city, there was a whole row of theatres near the spot in question. An architect now seriously proposes to erect four or five new theatres at the Place, and the Commission of Dramatic Writers, with Mr. Dumas at their head, warmly support the proposal. It is scarcely likely, however, that any Municipal Government will sanction or at any rate adopt such a plan of concentration.

The Louvre possesses from 1,200 to 1,500 pictures of the Dutch, Danish, and German schools, which, with some exceptions, have never been placed on the walls. During the late Empire a number of these works were lent to decorate the houses of ministers and officials, and in one, if not more, instances to public clubs, and for one season a number of them were exhibited in the former Salle des Etats, which is now to be devoted specially to them. This arrangement will add another important feature to the Louvre collections.

The commissioners for the Lyons Exhibition have appointed a general and an active committee for the department of Fine Arts. The former body is composed of the sculptors Guillaume, Perraud, and Barye, all members of the Institute; the painters Pils and Gérôme, of the Institute, Corot and Chintreuil; the architects Labrouste and Lefuel, of the Institute; and M. Barre, chief engraver at the mint. The acting committee consists of MM. Dubois and Falguiere, sculptors: Bonnot and Jules Lefebvre, painters; Morgan, architect; and Lagrange, engraver, the two latter having won the Grand Prix de Rome.

The Royal Academy are exhibiting a third collection of pictures by the old masters. The pictures are much fewer in number than on preceding occasions. This year, however, the Academy have had the good fortune to obtain some of the famous Hertford pictures, of which Sir Richard Wallace lends 12, and these are some of the most notable in the collection. The two large Rembrandt portrait pieces of the Burgomaster Palekan and his wife and children; the two magnificent full-lengths of Philippe le Roi and his Queen, by Vandyck; the famous Rubens landscape, with the rainbow; "The Nelly O'Brien" of Sir Joshua; a large and very fine example of Murillo, "The Charity of St. Thomas," are alone an exhibition. The Duke of Buccleuch sends 46 pictures, including many small portrait sketches in brown by Vandyck. Mr. Thomas Baring has lent the "Quentin Matsys," "The Calling of Levi," and the "Lucas Van Leyden, of his collection. Mr. Pender's fine landscape, by Turner, and Mr. Bicknell's renowned "Palestrina" are, perhaps, as splendid examples of our great painter as could be obtained. The Italian school is not very prominent, there being no very great work of Titian, and only one small but yet very beautiful work of Raphael —"The Virgin and Child," from the Duc d'Aumale's collection, which takes the place of honour in the great room between two admirable portraits by Holbein of Sir Wm. Butts and Lady Butts, belonging to Mr. W. H. Pole Carew. The Dutch school fills one whole gallery, and amongst them are some gems by Terburg, Teniers, Cuyp, and others. The English school is represented by Mulready, with his "Village Buffoon," his Academy diploma picture, and Wilkie, with his "Blind Man's Buff" and "The Penny Wedding" (from the Queen's collection at Buckingham-palace); with many very beautiful portraits by Reynolds, Gainsborough, Hogarth, Owen, and Lawrence; with some fine landscapes by Cotman, Crome, Wilson, and Constable; and Etty, with "Cleopatra," belonging to Mr. Hikman Hodgson, and the "Rape of Proserpine," from Mr. J. Gillott's collection. The Hampton-court galleries have furnished several very interesting pictures, amongst them the fine work of Paul Veronese, "The Expulsion of Heresy."

An amateur has had the good fortune to make an important discovery at Antwerp, namely, an unusually fine work by Teniers the younger, which had become covered with such a thick coating of dirt as to be almost invisible. The composition includes no less than sixty-two figures, and the execution of the picture is in the artist's best style; it is, moreover, signed, and an engraving of it has also been found with the name of the painter duly attached. The work is now on view at the Cercle Artistique of Antwerp.

The Heliotype Company are about reproducing some of the best specimens of their process in large sizes, suitable for framing. Members will remember that several of the large-sized illustrations were exhibited in the rooms of the Society on the occasion when Mr. Edwards read a paper upon the heliotype process.

The suppression of a large number of religious establishments in Italy has given the government an opportunity of adding valuable works of art to the public collections. Some fine works by Perugino and his contemporaries, and by other masters less known, have been added to the gallery of the Academy of Perugia.

Provincial exhibitions seem to largely encourage the production of works of art in Belgium. At a recent exhibition in Ghent, the amount realised for sales was nearly £7,600.

The following is taken from the *British Journal of Photography*, *apropos* of a recent visit to Paris:—"Plenty of photographs in every shop, illustrative of the wretched devastation which was visible on all sides. In a place like Paris, there was, of course, all qualities, shapes, and sizes; and, in addition to *souvenirs* of the ruined public buildings, there were to be bought a great variety purporting to be faithful representations of the events of the siege, such as barricades, executions, streets with dead bodies lying in them, and so forth. These, it is needless to say, were fictitious, carefully-arranged tableaus, but terribly natural, and greedily bought by tourists, the greater portion of whom never for one moment questioned the reality of the representation."

The Fine Arts section of the Belgian Academy of Sciences has been engaged on the consideration of a scheme by M. Gallait (the president for the appropriation of the site of the former Ministry of Justice in the Rue de la Régence, for an edifice for the proposed triennial Exhibition of Fine Arts. The commission charged with the preparation of the final plan consists of MM. Gallait, Balat, Portaels, Alvin, Ed. Fétis, Payen, Gustave de Man, G. Geefs, and Fraikin. A still more extensive project is contemplated, namely, the erection of a grand assemblage of buildings, for public ceremonials, on the "Plaine des Manœuvres"—the Belgian Champ de Mars.

It has been announced that Mr. G. Gilbert Scott proposes to read before the Royal Institute of British Architects, on April 8th, a paper "On the Albert Memorial."

The General Exhibition of Water-colour Drawings is now open at the Dudley-gallery, Egyptian-hall, Piccadilly.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

February 14th.—"On the Study of Economic Botany, and its Claims Educationally and Commercially Considered." By James Collins, Esq., F.B.S. Edin., Curator of the Museum of the Pharmaceutical Society of Great Britain. On this evening, Maxwell T. Masters, M.D., F.R.S., will preside.

February 21st.—"On Prison Labour, as an Instrument of Punishment, Profit, and Reformation." By F. J. Mouat, Esq., M.D., late Inspector-General of Prisons in Bengal.

February 28th.—

March 6th.—"On the *Goliath* Training Ship." By Capt. Bourchier, R.N.

March 13th.—"On the British Trade with France during the last Ten Years, in its relation to the General Trade of the United Kingdom." By Leone Levi, Esq., Professor of the Principles of Commerce and Commercial Law in King's College, London.

March 20th.—"Notes from a Diamond Tour through South Africa." By Thomas Wm. Tobin, Esq.

March 27th.—*Passion Week.*

INDIA CONFERENCES.

February 23rd.—"On India as a Field for Private Enterprise." The Conference will be opened by Frederick Campbell, Esq., of Assam.

CANTOR LECTURES.

The First Lecture, on "Mechanism," by the Rev. Arthur Rigg, M.A., was delivered on Monday evening, February 5th. The remaining lectures will be given as follows:—

SYLLABUS.

Lecture II.—Monday, 12th February, 1872.

Motions produced by Rolling—Forms of Wheels—Circular, Elliptic, Logarithmic, and Lobe Wheels—Mangle Wheels—Star Wheels—Examples.

Lecture III.—Monday, 19th February, 1872.

Motions produced by Sliding—Forms of Teeth on Wheels—Teeth for Velocity—Teeth for Power—Cams—Screws—Worm Wheels—Examples.

Lecture IV.—Monday, 26th February, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies—Cam Pullies—Shafts not parallel—High Velocity Cords—Fusees—Illustrations.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links—Cranks—Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. Arthur Rigg, "On Mechanism."
London Institution, 4. Professor Odling, "Elementary Chemistry."
Royal Geographical, 8½. 1. Letters from Sir Samuel Baker. 2. Capt. Blakiston's Journey round the Island of Yeddo, with comments by Sir Harry Parkes.
Institute of Surveyors, 8. Discussion on Mr. E. J. Smith's Paper, "Land."
Medical, 8.

Tues.....Civil Engineers, 8. Mr. Bradford Leslie, "Account of the Bridge over the Gorai River on the Goalundo Extension of the Eastern Bengal Railway."
Photographic, 8. Annual Meeting.
Royal Institution, 3. Dr. W. Rutherford, "On the Circulatory and Nervous Systems."

Wed.....**SOCIETY OF ARTS, 8.** Mr. J. Collins, "On the Study of Economic Botany, and its Claims Educationally and Commercially Considered."
Graphic, 8.
Royal Literary Fund, 3.
Science and Art Department (South Kensington Museum), 2½. Professor Guthrie, "Elementary Physics and Chemistry."

Thurs...London Institution, 7½.
Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Dr. Murie, "On the Habits, Structure, &c., of the Three-banded Armadillo." 2. Mr. A. Müller, "On a Chinese Artichoke-gall." 3. Mr. W. F. Kirby, "Comparative Geographical Distribution of Butterflies and Birds."
Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."
Society for Encouragement of Fine Arts. Second Conversazione of the Session, at the New Flemish Gallery, St. James's-street.
Chemical, 8.
Numismatic, 7.
Royal Society Club, 6.

Fri.......Philological, 8¼.
Royal Institution, 9. Dr. Gladstone, "On the Crystallization of Silver and other Metals."

Sat.......Royal Institution, 3. Mr. Wm. B. Donne, "On the Theatre in Shakespeare's Time."
Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."

Journal of the Society of Arts.

No. 1,004. Vol. XX.

FRIDAY, FEBRUARY 16, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

MOSCOW POLYTECHNIC EXHIBITION.

The Committee met on Thursday, at two o'clock. Present—Messrs. Andrew Cassels (in the chair), Andrew Murray, Hyde Clarke, Edwin Lawrence, Donald Nicoll, Gabriel Komensky, Frank Buckland. The Committee was attended by M. Victor Della Vos, Conseiller d'Etat, Directeur de l'Ecole Impériale Technique at Moscow, who is visiting this country on business of the Exhibition.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

TENTH ORDINARY MEETING.

Wednesday, February 14, 1872; MAXWELL T. MASTERS, Esq., M.D., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Benson, Henry, 50, Aldermanbury, E.C.
Boyd, William S., 13, Moorgate-street, E.C.
Brock, C. T., 3, Percy-terrace, Nunhead.
Brooks, Herbert, St. Peter's-chambers, Cornhill, E.C.
Budget, H. H., 5, Monument-yard, E.C.
Bullock, George, 2, Holland-park, W.
Donnatt, George, the Circus.
Danberry, Henry, 67, Gloucester-street, Pimlico, S.W.
Eaton, William M., 16, Prince's-gate, S.W.
Emmens, Stephens H., Church of England Assurance Institute, King-street, Cheapside, E.C.
Evans, Oliver, Broom-hall, Carmarthenshire.
Hartmount, Edward Hergberg, 8, Great Winchester-street-buildings, E.C.
Head, Albert A., Albion-road, Stoke Newington, N.
Herron, George R., 163, Bermondsey-street, S.E.
Horniman, Frederick John, Surrey-house, Forest-hill, S.E.
Macleod, William, M.D., Ben Rhyddring, near Leeds.
Muir, H. B., 19, Leadenhall-street, E.C.
Schlesinger, Dr. Maximilian, 25, Upper Bedford-street, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Crawford, Tyson, Messrs. Dollond and Co., 1, Ludgate-hill, E.C.
Davison, T. F., 80, Newgate-street, E.C.
Dipnall, James F. T., Beckenham, Kent.
Dow, Patrick C., 39, Lime-street, E.C.
Erlanger, the Baron, 43, Lothbury, E.C.
Evered, R. B., 28, Drury-lane, W.C, and Surrey Works, Smethwick, near Birmingham.
Gibbons, George, 9, Southwark-street, Borough, S.E.
Harris, Rev. J. C. Lloyd, Billinghurst, Sussex.
Hopkins, Henry, 42, Houndsditch, E.
Isaacs, Henry A., 60, Fenchurch-street, E.C.
McLeod, Sir Donald Friell, Bart., K.C.S.I., C.B., 1, Clarendon-road, Victoria-road, Kensington, W.
Malam, William, Langley-villa, Forest-hill, S.E.
Mills, Charles H., M.P., 67, Lombard-street, E.C.
Mitchell, Benjamin, 8, Dacre-park, Lee, Kent, S.E.
Nicholls, H. F., Mayor of Bridgwater.
Norwood, C. M., M.P., 21, Billiter-street, E.C.
Pease, Charles, Darlington.
Talbert, B. J., 11, Argyle-street, Regent-street, W.

AND AS HONORARY CORRESPONDING MEMBER.

Delondre, Augustin, Rue des Juifs, 20, Paris.

The paper read was:—

ON THE STUDY OF ECONOMIC BOTANY, AND ITS CLAIMS EDUCATIONALLY AND COMMERCIALLY CONSIDERED.

By James Collins, F.B.S. Edin.

Honorary Corresponding Member of the Société de Pharmacie of Paris, &c., Curator of the Museum of the Pharmaceutical Society of Great Britain.

The subject of economic botany is one of very great importance. Its practical utility, forming as it does no mean portion of the very groundwork and foundation of commerce and manufactures, and, therefore, of national prosperity, apart from the many interesting features which appertain to its study, is sufficient excuse for my bringing it before your notice this evening. The subject, too, is of such large extent, and its different points so varied, each seeming to demand a separate hearing, that I feel compelled to throw myself on your kind indulgence—an indulgence which, I am fully aware, you are ever ready to show. It is not my intention this evening to dilate on the importance of economic botany, which must be evident to all present, but rather, taking for granted that its importance will be conceded, to dwell on the necessity which exists for a more widely disseminated knowledge of it. If we look around us, we cannot help acknowledging how, for our food, our clothing, our very existence, we are dependent on the vegetable kingdom. Without it, man could not exist, and before the earth was fit for his abode, an All-wise Creator made the "earth bring forth grass, the herb yielding seed, and the tree yielding fruit after his kind;" and from the period when man received his first lesson in economic botany—"Behold I have given you every herb bearing seed, which is upon the face of all the earth, and every tree in which is the fruit of a tree yielding seed, to you it shall be meat"—this dependence has continued. In fact, to attempt to dwell on our dependence on the vegetable kingdom would be dealing with the veriest truisms, and would be a task even more hopeless than that essayed by the quaint Bernard Palissy, in attempting to describe our dependence on wood, a task which he gave up in despair, saying:—"I have divers times thought to set down the arts which shall perish when there shall be no more wood, but when I had written down a great number, I did perceive that there could be no end to my writing, and having diligently considered it, I found that there was not any which could be followed without wood. . . . . . And truly I could well allege to thee a thousand reasons, but tis so cheap a philosophy that the very chamber-wenches, if they do but think, may see that without wood it is not possible to exercise any manner of human art or cunning."

The science of botany embraces every fact which has reference to plants, either living or dead. For convenience of study, it is subdivided into several departments, each of which is so large as to require from the student undivided attention and great concentration of energy before he can become thoroughly conversant with it. We may, for our present purpose, thus classify them. First, we have organological, or structural botany, which treats of the internal and external structure of the various parts or organs of a plant, without reference to its life; second, physiological botany, which treats of the life of a plant and the functions of its various organs; third, systematic botany, which treats of the relations of plants to each other, and their arrangement or classification, according to affinity; fourth, palæontological, or fossil botany, or the distribution of plants in time; fifth, geographical botany, or the distribution of plants in space; and, last, though not least, economic or applied botany, or the use of plants and their application to the economy of life. This latter may be subdivided into (A) that which interests itself in living plants, viz., 1, agricultural, or field culture; 2, horticultural, or garden culture; and 3, arboricultural, or tree or forest culture: and (B) of the utilisation of plants in 1, food; 2, medicine; and 3, manufactures. It is to the latter division we shall principally confine our remarks. First, then, I refer to its educational aspects.

The study of economic botany, or, at least, the medical portion of it, enters as a part, and a very necessary part, into the curriculum of medical and pharmaceutical students, especially of the latter. I have used the words "very necessary," advisedly, as I may be reminded of the opinion of an eminent professor, one who is deservedly looked up to as an authority in all that pertains to natural history, as to the value of a knowledge of *materia medica* to medical students. He has expressed himself that such knowledge is as much good to medical students as "making them belong to the Iron and Steel Institute and learn something about cutlery because he uses knives." But I venture to think that the comparison does not hold good. A student knows that it is steel he is using, and does not need to be taught the difference between such a substance and, say, a linen bandage, neither is he likely ever to mistake the one for the other. A medical man depends largely for his medicines upon the pharmaceutist, by whom they are prepared with a greater amount of skill than he could bring to bear; yet, apart from all considerations of a liberal professional training, it is highly necessary that he should know something of the history of the drugs which he administers; for instance, he should know the difference between cusparia and nux vomica barks, or between horseradish and aconite roots, and be able to discern between the true and the false, the pure and the adulterated; moreover, he should be prepared to act for himself in the absence of assistance from a pharmaceutist. If such very necessary knowledge were, as a rule, wanting—which, happily, is far from being the case—at least one part of the French wit's definition of a medical man, as one who pours medicine, of which he knows little, into a system of which he knows less, would certainly be correct. And we may here remark that by far the largest, most valuable, and accurate portion of our knowledge of economic botany is due to the labours of those whose professions have required some acquaintance with the subject, the pursuit being of such interest that the acquirement of even a modicum of knowledge, for purposes of examination, proves an incentive to its further study.

The teaching of economic botany in schools I look upon as of the highest importance. The object of teaching is to supply knowledge that shall enable the recipient to take his or her place in the world's great workshop with credit and success; to be fit for the counting-house, the market, the shop, or the home, either in this country or abroad. It is a well-recognised fact that it is not sufficient to teach the "three R's," but that it is necessary also to call forth and train the thinking powers, and develop the faculty of observation. "Sight," it has been truly observed, "is a faculty, seeing an art." Like a mirror, the eye reflects an object, but unless some knowledge or conception of the object be possessed, like a mirror, it, too, is insensible, for "death lives where power lives unused."

> "In the material eye, you think, sight lodgeth.
> The eye is but an organ. Seeing streameth
> From the soul's inmost depths. The fine perceptive
> Nerve springeth from the brain's mysterious workshop."

Often is the phrase, the "dull routine of commercial life" used, and truly it is so, if the various substances which pass under notice have their only meaning in pounds, shillings, and pence. But how different is the case if the worker knows something of the source, the history, and the associations of these same substances. How different is the interest shown in the carrying out of the daily duty, and how much more valuable does such service become. On the Continent, trade education is well looked to by the respective governments, and books are published with the specific object of enlightening the future merchant or artisan on the characters and properties of the substances which he will have to trade in or manipulate, for it is well understood that the well-being of a country at large is affected for better or for worse as the rate of diffusion of such knowledge is greater or less. As Dr. Yeates justly observes, in his preface to the "Natural History of Commerce":—"The complaint is now general that this knowledge is less frequently met with amongst us than it should be, while our Continental neighbours are so sensible of its advantages that they are providing it liberally for every man, woman, and child within their reach. They feel that it is in itself property and the prolific source of wealth. They see that it cannot be carried off by an enemy, or paralysed by a panic. They find that it costs nothing to defend or to insure; that it is not merely a circulating commodity, yielding a single profit to its professor, but rather a fixed and constantly productive capital." And speaking of the technical schools of Leipzig, Antwerp, Berlin, and Amsterdam, he says:—"In them the future Dutch or German merchant is taught to look beyond the limits of the Zollverein, and to regard the world at large as a vast storehouse, with the contents of which he must make himself familiar. At school he studies the sources of supply for the goods he must hereafter deal in. A counting-house, he is told, is a place in which he will be expected to use his knowledge, and not to seek it. He is first made acquainted with the laws and conditions of soil and climate, and then brought into contact with specimens of produce from the different kingdoms of nature; these he is required to examine and describe methodically."

I am very glad to find that this Society, ever ready as it is to give its aid to the improvement of commerce, proposes holding examinations in the science and technology of the various arts and manufactures of this country. It is assuredly a step in the right direction, and cannot but prove highly beneficial. What interest will such school teaching impart to every-day life, and to the various products which meet the scholar's eye! Well do I remember when, as a pupil-teacher, I tried to teach my class geography, other than in the parrot-like manner of repeating the names of various places, by weaving the lessons into a narrative of voyage or travel, describing the people, their customs, the products of the country, and so forth. The experiments, though crude, thoroughly repaid the pains taken, as shown by the great amount of attention given, and the progress made. And in this manner how much additional interest can be thrown into lessons in which products are mentioned, such as of

> "The various treasures of the Indian strand—
> The fragrant cinnamon, the glowing clove,

> And all the riches of the spicy grove;
> Of drugs of power the fever's rage to bound,
> And give soft languor to the gaping wound."

Even that dread implement of castigation, the fear of evil-doers, gets more respected when something is known of its history. In a dusty schoolroom in Hanover, some years ago, might have been seen a knot of boys, discussing how they might rid themselves of the "magisterial sceptre," the meanwhile converting the hateful canes into a source of amusement, by cutting and smoking them as impromptu cigars. Thinking that the canes were a kind of willow, they made up their minds to find the source, and extirpate the baneful plant. Seeing a waggon-load passing through the town, they followed, and asked the owner their origin. But his answer dashed their fond project to the ground, for he told them that the canes were brought from the East Indies, and that the supply was unlimited. Encyclopædias confirmed the unwelcome news. Foremost amongst the boys, at least in the search for information, was one who, in later years, beside proving himself one of our best botanical explorers, wrote a history of this class of plants, of which Humboldt expressed a high opinion. I refer to Dr. Seemann,* who was our chairman when I had last the honour of addressing you.

Professor Wilson, speaking of the necessity of such knowledge being taught in schools, in order to the better fitting for the battle of life, says:—"We go forth in hundreds every year to seek, as we say, our fortunes, as if the seeking was all on our side, and we should know Fortune if we saw her. And it may be, that all the while our fortune, like a lost bride, is seeking us, and too often, like Gabriel and Evangeline in Longfellow's sad story, we pass each other in the dark, and, all unconscious of the fact, bid farewell for ever.

"How many of our young men who visit foreign countries, bent on commercial enterprise, could tell whether the exudation from a tree was a gum, a sugar, a manna, a resin, a gum-resin, a camphor, a caoutchouc, or a gutta-percha; whether a particular tree would yield oil or not, or fibres suitable for fabrics, rope, and paper; whether a wood was soft or hard, lasting or destructible."

The result of such teaching is easy to anticipate. In the counting-house, in the market, and in the workshop, at home, and abroad, we should have intelligent workers, whose knowledge, beside engendering and strengthening a love for their calling, without which success is impossible, would be found in numberless ways to prove itself useful, and thus contribute in no slight degree to success, and raising up a band of observers who would be constantly on the watch for improving or extending our present supplies of raw material, and be capable of forming an approximate estimate of the value of the various substances coming for the first time under their notice.

It would be well, perhaps, just to indicate the meaning I wish to convey when I speak of teaching this subject in schools. I would not have it taught to the exclusion of other equally important subjects. The following is an example—which, in the carrying out, might be modified to suit the requirements of the case—of the manner in which such lessons could be given.

I would devote in each week two or three hours, more or less, according to the progress made in other subjects, to elementary lessons on the best known and most commonly used vegetable products. I would preface such a course by a few lessons on the various parts of plants and their structure, so that the scholar might know the relation of a product to the plant producing it. This should be copiously illustrated by specimens of common field plants, which the scholars would take pleasure in collecting, by specimens of vegetable products, and by the free use of the black-board. The necessity for well and judiciously illustrating every lesson should not be lost sight of. This done, the vegetable products themselves should be dealt with in simple natural groups, such as substances used as food, fibres, dyes, and so forth. A strictly scientific grouping of the substances, in natural orders, must not be thought of for such a purpose, as the association and comparison of analogous substances would be lost sight of. As an exercise, and as a means of more thoroughly fixing the lesson in their minds, and also as giving the teacher an opportunity of correcting any wrong ideas, the scholars should be required to reproduce from memory the various facts brought before them.

But I am fully aware that there are two great difficulties in the way of the teacher in this matter, namely, the want of good text-books, and of specimens to illustrate the lessons. The literature of economic botany, unfortunately, is of a very scattered character, information having to be looked for in odd and out of the way places. At the present time there is no good single book for teachers, nor one which could be put into the hands of scholars. On economic plants, especially those used in medicine, information of the highest and most trustworthy character may be found in Pereira's or Royle's "Materia Medica." Lindley's "Flora Medica," and the same author's "Medical and Economic Botany," contain botanical descriptions only. But all of these are too special, and contain descriptions of many substances which, though to the economic botanist of very high interest, yet are not required in a text-book for general use.

Dr. Yeates's "Natural History of Commerce," part of which is devoted to economic botany, is the most useful and best book we have for school and general purposes. None of these, however, come up to my idea of what such a text-book on economic botany should be. Still, however, in the books I have mentioned, and some few others, the teacher will find information sufficient to enable him to give excellent object lessons.

The procuring of specimens, however, is of much greater difficulty; yet, by a moderate amount of perseverance on the part of the teacher, it can be overcome. I am not acquainted with any published sets of specimens adapted for teaching purposes, and the teacher is thrown, to a great extent, on his own exertions in procuring them. It is absolutely necessary that the teacher should be able to show his scholars the raw products which form the subjects of his lessons. But most, if not all the specimens required by the teacher for elementary lessons are procurable from grocers, druggists, and others, for a few pence each, and the scholars themselves would gladly contribute specimens for such a purpose. Such a collection, together with some articles manufactured from them, could be placed in a case or drawers, where they could be seen, and would greatly add to the interest of the schoolroom. This could all be carried out at a very little expense. The cost of the specimens themselves would be small, and they need not, except in the case of liquids, be kept in glass bottles, the primary cost of which, together with that of replacing frequent breakages, might be a serious consideration. Strong cardboard, or, better still, wooden trays or boxes, answer very well. If the expense be not objected to, a nest of small drawers, of about nine inches long, four inches wide, and two inches deep, would prove admirable, and, if well made, would stand any amount of legitimate wear and tear. In the Pharmaceutical Society's Museum, we have specimens in such drawers, which allow of the students thoroughly examining them; the drawers have stood an enormous amount of wear and tear, and the arrangement is highly appreciated by the students. The specimens should be carefully labelled with the common and best known name, their use and their habitat specified, and, if thought fit, the scientific name also; but a scientific name on such a label should not be too prominent, and certainly should

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[illegible] writing the above remarks, the sorrowful news has been [illegible] m Nicaragua that Dr. Seemann has died from the effects of a [illegible] r. Botany has thus lost one of her best workers, and economic [illegible] y [illegible] of her best advocates. And I would record my humble [illegible] Dr. Seemann's love of science, genial good fellow-[illegible], and gentlemanly qualities.

not be given to the exclusion of the common one. Scientific names are absolutely necessary in fixing specifically individual plants. The same combination of generic and specific names cannot be used for more than one species, while common names are very loosely applied; yet, as it requires almost an apprenticeship to fix scientific names in one's memory, it would be too great a burden for most scholars. Of course, this remark must not be taken as indicating a want of appreciation of scientific names; I am only considering the requirements of the elementary schools, and am anxious to remove every possible difficulty. Good coloured diagrams, with bold outlines of the most prominent plants, could be drawn by the teacher or scholars. Before long, I trust that cheap cabinets of specimens for teaching purposes will be purchasable at reasonable prices. After the passing of the Pharmacy Act of 1868, by which law every intending pharmaceutist is obliged to undergo examination, a great need of cheap portable collections of *materia medica* was felt. Two or three firms undertook to remove this difficulty, by making up sets of such specimens, and selling them at as low a price as possible. One of these firms, Messrs. Evans, Lescher, and Evans, of Bartholomew-close, have very kindly, at my request, specially prepared two of their collections, modified somewhat for general use. These are lying on the table. The medicinal preparations are left out, and other substances could easily be added.

Happily for this country, we have at Kew one of the finest and most complete museums of economic botany in Europe, which, it is not too much to say, is the object of unqualified admiration from all who are judges in these matters. We are indebted for it to the exertions of the late Sir William Hooker, and the present Dr. Hooker, C.B.; and if ever a society of economic botanists should be formed, no more appropriate name could be found for it than that of "The Hookerian Society." But this by the way. I mention the Kew Museum here simply to direct the attention of teachers to it, as one of the finest aids and supplements to their teaching. No better holiday, as regards health and enjoyment, and no pleasanter way of communicating information than, if the distance is not too great, to take their scholars to Kew. It could even be held out as an inducement to general good behaviour and progress in the study I am advocating. The catalogue of the museum and gardens is full of information.

Unfortunately, from various causes, the fact that museums should be, and if rightly managed are, powerful instruments of education, is lost sight of. The teaching capabilities of a good museum are very great, but they have, till recently, been looked upon as receptacles for curiosities. Frequently it has happened that, when a person has had anything which has been out of the common, or could better employ the space such things occupied, he has sent it off to a museum, without any consideration as to its fitness. And thus museums have been looked upon almost in the light of a showman's collection, of which it may be said—

> "Monsters of all sorts here are seen,
>   Strange things in nature, as they grew so.
> Some relics of the Sheba Queen
>   And fragments of the famed Bob Crusoe."

One of the very best speeches I have ever met with on the subject of the proper use of museums is one by Sir Bartle Frere, given at the opening of the Bombay Museum in 1862. I quote the following:—

"Let us remember this museum is designed to be no mere collection of rarities and curiosities, at which crowds may gaze in vacant and resultless astonishment; you have purposed that it shall be a great engine of education,—in the words which you have so aptly quoted from the great lawgiver of scientific research, a 'College of Inquiry,' as distinguished from a 'College of Reading.' Here, as in a microcosm, you will collect specimens of whatever in art or nature ministers to man's wants or occupies man's thoughts. The student will here read, not through the imperfect medium of language, but in the products themselves visibly placed before him, the history, so far as human eye can trace it, of each wondrous process and product of nature. He will here trace, step by step, how the intellect of man, in various ages and in various countries, has turned those processes and products to human use, and how art has striven to impart to the result of her labour somewhat of that Divine image of those more than human characteristics of beauty, variety, perfection, and adaptation, for which the rudest of mankind ever yearn, and which the most civilised never fully attain to."

Local museums, when properly conducted, are of great use, but no such museum is complete unless economic botany is fairly represented.

In concluding my remarks on the educational aspect of the question, I would say that not only should the subject be taught in our elementary schools, but also in all educational establishments, in our universities and colleges, and that greater facilities should be given, by series of lectures and other means, for the acquisition of some knowledge of this subject by the masses.

We next pass to the claims which economic botany has on the attention of the commercial world. At least half of our commerce consists in the gathering in and sending forth again raw and finished materials derived from the vegetable kingdom. The claims of economic botany, therefore, rest not only on the fact that a knowledge of these products would give additional interest to every-day life, but upon the other fact, that if a more systematic attention were paid to the subject, the result would be largely beneficial to commerce. There is, however, a great absence of information amongst those engaged in commerce, concerning the very products on which their fortunes are built. All who have ever had any experience in endeavouring to ascertain the history of any substance, know full well the difficulty. Let me not, however, omit here to do full justice to the willingness with which all possible information is given. I have never yet gone to any merchant or broker, who has not evinced the utmost readiness to afford me every assistance in any inquiry. And yet the fact remains, and what I would endeavour to urge on the attention of all concerned is, that the possession of even the rudiments of a knowledge of economic botany is as necessary and as valuable as that of any other branch of knowledge which is deemed at present essential; and that no one should enter, either as master or servant, into commercial life, where vegetable products form the articles of trade, without some knowledge of them, and the greater the amount the better.

There are many duties inseparable from the calling of a merchant besides that of making money, which is the mainspring and end of all commercial enterprise. The merchant has to gather from the ends of the earth the workable materials required for the sustentation of our arts and manufactures; also to send forth the finished products, for the preparation of which the most perfect mechanism and the highest scientific knowledge has been brought to bear. In this, whilst seeking his own ends, he has necessarily, and possibly unconsciously, acted as a great civiliser of the world. But he should not be content with receiving hap-hazard what others send—he should use his best endeavours to extend and improve existing sources of supply, and to open up new ones. The mainstay of commerce, and the existence and onward march of civilisation, is bound up with the exchange of workable materials. The merchant procures from a country substances which are produced, either spontaneously or by cultivation, in quantities above and beyond that required for home consumption—which, but for their capability of utilisation elsewhere, would be so much waste and useless material—and carries them to another country where a want of them exists. By this exchange, the superabundance in the one country is made to supply the scarcity in the other, and thus he acts as a great civilising agent by promoting commercia intercourse. What a state of living death would the world be in if each country, within its own area, satisfied all the wants, natural or acquired, of its inhabitants. If, for instance, Captain Cook's statement that, "if an inhabitant of the South Sea has planted ten bread-fruit trees during his life, he has fulfilled his duty to his family as completely as a farmer amongst us who has every year ploughed and sown, reaped and threshed; nay, he has not only provided bread for his own lifetime, but left his children a capital in the trees," was universally true.

In fact, in such a state of affairs commerce could not exist, for, as Cowper has beautifully put it:—

> "The band of commerce was designed,
> T'associate all branches of mankind;
> And if a boundless plenty be the robe.
> Trade is the golden girdle of the globe.
> Wise to promote whatever ends he means,
> God opens fruitful nature's various scenes.
> Each clime needs what other climes produce,
> And offers something to the general use;
> No land but listens to the common call,
> And, in return, receives supplies from all.
> This genial intercourse, and mutual aid,
> Cheers what were else an universal shade."

Let us for a few minutes direct our attention to the two duties of a merchant—those of extending and improving present and opening up fresh sources of supply. No systematic efforts are made by our merchants, as a whole, to search the earth for its treasures. There are, happily, a few, though very few exceptions to this rule. "The noblest and vilest of substances. gold and guano," as Professor Wilson well expressed it, "are stumbled upon hap-hazard. With a kind of mad patience, we go, year after year, to the same source for products, without trying to ascertain if they are present elsewhere, and we are daring and reckless enough unceasingly to scour strange lands and seas. But of what avail is all this, if we only guess at the value of the strange objects we encounter, without a thought about taking action to ascertain its possible utility?" What a gain to the world is a new land carefully explored, and its products prominently brought to notice! Many new lands are looked upon in the same light in which the whole of Africa was formerly, as—

> "Barren sand,
> Where nought can grow, because it raineth not;
> And where no rain can fall to bless the land,
> Because nought grows there."

But a mere glance at the "Flora of Tropical Africa," now publishing, reveals such floral riches as to require no prophetic foresight to predict for it a great commercial future.

In exploring new lands, sufficient attention is not paid to this question. The chief aim of exploration is the increase of geographical knowledge; but every science should have a present and direct, though it always has a future and indirect, practical end, that of bringing the new lands within the pale and under the beneficial influences of civilisation. Every such explorer is a pioneer of commerce. But how much sooner would such a result be brought about if the traveller always used his best efforts to collect all the information respecting products and specimens of the products themselves on every possible occasion, and thus hastened the practical results of his toils and hardships. On all our exploring expeditions, there should be an economic botanist appointed, to give his special attention to this very important practical inquiry. But it is frequently thought sufficient to collect strange objects, and little thought is given to those objects which are likely to prove of practical value. This assuredly should not be.

Residents abroad can be made the means of no end of good. Often at their very doors are materials in great abundance, which could be utilised in our own country if the requisite knowledge existed to rightly direct inquiries. But it often happens that, where products are sent home, for lack of proper information accompanying them, no result is achieved. How different it would be if that same correspondent had received a preliminary training, even of an elementary character. But much of this would be remedied if proper instructions were sent out. Often, when appeals for information to residents or intended residents in a foreign country are made, the answer is, "Give me instructions what to look for, and what kinds of samples should be sent." In the case of one product alone, namely, india-rubber, to which I have paid much attention, I have frequently been appealed to for instructions as to what kind of specimens should be collected, and how collected; and at the request of Mr. Silver, who takes a warm interest in everything, both scientifically and commercially, connected with the subject, I wrote a series of instructions purposely for his correspondents abroad. But such things require to be done systematically, and on a large scale. Much good would accrue to commerce if general instructions, or instructions drawn up to suit each country, were printed and circulated amongst our consuls and other public and private individuals abroad.

Every one who has had opportunities for observing the commerce of this country, must have noticed from time to time various substances, forwarded by sanguine collectors or merchants, who perchance have seen the substance used by the natives of the place, or observed that it existed in great abundance, the object being to ascertain if they were of any use, or, as it is termed, to "try the market." But amid the press of other business, yielding a certain present money value, or in the presence of powerful rivals, in the face of which it may or may not be of value, it is almost impossible to obtain any recognition, and is speedily lost sight of and forgotten—a result enough to damp the ardour of most persons. There are many points which have to be considered in sending a new substance, and have to be provided for before success can be obtained. Some substances may be useful, and in great abundance, but they would cost more than their value to bring them to a market. Others, again, are of sufficient value to more than repay the cost of transport from a foreign port to this country, but from the absence of carriage, and the dearth or absence of labour, they cannot be utilised. Many valuable timber trees labour under this disadvantage. Efforts should be made in such cases to remove, if possible, these drawbacks, by placing such substances under conditions more favourable. Even where there is no difficulty in the transport, and no dearth of natives, the greatest difficulty is experienced in getting the natives to stir an inch, or undertake any labour, unless their own sweet will inclines them, or their wants, often more artificial than natural, impel them. It is almost a proverb amongst traders that wants, or even vices, have to be created, in order to furnish incentives to labour beyond that required in order to obtain the few yards of European cloth which they covet, to substitute for that of their own manufacture, or that the produce and shade of their own vine and fig-tree supply them with. Other substances, again, are sent, for which there is no immediate or present demand; and though they may be better suited for a purpose than one in use, yet the difficulty of establishing a new trade, and bringing about a substitution. is so great with a people so conservative and strongly prejudiced as we are, that rarely does the original importer meet with anything but loss. Deficiency of information, however, does more than anything else to injure and retard the introduction of a new substance. The difficulty of obtaining information respecting a new substance is very great. Often the only information sent amounts to this, "is it good for anything?" and the specimen itself has been selected with such an absence of judgment, and is often of so fragmentary a character, that to attempt to ascertain its source is almost as hopeless a task as endeavouring to find out a person's name by a lock of his hair. In sending economic products, dried specimens of a branch of the plants producing them, with the leaves, flowers, and fruit attached, also specimens of the bark and wood, also specimens of the leaves, flowers, and fruit, preserved in spirit, should be forwarded. And these specimens, together with the product, should all be obtained from the same identical plant. This is especially necessary when the product is a gum or other substance having no organic structure. Great care should be taken to append the correct vernacular names, as vernacular names properly applied are of material assistance in the recognition of the substance. Vernacular names, however, though they are undoubtedly the economic botanist's best friend, yet, if great care is not taken, prove a constant source of error. A name belonging to one substance is often applied to others, from a real or fancied resemblance, or from ignorance. This is especially the case in colonies. A person leaves his native country to make his home in another, and carries with him the old scenes and associations vividly impressed on his memory, and to perpetuate them he names the plants around him after those of his native heaths and hedge-rows, making a plant do duty for his native violet, however far removed it may be in other respects. But let not my remarks be taken in depreciation of vernacular names; I value them highly, as my words elsewhere will show;* but what I wish to insist on here is that great care should be taken in bestowing them accurately, and that it is not sufficient to find the vernacular name of a product in connection with a botanical name of the plant in any work, to establish the identity; that, in short, they are but a means to an end, not the end of inquiry itself.

The geographical source of a product should always be accurately indicated. Even at the present time the localities where some of our utilised substances are obtained are only guessed at, and this arises from various causes. Many of the ports of shipment—Singapore may be taken as a good illustration—are only entrepôts for neighbouring districts or countries, and a product may, before it arrives there, have been brought a long distance from the interior, or by native craft from another country. Or, again, a ship may call at several ports, and only be "entered" here as from the last port she quitted; or she may break bulk from some cause, or the article may only be a re-shipment. I remember an amusing instance of re-shipment of this kind. Seeing in the "Customs Bill of Entry" a parcel of india-rubber entered as coming from Australia, and having heard from various sources encouraging accounts of Australian rubber, I naturally was very anxious to see this, the first importation. After a long series of inquiries at the Custom-house, brokers, and docks, judge of my disappointment when I found it consisted of "returned stores," old india-rubber tubing, which ultimately found its way to a marine store dealer's. These are a few points which require attention, in order to give merchants every facility of judging of the value of new products, and at the same time of increasing our knowledge.

But one of the greatest aids to our merchants and manufacturers would be a good trade or commercial museum. Here the pharmaceutist could see grouped together all the medicinal substances, and could select and could judge whether any yielded an analogous extractive principle and the same action as one of which the supply was deficient; the cabinet-maker could judge of the colour and direction of the grain of a wood; the perfumer of the odour of a substance; the shipbuilder the tenacity of a wood and its power of resisting atmospheric influence; and the dyer of the dye he is in search of; and the fibre merchant and the paper manufacturer of the substances most likely to yield them the best results. Thus each one would have presented to his eye the substances in which they felt the most interest, and all grouped together.

Professor Edward Solly, in his lecture delivered before the Society of Arts, on the "Scientific Results of the Exhibition of 1851," has the following very pertinent remarks on this question:—

"If you were to place before any manufacturer specimens of all the substances which could be employed in his particular manufacture, and if you could tell him from whence each could be procured, its cost, the quantities in which he could obtain it, and its physical and chemical properties, he would soon be able to select for himself the one best suited for his purpose. This, however, has never happened in relation to any one art; in each case the manufacturer has had to make the best of the materials which chance or accident has brought before him. It is strange and startling, but, nevertheless, perfectly true, that even at the present time there are many excellent and abundant productions of nature, with which not only our manufacturers, but, in some instances, even our men of science are wholly unacquainted."

The truth of these remarks will be felt strongly by anyone who takes the trouble to examine any of the great divisions of raw material. He will obtain tolerably complete information respecting most of those substances which are known to trade and commerce, but of the greater number of those not known to the broker he will learn little or nothing. Men of business do not feel the want of such knowledge, because, in the first place, they are ignorant of its existence, and, secondly, because they do not see how it could aid them in their business, and if it should happen that an enterprising manufacturer desires to learn something of the cultivation and production of the raw material with which he works (or desires to work) he generally finds it quite impossible to obtain any really sound and useful information.

An inseparable part of such a museum would be a chemical laboratory. To such a museum specimens of every new substance should be sent, in order that they might be examined botanically and chemically, and their value proximately determined. For such an examination those who are directly interested in the substance would not object to pay a fee. Such researches would not come between the importer and his profits. Such a museum, when its objects became known, would meet with speedy recognition and support.

Another question, which has a very important bearing on economic botany under its commercial aspect, is the cultivation of those economic plants not already cultivated, and their acclimatisation in localities where the various conditions which are so many elements of success are more controllable than in the native habitats. We are so fortunately situated that our territorial possessions have a geographical range amply sufficient to satisfy the climatic desiderata of every plant. It may be received as an axiom beyond all controversy, that spontaneous forest products cannot be depended on for regular supply, and that, sooner or later, recourse must be had to cultivation.

What a complex question is civilisation, and its modern representative colonisation, even if viewed in their connection with forest products. If we view a primeval forest, where the influence of man has never been felt, it has the appearance so well pourtrayed by Tennyson—

> "The mountain wooded to the peak, the lawns
> And winding glades high up like ways to Heaven,
> The slender cocoa's drooping crown of plumes,
>
> * * * *
>
> The lustre of the long convolvuluses
> That coiled around the stately stems, and ran
> Ev'n to the limit of the land,"

And where giants of the forests

> "yclad with sommer's pride
> Did spread so broad, that heaven's light did hide,
> Nor perceable with power of any starr."

And nature is marked everywhere by mutual relations and adaptations, and thus producing a beautiful harmony, which on the approach of man is changed into discord. His steps are marked by the restriction or destruction of indigenous forms of life, vegetable and animal, which are supplanted by others of foreign origin. Of the various stages of man's social progress, the pastoral and agricultural conditions are the most destructive to forest products. The sound of the axe is heard; fire encircles the trunks of many a tree, for fire is said to improve the soil; and a clearing is made, which is soon covered with a different and frequently aggressive form of vegetation. Soon, through slovenly husbandry, the first portion of land is exhausted, and the process of destruction is repeated by the removal of further portions of forest which hem them in. The spontaneous products formerly at their very doors have now to be sought far away, or, if they have representatives nearer, they are reduced to struggling weeds. Of this tenacity of locality, and degradation, as it were, under man's influence, I had a remarkable instance given me by a traveller. He had been endeavouring to find the source of a vegetable product, and had thoroughly examined the outskirts of the settlement where he was staying; but the only plant that he deemed, from its generic position, could yield it, existed only as a weak-growing tender climber, and it was only after seeing the plant fully developed, away from the influence of man, that he could verify his surmises.

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* Seemann's "Journal of Botany," vol. vii., p. 361.

As an illustration of the truth of the axiom, that we cannot depend upon spontaneous forest growth for a regular and lasting supply of any product in considerable demand, I may refer to two important substances, viz., india-rubber and chinchona. In the one case, the present sources of supply are being rapidly exhausted through the ignorance of native collectors; and, in the other, the resources of the science of economic botany have placed us in a far higher position than we were, not only rendering us independent of native collection, but promising much more plentiful supplies.

Through the kindness of a correspondent, Mons. Paul Lévy, who is practically acquainted with the subject, I am enabled to give you an account of the collection of india-rubber, which will serve very well to convey a general idea of how forest products are collected, and also to illustrate a few points to which I wish to draw your attention:—"To those who are unacquainted with the forests of intertropical America, the obstacles there met with are incomprehensible. The traveller finds an inextricable confusion of vegetation, covered with creepers, through which a day's hard labour will not secure the advance of a hundred feet. Now, a straggling and slimy marsh, out of which he is only with difficulty able to extricate himself; next, an insurmountable ravine, which it is necessary to flank, thus tripling the amount of labour. Add to these the perpetual fear of wild beasts, and the frequent want of water, and then judge of what passes in the mind of the poor *hulero*, who, after many of such risks and much labour, arrives at the foot of a tree he had seen from afar, and discovers it is not what he seeks. Besides the qualities required in a *hulero* to enable him to find his way in an obscure forest, it is necessary for him to serve an apprenticeship to learn how to properly bleed a tree; that is to say, to extract as much milk as possible from the tree without killing it. With respect to killing it, however, he is not at all particular. Near the towns, all the trees along the roadsides are marked by scars made by amateur *huleros*, and present strange, exaggerated forms. The forests are full of these attempts, by which, in ten years, the most beautiful trees within a circle of many leagues of the rancho of a would-be Indian *hulero* are frequently destroyed. It is to this cause alone that the blighted appearance of the forests of the inhabited part of Nicaragua is due. The cut with the machete, to be successful, must penetrate at one blow through the bark without touching the wood, otherwise the tree is destroyed; and from the difficulty of handling the machete, and the carelessness of the *huleros*, caoutchouc trees are destroyed with fearful rapidity. The *hulero*, having collected his rubber, returns to the towns to dispose of it, where he is subject to great wrongs from the small traders, nearly universally a very low class. When the price has at last been agreed upon, the *hulero* finds that the greater part is already owing for his outfit and spirit score, and frequently the trader does not part with him till the small balance is expended in debauchery and drink. Full of revengeful feeling, the cheated, hardly-dealt-with *hulero* departs, and destroys all the trees he meets with on his road. The contract between a party of *huleros* and an agent is made after quite a patriarchal fashion. They regard each other seriously, strike hands, and the bargain is completed. It is to the agent that application is made to secure the active and armed resistance of the *huleros* in case of a revolution. He generally succeeds in engaging them in the civil war by means of a good bounty, a high rate of pay, a considerable equipment, and a more handsome dress than that of the other soldiers."

Now, it can be easily seen from this, that such collection of forest products is precarious and objectionable in several ways. First, with regard to the collectors themselves. It is, as a rule, only when other means of employment are wanting that they take to that of collecting, and, even on moral grounds alone, such a life is anything but humanising. Frequently, too, such operations are interrupted by the caprice of some petty ruler, who requires their services in warfare. This is the case everywhere. Then, often, from causes other than natural, the trees yielding the wished-for product are so far apart as to necessitate a vast extent of ground to be gone over before any quantity can be collected, which greatly adds to the cost, and in many cases precludes the possibility of collection at all. The transport, too, is difficult, confined very often to human or animal porterage, which will not allow of bulky articles being collected. Many valuable woods labour under this disadvantage, and unless they are on the margin of navigable rivers, and can be thus floated down, they are lost to man's use. Now, the great object of cultivation and acclimatisation is to centralise and concentrate in a manageable space. The modes of collection adopted afford many reasons why, in the case of all necessary products, cultivation and conservancy should be resorted to. The native modes of collection are, to say the least, very destructive, and entail a great loss of material, for often, were cheap means of transit available, other parts now wasted could be utilised. We may allude to four common operations employed in the collection of vegetable substances, viz., (1) the collection of those parts of a plant, such as flowers, fruits, and seeds, which do not necessarily entail the loss of life to the plant; (2) the incision or tapping of the tree for the collection of gummy and milky juices; (3) barking the tree; and (4) a mode which involves the total destruction of the tree. The collection of the fruits and seeds of trees does not necessitate the destruction of the tree, but it is quite a common custom with natives to destroy the tree to save themselves trouble. Tapping or incising the bark is resorted to in order to obtain milky juices and gums, such as gamboge, india-rubber, gutta-percha, maple sugar, and the like. The sugar-maple is generally tapped with a three-inch bit to a depth of one and a-half to two inches. Tapping does not check the growth of the maple, though it injures its wood, and renders it lighter and less dense. The general yield of juice is twenty gallons in the season of thirty days. Tapping, when done judiciously, does not injure the vitality of a tree, but there are two great dangers in this operation, namely, over-tapping, or bleeding the tree to death; and, even after judicious tapping, not allowing a sufficient length of time to elapse before the operation is repeated. Natives always resort to overtapping, and frequently even cut down the tree for the sake of obtaining a larger yield. In many cases they are sure not to visit the same spot again, and therefore they bleed the tree as long as they can. This impoverishes the tree, and predisposes it to succumb to atmospheric changes, and to the attacks of insects, for healthy trees are not nearly so liable to these latter destructive agents, and very seldom does a tree long survive the united influences. Barking, too, in some cases, if carefully performed, does not injure the tree; the cork tree, it is well-known, improves under the treatment. Mr. Mc Ivor has adopted this method of barking cinchona trees, and it is found that it does not injure the tree in the least. He thus describes his *modus operandi*:—

"In removing the strip of bark, two parallel cuts should be made down the stem, at the distance apart of the intended width of the strip of bark; this done, the bark is raised from the sides of the cut, and drawn off, begining from the bottom, care being taken not to press or injure the sappy matter (*cambium*) left upon the stem of the tree. This *cambium*, or sappy matter, immediately granulates on the removal of the bark, and being covered (with moss), forms a new bark, which maintains the circulation undisturbed."

The renewed bark is nearly as thick in one year's growth as ordinary bark is in three years, and is, moreover, very much richer in quinine. Mr. Mc Ivor's method, I am afraid, is however much too delicate an operation to be successfully performed by any but skilled persons.

The total destruction, except in the case of herbaceous and quickly-growing plants, or where the trunk or other vital part of the tree is required for use, is totally uncalled for, and even where necessary, the future supply should always be guaranteed by re-planting. This total destruction is the more highly reprehensible in the cases of trees yielding useful juices, such as india-rubber and gutta-percha, with which the subject is more intimately connected. The reason assigned is that the yield by simple incision or tapping would not be remunerative; but this is not the case. The actual reason is the existence, to a greater or less extent, of a presumed or real right of common proprietorship, and the absence of government oversight in the forests where this mode of collection is practiced. Self-denial and forbearance from monopolising any sources of supply are virtues not looked for in the most civilised countries, much less amongst untutored savages.

A collector reasons thus, if he reasons at all on the subject, "If I do not take all I can get, some one else will, and why should I leave that which will enrich a less scrupulous collector." Even in India, where the necessity of forest conservancy is fully recognised and carried out, the notion of the inhabitants of a right of common proprietorship is a source of constant trouble to the Department, and the enforcement of a parental conservancy against individual devastation is looked upon by some of the inhabitants as a great injustice. Even where the right is recognised, and licenses are taken out under a full understanding of this fact, constant damage is done by excesses. In an able report on the caoutchouc forests of Assam, Mr. Gustav Mann says:—

"The privilege was sold (in the Durrung district) for 1,012 rupees to kyahs, in the Mungledye Bazaar, who purchased 2,500 maunds, but had not the slightest control over the tapping of the trees by those to whom they sub-let their right, and encouraged the latter as much as was in their power to obtain the largest possible quantity during the short time they held the monopoly of buying it, as consistent with their interest, without any regard, however, for future supplies, which was of most disastrous consequence, in as far as it induced the men who tapped and collected the rubber to indulge in the most outrageous wholesale destruction of these valuable trees, by either felling them with axes, or, if this was too troublesome, to collect firewood and burn them down, so as to render the operation of tapping more convenient than it would have been had the trees been left standing; and several hundred magnificent trees were counted, in all directions, lying on the ground with cuts across their trunks and roots from six to 18 inches long, three inches broad, and a foot to 18 inches apart, and smaller cuts on the upper branches of them, by which all that they could yield was extracted immediately after they were felled, with an utter disregard for future wants. So that at present there is absolutely no rubber worth speaking of to be got from these forests, nor for centuries to come, unless the tree is replanted."

It therefore cannot be too deeply impressed on all interested in the subject, that every useful vegetable product for the supply of which we depend on spontaneous production, and also those which could supplement these supplies, should be, by cultivation and acclimatisation, brought under conditions where the various desiderata, such as the improvement of quality, quantity, purity, an easy collection, with as little loss of material as possible, unfailing supply, and a cheap transit to the seats of consumption, could be attained, thus lowering the price and increasing the utilisation. The Indian government have wisely directed their best energies to this subject of acclimatisation, and in no instance have the results been more manifest than in the successful cultivation of the cinchonas.

The first cinchona plants arrived in India from South America under the superintendence of Mr. C. R. Markham, in 1861. The last report from one plantation, that in Bengal, gives the following numbers:—*Cinchona succirubra*, 1,233,715; *C. officinalis*, 440,000; *C. calisaya*, 33,000. And to show, rather in illustration than in proof, that the plants do not deteriorate but improve, I will quote a single case.

In 1859, Mr. Howard received from South America bark and seeds of *C. officinalis*. The bark yielded by analysis 3·11 of alkaloids. The seeds were sown, and an English grown plant yielded 1·93. One of these growing plants was sent to India, and this plant, partly grown in England and partly grown in India, yielded 2·36, whilst a third generation, descended from the latter plant, yielded 3·33, thus showing a per-centage of the Indian grown plant of 0·22 over that of the South American parent. In fact, a variety of *C. officinalis* grown in India yielded 11·40 per cent. of alkaloids, and of this 9·75 per cent. was quinine.

As to the advancement of our knowledge of economic botany, I should like to say a few words. At the present time we have no society which deals specially with this subject. At one or two of our existing societies papers are occasionally read on vegetable products, but what is really wanted is a society, or section of an existing society, which would give its attention systematically to this very important branch of the science of botany. I trust I am not too sanguine in anticipating that such a body would meet with warm support from our merchants and manufacturers. Any remarks, however, I may here venture to make on the work of such a society will not be out of place, as they will be equally applicable to individual effort.

One of the surest means of progress towards accurate knowledge is the collection of well-authenticated specimens of vegetable products, specimens which, being obtained by personal collection or other equally reliable source, and accompanied by leaves, flowers, and fruit obtained from the same identical tree, could be accepted as of critical value. It is very necessary that herbarium specimens should be collected from the same identical tree. Some trees may be so very similar in general appearance as to be considered identical by an inexperienced person, yet, when examined by one skilled in such things, may be found to be totally dissimilar in properties and structure. And when the name of the tree yielding a useful product is known, it allows of the product being searched for elsewhere. Too much reliance, it is feared, has been placed in the presumed good faith of "intelligent natives." It is said that the practice is not uncommon with them, when instructed to go to a particular spot at some distance, and procure a certain specimen, that, having arrived at a safe distance from their starting-point, they calculate the time it would occupy to go to and return from the place indicated, they take their rest under some shady tree, and when the time has expired, collect a specimen from a neighbouring tree, and return with it as the result.

Even where a traveller collects his own specimens, he has to be constantly on his guard, as the natives frequently use every artifice to mislead him. However good a specimen may otherwise be, if its history and its source are unknown, it is almost valueless for purposes of scientific study. Also much good can be done by endeavouring to clear up the many doubtful points with regard to the history of many of our even commonest products. Dr. Lindley, in the preface to his "Flora Medica," says, "All are aware how conflicting are the statements found in books and made in conversation respecting the sources from which medicinal substances, often of the commonest kind, are derived." These remarks, penned in 1838, are, to a great extent, equally true now. The Admiralty have done good service to science by publishing a "Manual of Scientific Inquiry," a new edition of which has recently appeared. One of the sections is devoted to economic botany and the various points requiring elucidation. But this could be done to a much greater extent, and with consequently greater results, by a society, in sending out instructions and inquiries to consuls, traders, and other residents abroad.

Recent and also old collections made by travellers should be examined and compared with published or other accounts. It has been found more than once that where one substance has failed from any cause, a new one has been substituted, and had the original name appended to it. To take an illustration of the good which may acrue from these researches, let me refer to an incident in the cinchona history. From the years 1852 to 1856, Mr. Howard was working on the Peruvian barks, and examining all the materials of the Spanish botanists, Ruiz and Pavon, with which he was acquainted, but the results did not fully satisfy him, and, to quote his own words:—"I could not help surmising that there must remain at Madrid further results of the labours of the Spanish botanists which might throw light on the many questions still left in obscurity. I consequently caused inquiry to be made, and in the year 1858, obtained by purchase 54 specimens of barks, of Pavon's collection, together with an original manuscript in Pavon's handwriting, which appears to have been commenced about the year 1821, and finished in 1826. This was sold before Pavon's death to a botanist in Madrid, from whom it passed into my hands." This manuscript Mr. Howard published in a magnificent volume, under the title of "Illustrations of the Neuva Quinologia of Pavon."

Mr. Markham also found the specimens and drawings of Ruiz, Pavon, and Mutis, illustrating the same question, "buried" in a cupboard in a tool-house at the Botanical Gardens at Madrid. And if this be the case, may we not hope that other valuable materials may be brought to light if sought for? The question must occur to every thoughtful reader of narratives of exploring expeditions, "What becomes of the materials resulting from these expeditions in cases where they have not already been published?"

The literature of economic botany labours under the disadvantage of other scientific subjects, of being "scattered," and even to a greater extent than most, and efforts should be made to remedy this evil. Some of the old works on the subject are even now of sufficient value to deserve reprinting.

I must now draw my remarks to a close. I have endeavoured to bring before you a few of the salient points of a subject of great interest to us all. There are many points which would admit of treatment at greater length, but time will not allow. The subject itself, irrespective of its many practical claims, is of an interesting and fascinating nature, in its various botanical, commercial, and ethnological bearings. For teaching in schools, it is at once useful in its relations to every-day life, inculcating habits of accuracy, observation, and perseverance in the pursuit of truth; and in closing these remarks, I would add, for the consideration of all intending students of the subject, this motto:—

> "Without questioning, no investigation;
> Without investigation, no truth;
> Without truth, no science."

For science is but truth ascertained by the many, classified for the benefit of the individual, and science, truly so called, must be isomeric with truth.

DISCUSSION.

Mr. Sedgwick S. Cowper said he could speak from experience of the immense field there was in Australia for the development of the resources of economic botany; and considering that that continent was about four-fifths the size of Europe, he hoped its importance would not be lost sight of. What was not so generally known was, that the aborigines, who were known in this country as "black fellows," were very well acquainted with the botanical riches of their native land, and were able to tell, not only the genus, but also the species to which the various trees and grasses belonged, though, of course, they could not describe or classify them scientifically. It was of the utmost importance that the rising generation, many of whom would, in future years, become colonists, should be so educated as to be able to take full advantage of the natural products of the countries which they might visit; and if this were more generally the case, there was no reason why Great Britain should be so dependent as she was at present for her supplies. Australia was wealthy, not only in the vegetable world on the surface, but also in the vegeto-mineral world immediately beneath, and if this wealth were properly developed, immense advantages would result. He could not refrain from bearing testimony to what had been done by Sir William Hooker and Dr. Lindley, men whose names went to form the history of their time, and whose efforts would be emulated by all who followed them. In conclusion, he begged leave to propose a hearty vote of thanks to Mr. Collins for his extremely interesting paper.

Mr. Ellis A. Davidson said he had devoted some time to the educational aspect of this question, and might therefore make a few remarks on that subject. One of the great obstacles which they met with in endeavouring to teach it to the lower classes—and it was to them principally they should look in the first place—was the repugnance they felt for the names; and therefore in the same way as he had found it necessary to convert practical geometry into linear drawing, and animal mechanics into living machinery, so he always used, instead of the term economic botany, the uses of plants. He had used this as the title of a small manual which he had recently prepared on the subject, and, judging by the great circulation which it had already obtained, there seemed to be great demand throughout the country for elementary teaching of this kind. He agreed entirely with the idea of doing away with scientific classification, because, by using that, they would only be addressing people in a language which they could not understand, and which there was no time to teach them. He proposed, therefore, to group the subjects broadly in the way in which they were classified in every-day life, such as bread plants, breakfast plants; next, starch-yielding plants, vegetables, plants used in arts and commerce, weaving, dyeing, timber, and so on, finishing with india-rubber and gutta percha. He maintained that a system of this kind would materially aid in doing away with those lessons which were very often thought a good deal of in schools, but which, as commonly taught, were mere nonsense—object lessons. It was of no use teaching children isolated facts, but they should always endeavour to teach children systematically, so that the pupil's mind might go in a given groove, and then not only would one subject be taught, but the method of study would be developed, and the child would really know what was the proper way of learning. With regard to collecting specimens, he had found that, once you assist the children upon the task, they very soon got up a very respectable museum; and he would add that any experimental teaching, such as the bruising of sugar-cane, the boiling of syrup, the making of starch from flour or potatoes, and examining the specimens by means of a microscope, would be of great assistance in exciting the interest and curiosity of the children. Drawing on the black-board was also a very important means of teaching, and in many respects superior to diagrams, for the children, seeing all at once, got to the end of the subject before they had mastered the beginning. This study was of great importance to girls—if possible, more so than to boys—as was shown in the case of the German ladies, who learnt it to a great extent, and their system of housewifery was superior to that of most other nations. It was well-known that the German house-wives were very ready at preparing simple remedies for ordinary complaints. The study of botany would also enable the learners to distinguish between poisonous and edible plants; and, to show the importance of this, he might mention that some time ago it was related in the newspapers that a man had been poisoned by eating the root of the bitter-sweet, which he had taken for a parsnip. With regard to taking pupils to the Kew Museum, he considered this a very valuable means of illustration; but in all these matters they must look for the assistance of masters and mistresses, who, whatever might be done by committees of management, were, after all, the life and soul of the schools which they superintended. Some time ago, being on the council of a large school in London, he recommended there should be a monthly holiday given for good behaviour, and suggested that the master might take the pupils to the Botanic Gardens or the Kew Museum, but the reply of the master was, that he begged to inform the council he was a schoolmaster, and not a parish beadle. He maintained that, mentally speaking, he was a parish beadle, although he would not admit it. He was happy to think, however, that this was a very exceptional case. Geography was constantly taught in schools, but it was only done in a one-sided and slip-shod manner if economic botany were not added to it; and, lastly, the teaching of this science was eminently useful in teaching children the dependence of one man and one country on another, and that all mankind were children of one God, and were placed in the world to be mutually serviceable to each other.

Dr. Brandis said he had been for some time connected with the forests in India, to which allusion had been made, and might, therefore, make a remark or two upon them. He could not, however, do so without first paying a tribute to the memory of Earl Mayo, whose death was a severe blow to all who had had the pleasure and honour of serving under him. After further adverting to the heavy loss which India had sustained in the death of the late Earl, Dr. Brandis said he must remark on the passage in the paper which referred to the notion amongst the inhabitants, that they had a common right of proprietorship in the forests, as being a constant source of trouble. There was no doubt that the inhabitants of India had very decided right in the forests, and, after all, the first duty of the British government was towards the natives, though the commercial public might rest assured that their interests would not suffer in the long run by justice being done to the inhabitants. In India, as on the Continent, and in England, there were various rights of common pasturage and turbary, and the same course was being pursued there as elsewhere of separating the various rights, and making arrangements, by which the State took exclusive possession of certain portions of the forests, leaving villages, towns, or private landowners in exclusive possession of other portions. The cultivation of cinchona had been referred to, and this was certainly one of the most glorious results of practical science; the cinchona plantations were now become almost forests, and before long they would be able to be coppiced every six or eight years, just as oak coppices were treated in Germany, Scotland, and elsewhere every fifteenth or eighteenth year, and this would, probably, be the simplest and most profitable mode of getting the bark. It was a matter for congratulation that true scientific knowledge was now thoroughly appreciated. When a regular administration of the Indian forests was first commenced, there was some difficulty in getting fit men for the work; he was then told very often of what an English gentleman could do if he were put in the right position, and he willingly bore testimony to the vast amount of good which English gentlemen had done in India, but he had always said that if these men were properly and specially educated for the work they had to do, they would be much more efficient. He was happy to say that this was now understood and appreciated, and the results would soon make themselves manifest.

The Chairman said there could be no doubt of the importance of the subject, for fully three-fifths of the raw material of commerce came from the vegetable kingdom, and, as had been stated by Mr. Collins, it was painful to reflect how imperfect was our knowledge of even many of the commonest of these articles. There were woods used in cabinet-making, the source of which was unknown, and could only be guessed at; and it was not yet decided what plant yielded the best Turkey rhubarb, although it was now well-known that it did not come from Turkey. The same remark applied to cardamums and a number of other drugs, which it would be tedious to enumerate, and if this were so with drugs in common use, it was no wonder if it were the case with rarer plants, such as *sambuco* and *condurango*, which had been recently put forward as a remedy for cancer. Mr. Collins had referred to Professor Huxley's views with regard to medical men studying *materia medica*, and he must say, though a great admirer of Mr. Huxley in most things, he thought he was very wrong here. That a medical man should not have some acquaintance with his tools seemed absurd, and with regard steel, he might say, as an illustration, that he had known one of the most eminent surgeons of the day, Sir William Fergusson, examine a knife in the operating-theatre, and not being satisfied with its quality, break it before the eyes of the maker, as a warning that inferior quality would not pass muster. It was of essential importance that a medical man should be able to distinguish between certain white powders, such as calomel and antimonial powder, white arsenic, sulphate of zinc, oxalic acid, sulphate of magnesia, &c. In many cases there was a difficulty in obtaining precise information with regard to foreign products; they were grown in the interior and brought down many miles to the coast, and when they arrived there it very seldom happened they were imported direct. Products from Mozambique and the East African coast were almost all sent to Bombay, from whence they came to England, and were entered as Indian products. With regard to the utilisation of common, well-known products, there was a great deal of ignorance. Both farmers and gardeners, for instance, looked upon charlock as an intolerable nuisance, which it was very difficult to get rid of; but very few of them were aware that its leaves were very succulent, and would form a vegetable for the table much superior in every respect to turnip greens. The same remark would apply to many fibrous plants. A great deal had been said about the introduction of the cinchona plant into India, and there could not be two opinions as to the immense importance of that subject; but with regard to the introduction of ipecacuanha, which was now being attempted, with considerable labour and expense, he would ask any one acquainted with India if there were not dozens and scores of indigenous plants bearing the same medical virtues, and which would be much more easily utilised. To show the immense amount of ignorance on botanical matters, he might mention a circumstance which came within his knowledge. A gentleman, a university graduate, was desired by his relatives to go to a seedsman for some peas to plant in the kitchen-garden, but passing a corn-chandler's, and seeing some split peas in the window, he thought they would do, and brought home the split-peas to be sown in the garden. As to the remedial measures, he must dissent from what had been said by some gentlemen, and insist on the importance of true scientific knowledge being disseminated, even if it were somewhat dry, if any solid progress were to be made. Popular knowledge was all very well, but it would not assist in developing present resources, or in opening up fresh ones. He held, in the first place, that the production and publication of colonial flora was of the utmost importance, for a good, thoroughly classified catalogue of native plants was required before any questions about economic value could be entertained. Mr. Collins' remarks on the importance of cultivation were very judicious, as had been proved in the case of cinchona, as was being proved in the case of caoutchouc, and as would be proved in the case of cotton. Cotton grew wild in the Punjaub, Scinde, and other parts of India, another variety in Abyssinia, and another, on a plant closely allied to it, in Australia, but none of these wild plants were of the slightest use commercially. Cotton must be cultivated to a large extent before it was of use, and Mr. Collins' remarks were very appropriate, in which he had followed the King of the Belgians, a remarkably shrewd man, in insisting on the importance of cultivation. It was also of primary importance that experimental gardens should be maintained in the various colonies, for many things took much longer time, and more attention and expense than any individual could give, before they arrived at anything like perfection. When Sir Walter Raleigh introduced the potatoe—if indeed we owed its introduction to him—it took more than one, two, five, ten, or probably twenty years before it became a common article of diet, and the use, therefore, of these colonial gardens was to try experiments which would overtax the patience and means of private individuals. Wild cotton was not converted into a marketable article in a short time. In many cases it took generations to arrive at anything like perfection in the cultivation of a plant or vegetable, and, therefore, these experimental gardens must be kept up at the public cost. The museum at Kew had, no doubt, been of great service, and of the one belonging to the Pharmaceutical Society it was quite unnecessary to speak. It was hardly necessary to recall the services of the bright galaxy of Indian botanists such Roxburg, Wylde, Royle, White, Hooker, and many others he could mention, to say nothing of Dr. Brandis, the Superintendent of the Burmese Forests, who was now present. To show, however, that medical men and scientific botanists had not been idle in the way of advancing economic botany, but had really laid the foundation of all that was subsequently done, he need only mention the names of Ferdinand Von Müller, director of the Botanical Garden at Melbourne, and Dr. Schomberg, of Adelaide; and, to show that private gentlemen were not altogether idle, he might name Major Trevor Clarke, who, though he did not claim to be a botanist, either economic or otherwise, was really one of the foremost. He simply claimed to be a country gentleman, but he had done more than almost anyone to improve the culture of cotton, having hybridised and raised seedling plants of great value in a green-house not one-fourth of the size of that room. Everyone, therefore, could do something to help forward the progress of this most useful and, indeed indispensable science. The Chairman concluded by putting the vote of thanks, which was carried unanimously.

Mr. Collins, in reply, said he believed Dr. Brandis had confirmed his statement with regard to the Indian forests. In corroboration of what had been said by the Chairman about East African products, going first to Bombay and thus being treated as Indian growths, he might mention that Dr. Birdwood proved this to be the case with gum *alibanum*, or frankincense, though it was denied strenuously at first that it came from Arabia. Dr. Royle's name had been mentioned, and he could only say that, in his estimation, he stood next to Dr. Pereira, his work showing an admirable combination of scientific and economic information. Baron von Müller, also, was doing an immense deal of work, in fact, a letter recently received from him showed that his industry was really marvellous. Everything he could do he did, to increase the commerce of the country, and open up its resources. In conclusion, Mr. Collins drew attention to various botanical specimens and drawings on the table, and to Mr. Howard's book, referred to in the paper.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

A meeting of the General Committee appointed by the Manchester Chamber of Commerce, to assist her Majesty's Commissioners to carry out the International Exhibition of 1872, was held on Monday, 5th inst. **Mr. Hugh Mason** presided.

The Chairman said he had called that aggregate meeting for the purpose of conference, and for receiving an explanation from General Scott, who had come from London as the representative of the Commissioners, in order to meet the Committee. He believed that the subcommittee which had been appointed to arrange for the exhibition of cotton in its various stages of manufacture were fully abreast of their work, and that they would have nothing to do at the last moment in regard to that particular department. He had also every reason to believe that all the other sub-committees were equally forward in their work. As they were met together on that occasion, it had occurred to him that it would not be amiss to express an opinion with regard to an agitation that was being carried on by a certain class of tradesmen in London, who felt aggrieved at certain transactions which took place at the last exhibition, as to the sale of the articles shown in the different departments. He (the Chairman) believed that the agitation was selfish, and not at all creditable. The London tradesmen maintained that as they had to pay heavy rents, and a large amount of money for rates and taxes, the permission to foreign exhibitors to sell articles which they had brought for exhibition was an interference with their trade, under certain special advantages. He maintained that that agitation was an unreasonable one, and that the grounds of complaint against the Commissioners were not at all defensible. If there was a class of persons who would derive any special profit from the Exhibition, it was that of the London tradesmen. It would be impossible for many thousands of persons to visit London during the Exhibition without putting into circulation a considerable amount of money, and promoting an amount of trade which otherwise would not have taken place. The tradesmen in the provinces would be more justified than the London tradesmen in complaining, for the Exhibition would be the means of drawing money from the provinces which, but for that great attraction, would have remained to be spent at home. It seemed to him a most unreasonable thing to say that the sales of articles would be the means of injuring art; but with respect to the material question, he maintained that the London tradesmen would derive special advantage from the Exhibition.

General Scott said he was happy to remark that almost the only difficulty which the Commissioners had experienced had been in respect of machinery which applied to the manufacture of cotton; but he hoped that they would be very successful, even in that respect. In all the other branches they had been specially successful. In the printing department, for instance, the proprietors of the *Times* had requested permission to print the *Evening Mail*, and, if possible, also the second edition of the *Times*, in the Exhibition. They not only intended to show the printing machinery in full action, which in itself was a very wonderful sight, but would show the system of composing, and the machinery for folding papers after they had been printed. That request, of course, had been granted. The proprietors of the *Echo* had made a similar application, and wished to sell their papers in the Exhibition. That brought him to the delicate question, should sales be allowed to take place in the building? The Commissioners would certainly not allow sales to take place in such a way as to interfere with the comfort of visitors. Instead of allowing any sales to take place in the Exhibition proper, as had been the case at all previous exhibitions, it was proposed that they should take place in an annexed space, forming a very small portion of the building, where duplicates of the articles exhibited and intended for sale would be kept. The Commissioners would rather adopt a conciliatory mode of dealing with the question than put themselves in opposition with such a powerful body as the London retail dealers. He believed the French nation would not, as was supposed, stand in the way of any arrangements which the Commissioners might make. Though, in some cases, there might be reason for doubt and hesitation, he believed that, in its general interest, the exhibition would far surpass the last one.

Mr. T. Browning, the secretary, read a list of the Lancashire exhibitors, together with the specimens of cotton, &c., which they proposed to send. It was arranged that a meeting of the Sub-committee should be held on the following Thursday; and the meeting concluded with a vote of thanks to General Scott.

Refreshments.—Messrs. Spiers and Pond have again obtained the contract for the supply of refreshments, and a number of fresh arrangements will be made by them which will materially conduce to the convenience and comfort of the public, in connection both with the bars and the dining rooms.

Royal Albert Hall.—On Thanksgiving-day, February 27th, a performance of "The Messiah" will be given in the morning, and a miscellaneous concert in the evening. The choir and band will be under the direction of Mr. Carter. Sir Julius Benedict will conduct. The artistes who will sing are Madame Lemmens-Sherrington, Miss Edith Wynne, Miss Enriquez, Mr. Sims Reeves, Mr. Cummings, Mr. Lewis Thomas, Mr. Maybrick. Herr Joachim will be the instrumentalist at the evening concert.

REFRESHMENTS AT THE EXHIBITION.

Sir,—The arrangements of Messrs. Spiers and Pond, with regard to the supply of refreshments to the public, last year were admirable, but, unfortunately, the conditions imposed by the Commissioners upon them and the public prevented myself and family from frequently availing ourselves of them.

My dinner-hour is seven o'clock, and when I visit the Exhibition I like to remain as long as I can looking at the exhibits, and when six o'clock comes I should like to make my way leisurely to the dining-rooms; but the rule last year was, that all persons who intended dining must be in the rooms by six o'clock. At that hour I was, several times, at the Albert-hall, which I was obliged to leave, without the option of passing through the buildings to the dining-rooms, which, however, on one occasion, by rapid motion, I reached only to find that I was too late. The door was closed in the face of myself and five other hungry companions. Now, Sir, cannot the rule that I have mentioned be modified, or, better still, abolished altogether, and *bonâ-fide* visitors to the Exhibition be allowed to have dinner quietly and comfortably after the Exhibition has closed. If it is necessary to maintain the rule, let the following modification be sanctioned:—"Those persons who intend dining after the Exhibition has closed must take tickets beforehand," such tickets permitting them to pass through the building to the refreshment-rooms, or, if it is necessary to stop the circulation of the visitors and dismiss them by the nearest exit, give them the privilege of entering them by a private entrance. This will be a boon to those who, like myself, do not wish to curtail the time allowed for examining the articles in the Exhibition, by devoting an hour to dining, but who object to make a journey, tired and hungry, in the face of rest and food, to such a far off place as Finchley.

EXHIBITIONS.

Universal Exhibition of Vienna, 1873.—A general meeting of the commission took place a few days since, when 120 members, out of 150, were present, including the Archduke Regnier, president, being supported by five vice-presidents, Comte Andrassy, Comte de Beust, Prince Hohenlohe, Comte Bosocki, and Prince Schwarzenberg. The greater part of the Cis-Leithan Ministers were present, and the Baron Schwarz made a long report, in which he said that Hungary would have a large space in the exhibition, in order to enable her to show her economic importance to the world. The grand central iron dome of the building is being constructed by the German firm of Harcort, and would be finished by the middle of September, 1873, and the wood-work by Adolphe Dietz, of Vienna; the flooring would be commenced on the 30th of September. A branch of the railway would be constructed from the Bridge of Stadian. In the allocation of the space in the exhibition, England, France, and Germany had been placed on an equal footing. Foreign exhibitors will be charged for space at the following rates per square metre:—Within the main building 10 florins; in the machinery gallery, 4 florins; and in the park and open courts, 1 to 8 florins. There will be no charge for space in the fine art galleries, nor in that part devoted to amateurs. Austria and Hungary reserve to themselves 30 per cent. of the space in the fine art gallery and the machinery court, 33 per cent. in the industrial galleries, and 50 per cent. in the rotonde. Baron Schwarz spoke of the great interest taken on all sides in the coming exhibition, and cited the fact that 10,589 letters had been received by the central commission.

CORRESPONDENCE.

CONCERTS.

Sir,—I have been constantly asked, and I have no doubt that the wives and daughters of many members of the Society of Arts have constantly been asking, "Is the Society of Arts going to give a series of concerts at the Royal Albert Hall this year?"

As I am unable to reply to the inquiry, not having seen any announcement in the *Journal*, I write to the editor, in the hope that he may be able to give such a reply to the inquiry as will satisfy, not only the members of my own, but those of other families.—I am, &c.,

A Lover of Music.

[The question shall be brought under consideration.—Ed. *J.S.A.*]

INDIVIDUAL PROVISION FOR OLD AGE.

Sir,—Of all subjects connected with the welfare of the working classes, none could be more important than individual providence for old age, and we are, therefore, under very great obligation to our Treasurer, Mr. G. C. T. Bartley, for the admirable paper read by him before the Society, in which the various methods of inducing saving habits amongst the people was carefully considered, and clearly brought before the public.

As a practical educationist, however, I cannot but feel that efforts such as Mr. Bartley proposes should be made, not in the workshop only, but in all our schools, and that the aid of school teachers of every class should be called in, so that the task may, a few years hence, be a less uphill work than it is at present. I am sure, Sir, that all who have endeavoured to teach our working population to lay by a trifle out of their wages will agree with me, that it is exceedingly difficult to make them clearly understand and appreciate the necessity for, and the benefits arising from, self-denial and economy. I do not here speak of the class called "artisans"—men who earn their regular weekly wages—whose habits are necessarily regular and punctual, for amongst these the numerous benefit societies, building societies, and the accounts in the savings banks, prove that the germ of the principle of economy exists, requiring only kindly co-operation and friendly advice of those competent to guide them in such matters, so that the results may be as advantageous to them as possible. But still, what has been accomplished is the result of accidental association of some men with others who are "in a club," rather than the action of a sound conviction; and, besides, in treating this subject, we must bear in mind that there are whole masses of our population who earn money—sometimes in plenty—who eat or drink it away at once, and when it is all wasted they "go to the parish," to be maintained on funds compulsorily obtained from the hard-working and thrifty.

I have been a guardian of the poor in a provincial city, where a large number of fishermen earn, during the salmon season, an amount of money which ought to be enough to keep them in comfort during the entire rest of the year; yet, in spite of the efforts of those who urge them to put by some money against a rainy day, the moment a cloud approaches, or a shower begins, they are in a state of starvation, having spent every penny they had earned in feeding, and, worse still, drinking. Yet the children of most of these people, and of those of their class, go to the primary schools; and soon it is to be hoped that every child in our country will be gathered into the educational fold. Here, then, is the opportunity for bringing our rising population under better and more sensible influences than their parents have had.

Our children should be taught "the conditions of well-being," the principles guiding wages, the results of labour, and the penalties of idleness, the purposes and uses of money, and the results of systematic saving of odd pence. These subjects should form a course of regular study in every school, and until they do, all efforts at subsequent improvement will be desultory and unsatisfactory. With the aid of such education, we may hope to make our children useful men and women, respectable tradesmen and citizens, instead of tramps and beggars. We can hope to enable the children of persons well-to-do at present, to keep and possibly improve their conditions, whilst we may enable the beggar's child to raise himself in the social scale, and if these are not the results our school boards aim at and attain, their institution will be a failure.

In all that I have said, I allude not only to schools for boys, but to those for girls as well; for although, as a rule, the man is the bread-winner, still the main portion of the scheming out (and hard scheming it is, sometimes), the distribution of the hard-earned wages, falls on the woman; she has literally to divide the loaf amongst the hungry children; she has to cut and contrive, so that the little ones may be clothed; she has to pinch, that the school pence may be paid; she it is who buys the little money-box, and asks "father" to drop a penny in it; and she can (if she has been taught) show the child that every pound saved can be made to earn money, even though its owner may be ill, or unable to work, and thus every shilling a boy or girl puts away is a brick in the foundation of the glorious structure of future independence.

We should have but little difficulty in inducing men to save if they had been thus brought up, and to accomplish this Mr. William Ellis has laboured with a degree of sincerity and energy scarcely equalled by any other man, and the country owes him a debt of the deepest gratitude for the benefits he has conferred on the schools which have enjoyed the privilege of his lectures.

Let us hope others will follow in the track; and it is indeed encouraging to see a man like Professor Thorold Rogers coming forward and writing an admirable little shilling book—a manual of "Social Economy"—for the upper classes of primary schools. In the introduction of this book, the author says:—"It does not follow that knowledge will make a person who possesses it discreet and wise; but no person will be discreet and wise without knowledge. After that training which is necessary for each person, in order that he may earn his living, no knowledge can be more usefully turned into account than that which explains the circumstances under which men live together in a civilised society, and confer benefits on each other."

Earnestly and anxiously do I plead for the introduction of this subject into all schools, and I am convinced that when this "consummation devoutly to be wished" is accomplished, we shall have but little difficulty in convincing men of the importance of "individual provision for old age."—I am, &c., Ellis A. Davidson.

29, Clarendon-gardens, Maida-hill,
11th February, 1872.

THE PROPOSED NAVAL UNIVERSITY.

Sir,—I thank you very much for your courtesy in finding room in the Society's *Journal* of the 26th ultimo for my second letter, urging, not merely the claims of the mercantile marine, but the advisableness, in the interests of the country and of science, of their being admitted to the advantages of any Naval University that may be established. In that letter I ventured to instance several recent occurrences and disasters, damaging alike to the nautical reputation of our Royal Navy officers, of our ordinary and of our first-class merchant services, and showing the great need there is of improvement in the art and science of "construction," and in what else concerns the ship, as well as in practical navigation and seamanship—in a word, in what concerns the sailor.

I am now anxious to supplement this advocacy with a third letter, directed to several points, to which, as it appears to me, the attention of the Board of Trade, the Trinity-house, of officers of the Royal Navy, of shipbuilders, and owners, and of merchants and mercantile commanders, might, with much advantage, be specially turned, and which should not be beneath the notice of professors in the lecture-room of a Naval University. I would allude:—

1. To the stowage of cargo and stores, and of dead weights generally, and "trim."
2. To the necessity of access to all the vulnerable parts of a ship.
3. To navigation and seamanship, with special reference to foul weather or accident.
4. To marine insurance.

1. Although the state in which the *Mægera's* cargo was stowed does not appear to have assisted in causing that fatal leak, which prompted Captain Thrupp to run for St. Paul's Island, and obliged him at last to leave his ship a disreputable waif on its inhospitable beach, I think the following observations, made by Vice-Admiral Forbes before the *Mægera* Commission, (*vide Times* 19th January), should not be left without some protest. He is reported to have stated that "he could say of his own knowledge that the ship was very ill-stowed, for he saw the cargo jammed in anyhow; but this, he thought, had in no way affected her labouring at sea between Plymouth and Queenstown; *the weight being in her, it mattered little about the manner in which she was stowed.* Taking the fact that she had 341 persons on board, and upwards of 400 tons of cargo; he did not think she was overloaded for safety, but that she was for comfort."

However true the italicised portion of Admiral Forbes' observations might be, if spoken of a ship whose cargo (as distinguished from other dead weights) formed a very small proportion of the total weight on board, there is hardly, I think, a worse condition for a vessel at sea than for her cargo and dead weights to have been stowed with no reference to the centre of gravity of the ship, whether damage to packages by the rolling and pitching of the vessel, or through the shifting, leakage, or washing out of contents, or the trim and stability of the ship when under pressure of canvas in blowing weather, be considered. It may be true that the landing of 127 tons of cargo from the *Mægera* only lessened her immersion by four inches (*vide* Admiral Forbes' evidence), but if these 127 tons were heavy goods, and were removed from the upper portions of her holds, their absence must have augmented considerably the stability, and improved the safety of the ship; it might be even doubted whether, had these 127 tons remained on board, with the additional pressure of the vessel on the water, and consequently increased upward force of the leak, the ship could have made St. Paul's Island, at all events, without throwing overboard a large quantity of cargo. Admiral Forbes had done good service, therefore, in lightening the *Mægera* as he did at Queenstown.

So far from its being of little consequence how a ship is stowed, it appears to me that commanders, mates, and stevedores ought to be strictly enjoined to stow so as to prevent goods from damaging one another, to keep the centre of gravity low, to prevent needless strain, and to adjust the ship's general trim. With the consumption of coals, &c., going on on board the *Mægera*, had her cargo been stowed high, the centre of gravity would have risen daily, and the ship might have been in danger from that cause weeks before the occurrence of the leak.

The brief report in the *Times* of the official inquiry into the recent loss of the *Delaware* off Scilly, did not, I think, touch the question of stowage. The ship, through a lamentable error, had neared the rocks too much, and being under-powered for her augmented size (having been lengthened) her engines were beaten by stress of weather; the ship refused her helm, and drove upon the rocks, and in a short time this splendid craft lay a helpless wreck, her valuable cargo wasted and lost, and her captain and crew—except two mates—drowned. I ask how was the *Delaware* stowed? I never saw the vessel, nor am I aware of any fault in the stowage of her cargo or other weights; but this I venture to think, that a very long, topheavy vessel would make more leeway than a ship, whether long or short, carrying her weights low; and that, making too much leeway (to whatever cause mainly due) aided in the *Delaware's* destruction. It is to be feared, indeed, that to top-hamper, deck cargo (whether dead weight or cattle) and to bad stowing, not a few of our nautical disasters might be traced.

2. Ready access to the more vulnerable parts of a ship must be acknowledged to be of vital importance. This, however, presents some special problems for naval architects and shipbuilders, and it is to be earnestly hoped that at the three days' meeting of the Institution of Naval Architects, to take place next month, those problems, and others arising out of the cases of the turret-ship *Captain*, the *Mægera*, the *Delaware*, &c., including the relative proportions of length, beam, and engine-power, and the thickness and quality of iron plates, will be dispassionately and fully discussed and determined. Can complete rigidity, or anything like it, in a gale be obtained in any vessel, 9 or 10 lengths of its beam, *i.e.*, of greater relative length and breadth than a column of the *Times* newspaper? Yet such are built. The Ark was six lengths of its breadth.

3. As a landsman, although with nautical predilections, I could not pretend to offer any suggestions on the subject of navigation, on the handling of a ship in bad weather, or on the occurrence of accident. I take it, that to avoid danger is a better maxim in practical seamanship than to run into it and get out out of it—in a word, that prevention is better than cure. Nevertheless, I feel there is often a lack on the part of commanders of knowledge of what, under circumstances of peril, ought to be done, and that the subject deserves, not only through inquiry by the Board of Trade and other nautical authorities, but would be fitly dealt with in the teaching of a Naval University.

4. On marine insurance I am not competent to speak with any authority, and my letter has already extended to a length that bids me bring it to a close. I would, however, put these questions. Do the unquestionable advantages to individuals of marine insurance prove it to be an institution of real national value? In other words, if the aggregate annual sum now paid in marine insurance premiums were expended in improved and stronger construction, and better equipments altogether of our ships, would better men adopt the nautical profession, and better hands man our vessels? And, as a corollary to this inquiry, would there be less loss of life at sea than at present? Judging from the large dividends and bonuses declared within the last month by the various insurance companies, apart from the profits of underwriters and brokers, the annual sum paid in premiums, to support rents, direction, management, &c., as well as yield dividends, must be simply enormous,—enough to build a small fleet. In my first letter I ventured to allude to the "moral and economical" question of marine insurance. A very important problem is contained in it. Does it promote the safety of life at sea, as distinguished from the recouping of loss of property; or does it tempt owners and captains of unscrupulous or rash character to run risks with old and unseaworthy vessels, jeopardising thereby life and property alike? Is not every man and cargo lost at sea a national waste? With these inquiries, and with no intention to asperse the character of our shipowners or captains generally, I leave the discussion of the marine insurance question to wiser heads than mine.—I am, &c.,

A Salt's Son.

Dryelande, 12th February, 1872.

THE INDUSTRIAL CLASSES ABROAD.

(*Continued from page* 147.)

SWEDEN.

The great *forte* of the Swedish artisan, we are informed by Mr. Consul Jocelyn, appears to be machinery, and in the construction of this he is equal to almost any one. In confirmation of this statement, he calls attention to the steam-engines of Gothenburg, or of Motala, which cannot fail to strike any observer, from the extreme beauty of their construction, as well as the fitness of their design; and, although the price of the article is higher than in England, owing to the absence of mechanical assistance, and the greater value of the materials employed, this very point serves to prove the excellence of the workmanship. At Motala, and also at Gothenburg, some English artisans are employed; but, although quicker in work, and perhaps more generally intelligent, the work turned out does not apparently differ in any respect from that done by the native workmen. The average wages of an artisan, in Stockholm and other large Swedish towns, is two rix-dollars, equal to 2s. 3d., a-day. They are seldom less, but frequently reach, in the case of skilled workmen, 14, 18, or even 23 dollars a-week—about £1 5s. Almost all work is now done by the piece, and not by time, except, of course, in cotton factories, and the wages, therefore, depend very much upon the ability and skill of the workman. Generally speaking, mechanics, and those whose trade demands a finer species of work, do not earn any higher wages than others; and it is found that among the most prosperous are iron-founders, and iron-foundery mould and model makers. Indeed, handicrafts requiring long experience and steady attention command a higher price than those which, like watch-making and mathematical instrument making, are dependent upon manual dexterity.

Lodgings suitable for artisans are plentiful in Stockholm, and are situated within a short distance of their work. The poorer classes often sleep several in one room, but this applies chiefly to day-labourers and those who cannot depend upon a weekly salary. For a room decently furnished and comfortably warmed in winter, the rent would be about 8s. 6d. to 16s. per month, according to situation and accommodation. The generality of the rooms are low, and not very well ventilated, especially in winter, when, owing to the cold, double windows are used, the inner one being pasted up so as to exclude all air. One pane is often made to open, but this is frequently not the case, and all ventilation will then depend upon the slight draught between the door and stove. Some workmen's lodgings recently erected at Norrköping and some other large towns are, however, very much superior in this respect to any private lodgings which an artisan would inhabit in the capital. The decrease of drunkenness in Sweden during the last six years, we are told, is one of the most remarkable features in the great improvement observable in the general moral and social character and bearing of its people. A considerable increase in the excise duty upon spirits has been maintained for some years, and has given an impetus to the manufacture of beer, which has now to a great extent taken the place of brandy.

With regard to matters of health, drainage, as such, cannot be said to exist in Stockholm at all. Some years ago, the subject was discussed, and many projects were proposed for supplying the town with sewers, but the idea was abandoned, chiefly on account of the great expense attending the tunnelling and cutting the very hard rock upon which the city stands. The municipal authorities now congratulate themselves that the plan was not carried out. They are convinced that the country gains by the present system, which is to immediately convert all refuse into an excellent manure, just in proportion to the rapidity with which it is produced. They maintain that by so doing the incalculable loss of the most valuable ingredients of manure, caused by the flushing of sewers, namely, that of the phosphates and other valuable salts, is altogether prevented. The population of Stockholm is 132,000; and yet, so admirably does the present system work, the refuse of the town is not permitted to remain for longer than a few hours within it before it is carried forth, and converted into a useful agricultural manure. No cesspools or other accumulations of decomposing matter are allowed to be located, and, except during the summer months, all un[illegible] is avoided. A very efficient staff of scavengers is maintained, and, on the whole, the town is as well off in respect of health from drainage as most other capitals. Dry closets are universally used, and the regulations respecting them are enforced by the municipality. The public health does not appear to suffer from the system, the rate of mortality being about 26 per 1,000.

This description of the working classes is confirmed by Mr. Consul Engström, who remarks that during the last twenty years a great and marked improvement has taken place in respect of the lodgings in Gothenburg, owing principally to the erection of a number of model lodging houses, at present offering accommodation to about 500 families. The rent in general is more moderate than in private houses, and very stringent rules as to cleanliness and order are enforced; the apartments are almost without exception well ventilated, cleanly kept, and, in most cases, comfortably furnished; and the example set has, in a greater or less degree, spread a salutary influence on all other lodgings occupied by this class of the population. In some industrial establishments, especially those in the country districts, the owners have erected lodging-houses for their workpeople, for the use of which they pay a moderate rent. The same improvement may be adduced as regards their moral and social condition, the reasons for which may, without contradiction, be attributed to the three following causes. These Mr. Engström states to be the educational laws of Sweden; the rules for restricting the sale of spirituous liquors; and the Act for regulating the employment of children and persons under adult age in factories.

Education in Sweden is compulsory, and, as a necessary consequence, therefore gratuitous. Every child from the age of seven years, if not incapacitated, must be sent to school, either to one of the primary gratuitous schools, or to some private school approved of by the educational board of the parish; and, as a general rule, they are kept at school six or seven years, or till the time when they have acquired a competent knowledge of the catechism, reading, writing, arithmetic, the history and geography of Sweden, and the rudiments of natural history, general history, and geography. Formerly drunkenness was one of the besetting vices of Sweden, but a favourable alteration has taken place. The reasons are, firstly, that Swedish brandies have become much dearer since an excise is levied on the produce—about 1s. 4d. per gallon; and, secondly, that the sale of brandy hasbeen considerably restricted, partly by a tax on the retail trade, and the licensing of brandy-shops for consumption on the premises, and partly by the Permissive Bill, by which a parish or a town can either entirely prohibit the licensing of brandy-shops in its environs, or restrict the number of these places. In Gothenburg, a society which has been formed exclusively for the purpose of promoting sobriety among the labouring classes has farmed the license of keeping brandy-shops in Gothenburg and its suburbs. With a view of attaining this end, it has greatly restricted the number of these places, and converted them into respectable eating-houses, where brandy, wine, and malt liquors are also sold. Strict rules for promoting sobriety and order are kept up; no brandy is sold on credit, and no person is allowed to drink till he gets intoxicated; and, further, no brandy is sold to persons under adult age. All the profits arising from these shops are handed over to the municipal authorities, and go towards diminishing municipal taxation. The profits during the last year exceeded £10,000.

Though wages in general do not range high, still they are higher in Gothenburg than in any other part of the country, and will suffice to maintain a man not encumbered with too large a family, if he is sober and industrious. The average wages of a common labourer, estimated at £2 10s. a month, will enable him to keep himself, wife, and two or three children, in a decent way. Of this £2 10s., 10s. per month goes for house-rent, £1 10s. per month for provisions, leaving 10s. for clothes and incidental expenses. Examples are not uncommon in Gothenburg of labouring men who, by dint of industry and sobriety, have raised themselves to a comfortable position, and brought up their families in a creditable manner; but, as a general rule, the credit in these cases is due to the wife, on whose thrift and economical habits the comfort of the family mainly depends.

TRIAL OF COTTON GINS AT MANCHESTER.

The second series of cotton-gin trials, commenced in Manchester on the 15th ult., have been brought to a conclusion. The object of the second series was partly to give entrance to machines not included in the first, but chiefly to allow manufactures to profit by the experience which the first trials afforded them, and to test the value of any improvements which this experience had enabled them to effect. The trials are thus described by the *Times*:—

The patentee or manufacturer of any form of gin had hitherto been content, in most cases, to go on turning it out according to pattern, in numbers regulated by the demand; and seldom possessed any intimate knowledge of its actual work upon large quantities of material. It thus not unfrequently happened that a gin, based on a correct principle, was imperfect by reason of some defect in a matter of detail, and, on the other hand, that much skill in contrivance and in workmanship was expended upon a principle essentially unsound. We observed, for instance, one gin, a typical example of the latter class, which, at first sight, seemed calculated to work with great rapidity and smoothness, and to turn out fibre and seed in large quantity and unexceptionable condition. But its chief feature was a horizontal blade, placed under such circumstances that it was necessarily made thin. In actual practice, it has been found that any small lump in the fibre, or any accumulation of fibre at a particular spot, is liable to lift or bend up the edge of this blade in passing beneath it; and that at these points the blade is frequently chipped and broken in contact with another portion of the machine, which it is intended to clear. Such breakages would, of course, be serious, even in the neighbourhood of a factory, but on a cotton estate, with no means at hand of repairing damages, a very few of them would render the machine altogether useless. The most remarkable of the machines which have been modified for the second trials is undoubtedly the knife-roller gin of Messrs. Dobson and Barlow, which has been altered in several particulars, and has had its speed of working greatly increased. This gin consists of a horizontal spindle, on which circular knives, comparable to quoits, are set obliquely at short intervals. As the spindle revolves, the knives pass just clear of a horizontal bar placed above them, in front of which is a Macarthy roller, and, as the cotton fibre is drawn out, the seeds fall down through the intervals between the blades. The alterations made in this gin, which are entirely the result of its having worked for several days under the observation of the manufacturers, consist chiefly in a change in the width of the blades, and in the degree of their obliquity to the spindle. Pegs also have been placed in the intervals between them, in order better to distribute the feed; and the construction of the Macarthy roller has been modified, with a view to increased durability. The original roller was built up of discs of leather placed at right angles to their axis; but in the new one the discs are placed obliquely, like the blades, and it is hoped that this arrangement will enable the roller to retain longer the slight roughness of surface which materially assists it in holding and drawing out the fibre. A system of outside screws has been added, by which the relative distances apart of the blades, bar, and roller can be modified very speedily, without stopping the machine, and the construction of the feed-board has likewise been somewhat altered. It will be highly interesting, when Dr. Forbes Watson's report is made public, to observe the changes in quantity and quality of work which these various modifications have effected. Dr. Forbes, the superintendent of the government factory at Dharwar, has ordered one of the saw-gins under his charge to be fitted with a roller and continuous wire saw like that of Cooper's gin, exhibited by Messrs. Garnett. The result has, as yet, only been imperfectly tested, but it seems likely to afford a machine in which any breakages may be repaired with extreme readiness, and by the hands of ordinary workmen. Among the gins which make their first appearance in the second series of trials are two small hand churkas and an Emery saw-gin. The latter is provided with a condenser, or pair of rollers, between which the issuing fibre is received and flattened into a coherent substance, so that it falls upon the ground instead of being blown to some distance by the draught of the machine. Until the quality of the fibre turned out by the various gins has been fully tested and reported upon, it would be premature to arrive at any conclusion with regard to their respective merits. But the trials have at least rendered it certain that in point of quantity of work, the best saw-gins have been beaten by more than one form of roller-gin; and also, that one particular roller gin has, in this respect, come prominently to the front, and distanced all competitors. The prevailing belief is, that the teeth of the saw-gins are apt to lacerate and injure the fibre; and, if this belief should be shown to be well-founded, it is manifest that they must before long be almost entirely superseded. Besides the gin trials, experiments have been conducted, in order to test the degree of pressure to which raw cotton may be subjected without risk of crushing the seed, and without injury to the fibre. Some of the Dharwar samples have been compressed to the extent of getting 44lb. weight into a cubic foot; and it is believed, from the appearance of the outside portions, that no harm has thus been done. The issue raised is an important one, because it is probable that, if raw cotton can be sufficiently compressed for easy freight, it will be found economical to have it ginned by the manufacturer rather than by the producer. The American seeds, and the seeds of Indian cotton of American descent, retain a large proportion of their fibre under any method of ginning, and retain as much as one quarter of the whole when imperfectly ginned upon the estates. This retained fibre would be of great value to paper manufacturers, by whom American seed is now actually imported. If the raw cotton were itself imported, the ginning might be effected by manufacturers in the best possible way, and the seed would be at once available—first, for the purposes of the paper manufacturer, and then as a source of supply of oil and of oil-cake. The husk, to which the fibre is adherent, would also have a definite, though small, value as a manure.

The following article from the *Draper* gives some further information:—

The experiments which have been conducted in Manchester, to test the various descriptions of cotton gins, were concluded, so far as the ginning is concerned, on Saturday. This week is mainly occupied in the preparation of samples for valuation, and in arrangements for the subsequent treatment of the cotton which has been cleaned by each machine. Dr. Watson has not confined his attention solely to the cotton gins and their performances, but has also tested the effect produced upon seed cotton by the pressure given to it when packed in bales for shipment, in the same manner that cleaned cotton is now packed. The object of this test is to ascertain whether or not the seed would itself be crushed and damaged, or do any harm to the cotton, if it were all packed together under heavy pressure, and sent to this country to be cleaned by gins here. This is a matter of considerable importance, for several reasons; and it is believed the result thus far apparent, is, that seed cotton may be thus treated without any injurious effects being produced, either upon the seed or the cotton.

Another operation has also been tried upon cotton in its pod, or just as gathered, and before it has been picked up by hand from its natural shell. We understand that till the machine to which we refer was brought out, there never was any attempt to prepare cotton for the ordinary opener and the gin, except by hand-picking. The machine tested for this purpose is one made by Messrs. Clarke and Figon, Rye, Sussex, and was in charge of Mr. T. A. Timmis, of Manchester, their agent for India, at the works of Messrs. Bellhouse, the Eagle foundry, David-street, Manchester. In general form it resembles an ordinary thrashing-machine, such as is now common in any farm-yard. The cotton to be treated is supplied to the interior of the machine by a fan, which blows it up an inclined spout. The advantage of this method of feeding over any other is, that any stones or other hard substances which may be among the cotton may not pass into the machine, but that they, being too heavy for the blast to drive them up the spout, may find their way downwards through an opening provided for them at the lower end, and fall to the ground. The cotton then passes through two cylindrical screens, each about 10ft. long. 2ft. diameter, formed of wire, and having within them a number of beaters spirally set upon central spindles. These arms, revolving in the screens, shake out the dirt, and pass the cotton on to a pair of toothed or pegged horizontal rollers, so placed that the cotton may fall upon them. The rollers are about 7in. and 15in. in diameter respectively, and 2ft. long; and they are driven at different speeds, so that a beating action takes place between them sufficient to knock or thrash off the pod, or shell, while, at the same time, no damage is done to the cotton. From the rollers the cotton and the pods pass through two more screens, similar to the first, and having lost much dust and dirt on the way, still having the loosened pods amongst it, the cotton comes out ready for the removal to the gins. The trial showed that a large quantity of raw cotton could be very quickly treated by the machine, but that it would still need to be picked over by hand before ginning; for, when subsequently tested by being ginned with the pods amongst the cotton, the finished sample was not so clean as could be wished. Still it may, no doubt, be true that such a machine would so thoroughly loosen a large quantity of cotton from its pods, at a very small cost, that subsequent hand-picking would be so much easier as to render the use of the machine of greater value. It has also one feature of considerable importance, which is, that it separates to a large extent any imperfect or undeveloped cotton, which not having arrived at maturity, is unfit for mixing with the general stock, and this alone may probably be of some practical value. Many of these machines are already in use, and on the whole the experiment with them was satisfactory. The power required is very small; about two or three horses power will drive it; and when thus driven and attended by three men, it will do as much work as 400 persons will by hand, or about 10,000 lbs. in twelve hours.

NEW PAPER FIBRE, BROOM.

It will be remembered that in the discussion on Mr. Johnstone's paper, "On Esparto," it was suggested by Mr. Hyde Clarke that esparto might be grown in the congenial climate of Asia Minor, and he recommended application to be made to the Ottoman Government and leading authorities. In consequence of this proposition, the paper was sent out to Turkey, and one of its first fruits is a sufficient response from Mr. Augustus Oakley Clarke, of Sokia. This place is a small town in the province of Smyrna, near the railway, and not far from the port of Scala Neva. Here are two English liquorice establishments. Mr. A. O. Clarke, the head of one of these, is the most distinguished experimental agriculturist and horticulturist in Turkey, and his experiments on hybridisation of cotton on a large scale are well-known to the members of the Cotton Supply Association. He does not think favourably of esparto-growing as an enterprise, though it takes no longer time than the fig (Smyrna fig) and olive of the same district. He, however, says that the broom, which is slightly cultivated for domestic use, has a suitable fibre, and that its cultivation may be easily extended. As Mr. Augustus Clarke was a resident in Spain before he introduced liquorice-making into Turkey, his opinion is entitled to great attention. It is to be hoped members of the paper trade will put themselves in correspondence with this gentleman, as his example would speedily be followed in his district, and he has presses on his own works, and steam-power fed by coal from his mines. The following is Mr. A. O. Clarke's communication:—

Sokia, 25th January, 1872.

SIR,—I am in receipt of your favour of the 29th ult., with a copy of the Society's *Journal*, in which is published an article on the esparto plant. In reply, I can have no hesitation in saying, I think it most improbable that any one will undertake its cultivation in Asia Minor, on account of the very long time required before any profit can be obtained from it, say fifteen years. It is very true, the vine and fig-tree require nearly this time before profitable bearing commences, but when a man plants either of these, he knows what he is about, and if he does not live to see the benefit of his labour, he knows, from experience, his children will; but the esparto grass being quite unknown, I feel convinced no native could be persuaded to attempt its growth. As far as myself is concerned, I intend to leave this country in the course of a few years.

I am informed by a party well acquainted with the Great Desert of Sahara, that the esparto grass grows there to an inexhaustible extent.

There is an article here called "broom," an annual; the appearance is very much like esparto, and I think it possesses equally as good a fibre; it produces a large quantity of seed, good for feeding cattle, poultry, birds, &c. If this seed could be introduced into consumption in England, at the price of Swinstone barley, the grass for paper manufacturing could be put down in England at a much lower price than the present value of esparto. I could easily extend its growth, so that in three years the article could be supplied in very large quantities. We have every facility for pressing, as we have powerful hydraulic presses in our liquorice works.

At present every farmer grows grass sufficient for his domestic wants as regards brooms. I will obtain about a hundredweight of it, and some seed, and forward it to my friends Messrs. Robert MacAndrew and Co., that they may exhibit the article.—I am, &c.,

A. O. CLARKE.

P. Le Neve Foster, Esq., Secretary to the Society of Arts, Manufactures, and Commerce, London.

PARAGUAY.

The Paraguayan Consul-General in London, Don Maximo Terrero, has recently published a note as to the position and prospects of the country he represents. He says:—

Paraguay, one of the states of the River Plate, situated between the 21st and 27th degrees of southern latitude, contains an area of 72,000 square miles. The country may be described as an inland peninsula, enclosed on all sides, except on the north, by two great navigable rivers, Parana and Paraguay. The whole surface belongs to the basins of these great rivers; a mountain range of considerable elevation stretching between them from north to south, so as to form their water-shed, and send the drainage, in nearly equal proportions, in opposite directions. Thus Paraguay, by means of the vast number of running streams which form the tributaries of the two great rivers on its boundaries, is one of the best-watered countries in the world, and is in consequence one of the most productive.

Its natural irrigation ensures it against drought, and supplies it everywhere with a suitable and inexhaustible motive power. In fact, in all that constitutes an agricultural country, rich lands, a fine climate, and abundance of water, Paraguay may be described as unequalled.

Unlike the open territories surrounding it, Paraguay is well-wooded, and among its trees are many that are valuable in the arts and manufactures. It abounds in medicinal products, such as rhubarb, sarsaparilla, jalap, sassafras, dragon's blood, copaiva, nux-vomica, liquorice, ginger, the tamarind, &c., and it produces dye-stuffs in immense variety, such as cochineal, indigo, vegetable vermillion, saffron, &c. Many of the forest trees yield valuable gums, some of which comprise the most delicious perfumes and incenses, whilst others are, like amber, hard, brittle, and insoluble in water. The *seringo*, or rubber tree, and the *palo santo*, which produces the gum guaiacum, crowd the forests in certain districts, and the sweet-flavoured vanilla is abundant. The filament of the caraguata, a plant which grows there in vast abundance, was exhibited in Paris, and declared to be superior to the jute of the East Indies. It will no doubt soon become an important export.

Upon the hills the celebrated "Yerba-Maté" (*Ilex paraguayensis*) flourishes abundantly. From this herb is produced the Paraguayan tea (*Maté*) which is so generally used throughout South America. The government monopoly of the sale of the yerba, and a heavy duty imposed upon its export, formed, at one period, the principal source of revenue in Paraguay; and the myriads of cattle, which, though scarcely required for food in a country so richly provided, yielded invaluable products in the shape of hides, tallow, hair, bones, and all that constitute so large a source of trade at Monte Video and Buenos Ayres. On the alluvial tracts, where cultivation is attempted with implements, however primitive and imperfect, sugar-cane, cotton, tobacco, rice, maize, and, in short, the greater part of the most valuable products of the tropical and temperate zones are raised in profusion. The climate, which has its heat greatly modified by the dryness of the atmosphere, inequalities of surface, running streams, and other natural causes, concurs with the natural fertility of the soil in producing a vegetation of great luxuriance and grandeur, offering to European emigration a most promising field.

Commodore Page, of the United States Navy, who, under the orders of his government, recently explored the tributaries of the river La Plata, speaks in enthusiastic terms of the banks of the Parana and Paraguay:—"On the isles of the Parana we saw the lovely gardens of the La Plata; we have now before us her parks. The Paraguay is the region of the palm, which here rises to a great height. The grass is green, luxuriant, and clean as a well-kept lawn. Deer gambol under the trees, and it needs not a vivacious imagination to conceive that, at each bend of the river, some noble mansion, to which these banks pertain, will appear. Habitations are alone wanted to animate the landscape, and complete the pleasant association of homes in this fair land. There are extended forests of these palms, so symmetrical, fresh, free from all that could detract from their beauty, growing apart at such exact and apparently measured distances, till we were filled with astonishment and admiration."

More than three-fourths of the entire territory of Paraguay is national property. Part of these government lands are let at a very moderate rent, under the single condition that they shall be well cultivated. On other portions of the national lands are large farms, where thousands of cattle and horses are bred by private speculation, realising 25 per cent. annually, and these farming establishments are let at a mere nominal rent to encourage immigration. The large grazing district of Caapuen has always been the wealthiest part of the country, and is remarkably well adapted for sheep, as well as for cattle and horses. It is hilly and temperate, and very much reminds one of the finest sheep farms of Scotland. A few English gentlemen have already begun to stock some of the old estancias in this district.

Metals abound in Paraguay. Iron and copper are found. Lead, quicksilver, and sulphur have been discovered, as well as coal and marble of the finest quality. The Spaniards, when they established themselves in Paraguay under Sebastian Cabot, found the natives decorated with gold and diamond ornaments, and there is little doubt that precious metals and stones are to be found on the territory, as well as in the adjacent empire of Brazil.

An idea may be formed of the fertility of Paraguay, from the fact that the ground around Assumption, the capital of the Republic, has been sown every year since its employment, which is over 300 years, without any kind of manure.

Unhappily for Paraguay, the great and prolific resources of this country have hitherto been neutralised. This has arisen partly from a mistaken policy, and partly from the misfortunes which arose out of that policy, now, however, finally abandoned. Up to a very recent period of her history, Paraguay was a country which held herself aloof from the divisions and warfares of the South American States. Paraguay established a principle of peace; but with that principle she also, unfortunately, established a principle of non-intercourse with other states. Relying on internal resources, she refused, in fact, either to import or export, and deprived herself, in consequence, of all those sympathies with the outer world which arise from commerce, enterprise, and the cultivation of the manufactures, sciences, and arts. After a long interval of peace, came the whirlwind of a war, which has ended, as might have been expected, in the devastation of the country. This being happily over, an effort is now being made to re-establish the commerce and credit of the country.

PRIMARY EDUCATION IN FRANCE.

M. Jules Simon, Minister of Public Instruction, has laid before the Commission of the Assembly his promised plan of public education. It is an elaborate document, and will doubtless give rise to long discussion. M. Simon adheres to the principle of obligatory instruction, with some few exceptions; but he has abandoned the two points with which his name has heretofore been identified, namely, that education should be absolutely gratuitous and laical. These changes will render the measure less objectionable than it would have otherwise been to one portion of the Assembly; but will probably cause violent opposition from the other side. According to the terms of the bill parents will be compelled by law to keep their children at school from the age of six to thirteen, that is to say, they must either send them to school, or prove that their education is properly provided for at home. Those who neglect or refuse to comply with these conditions will, in the first place, receive a private reprimand, to be followed, in case of contumacy, by a public reprimand, by the withdrawal of relief in case of indigence; next by fines, which are to increase in amount, and finally by deprivation of civil right for a period not exceeding three years. In the case of children employed in factories, or by farmers, or other persons, the employer will be bound under like penalties to see to their education. The bill includes the principle of education qualification for the suffrage, but its action in this case is necessarily deferred; as it stands at present, no person, after the 1st of January, 1880, will be allowed to have his name placed on the list of voters unless he can produce a certificate of a certain amount of study at school, or by making an application in writing in the presence of the *maire* and two municipal councillors. One great complaint against the bill is that it contains no provision for the improvement of the position of common school-teachers, and especially for the schoolmasters in villages, whose miserable condition renders them, as a rule, totally unfit for instructors. The Finance Minister has probably been compelled by circumstances to insist on this important reform being deferred. But the grand complaint of all is that M. Jules Simon's bill does little or nothing towards setting aside incompetent clerical teachers. It has always been a cause of dissatisfaction that, while no laical person, male or female, could exercise the profession of schoolmaster, schoolmistress, or teacher, without passing a rather severe examination and obtaining a certificate, clerical teachers and nuns were submitted to no such rule, and, as it was said, were thus enabled, however ignorant, to compete unfairly with regularly-educated teachers. M. Simon's bill provides that those nuns who have acted as schoolmistresses or teachers for four years shall still be allowed to do so without certificates, while clerical schoolmasters will be allowed to act without any such certificate until 1876, the reason for which is certainly not apparent. With respect to the question of clerical or lay teachers, it is provided that, in case of the resignation, dismissal, or death of a common schoolmaster, the municipal council of the locality shall decide whether the new master shall be clerical or not, there being an appeal, however, to the Superior Council of Public Instruction. Under present circumstances, these provisions are regarded as highly favourable to the clergy, and are consequently regarded with great disfavour by the majority out of doors, at least in Paris.

THE NEW PORT CHARGES AND DUTIES IN FRANCE.

The new law, passed on the 30th of January, has been promulgated by decree; the following is the substance of it:—

Art. 1. Merchandise imported in foreign vessels, except those from the French colonies, will be charged at the following rates per 100 kilogrammes:—From countries in Europe, and the basin of the Mediterranean, 75 centimes. From beyond Europe, and to Cape Horn, and Cape of Good Hope, 1 fr. 50c.; from beyond those capes, 2 francs.

Art. 2. The above surcharges not to apply to guano.

Art. 3. Merchandise from beyond Europe, imported into France from European entrepôts will be surcharged at the rate of 3 francs per 100 kilogrammes. This article does not apply to merchandise which already pays a higher surcharge.

Art. 4. The above articles, 1 and 3, are applicable to the commerce between Algeria and foreign countries.

Art. 5. The duties in the importation of ship and other vessels are fixed as follows:—

	Per ton guage.
Sailing vessels, rigged and fitted in wood	40 francs
,, ,, wood and iron	50 ,,
,, ,, all iron	60 ,,

Steam vessels same as above, with the duty on the machines in addition.

	Per ton guage.
Hulls of ships, in wood	30 francs
,, wood and iron	40 ,,
,, all iron	50 ,,

These duties not to apply to foreign vessels proved to have been purchased before the promulgation of this law.

Art. 6. All vessels coming from foreign ports, or from the French colonies and possessions, whether partially or totally loaded, will pay the following quay-dues, per ton measurement:—From Europe and the Mediterranean, 50 centimes; all other parts, 1 franc.

In case of visiting several French ports, the duty will be taken at the first only.

NOTES ON ART.

Whatever may be said of certain branches of English art, there can be little question respecting the charm and the multiplicity of water-colour drawings, or, as too many must unfortunately be called, paintings in water-colour. The two styles ought to be kept as separate almost as oil-painting and fresco, or pencil and crayon drawings; they have scarcely anything in common; the handling is totally different, and, with all the ability in the world, gouache and opaque water-colour painting of all kinds never can produce the effect of transparent colours. The defence of the use of opaque colours is that they save a vast amount of trouble; this is admissible in itself, but, seeing that the effect is invariably different, the world should learn to regard the two manners as almost unconnected with each other. It would be a good thing to see a positive separation in our galleries, for each method would tell better apart from the other; but, there being little hope of this, it is well to be able to record that, in the water-colour exhibitions at present open, there is a fair proportion—a larger proportion than usual—of pure, transparent water-colour drawings.

The Society of Painters in Water-colours, the old society, deserves first mention. The great room in Pall-mall East, commodious, well-arranged, and well-lighted, as it is, presents this winter a charming appearance. There are nearly four hundred works on the walls, and although, like all exhibitions, it would be greatly improved by rather more severe sifting, still the proportion of good and even splendid works is highly satisfactory. This could scarcely be otherwise when we look at the names in the catalogue. First, the newly-elected President, Sir John Gilbert, contributes six works, two at least of which are remarkable, even as coming from his facile and experienced pencil. Of the members of the society, Messrs. T. M. Richardson, C. Smith, Birket Foster, C. Davidson, W. Callow, G. Dodgson, E. Duncan, H. Gastineau, E. A. Goodall, E. Lundgren, Jenkins, Danby, Glennie, P. J. Naftel, J. D. Watson, J. W. Whittaker, and H. B. Willis are the largest contributors; while the Messrs. Fripp, Evans, W. Goodall, and A. W. Hunt are not represented. The associates, and especially Messrs. Collingwood, Cox, jun., J. Burgess, Callow, Deane, Hall, Jackson, Marks, Newton, and Powell, exhibit in full force; and the ladies are represented by Miss Gillies, Miss M. Harrison, and Mrs. H. Criddle. Amongst so many admirable works may be mentioned "Marmion" (173), by Sir John Gilbert; "Black Alder Bushes" (34), by Mr. J. W. North; "A Moorland Beck" (37), by George Dodgson; "The Town-hall, Como" (46), by E. A. Goodall; "Llanfairfechan, Caernarvonshire" (61), by D. Cox, jun.; "Windfalls" (66), by J. D. Watson; "Frankfort-on-the-Maine" (67), and "On the River Tallock, Argyllshire" (82), by T. M. Richardson; "Frankfort" (93), by W. Callow; "The Porch of San Fermo Maggiore, Verona" (101), by W. W. Deane; "Beechen Hollow" (104), by J. W. North; "The Market-place, Seville," and another (109), by P. J. Naftel; "The Castle of Ischia" (112), by E. A. Goodall; "On the River Wye" (119), by Thomas Danby; "Water-fall" (127), by F. Powell; "Proscida, Bay of Naples" (167), by E. A. Goodall; "On the River Irfou" (187), by T. Danby; "The Chimney in the Gate-house, Kenilworth" (199), by J. Burgess; "Study of Amaryllis Lily" (240), V. Bartholomew; "Loch Goil" (249), by F. Powell; "Winter" (269), by C. Brandwhite.

The Eighth General Exhibition of Water-colour Drawings is also open in the Dudley Gallery of the Egyptian-hall. The collection here numbers nearly 700, and although many of the works are of small size, the walls are, unfortunately, overcrowded, and it is painful to see works which have cost the artist much trouble either placed so high as to be utterly lost to the visitor, or actually down on the dusty floor, in danger of annihilation from any careless foot. There are four screens in the room, and although these seldom present satisfactory places for pictures, they are less objectionable than the edge of the matting or carpet. One feature of this exhibition is the large proportion of lady exhibitors, many of whom contribute charming specimens of their art. Amongst the most prominent works in the gallery may be mentioned "Views of the Ruins of the Tuileries, and the Hotel de Ville," by Mr. R. Phené Spiers, admirable for their truthfulness, architectural as well as picturesque; the "Temple of Koom Ombos, Upper Egypt" (43), by H. Pilleau; the "Old Curiosity Shop" (94), by Miss A. McWhirter; "Venice" (117), by Mr. F. B. Van Moer; "Pasture Land among the Mountains" (190), by G. Mawley; "Sweet, My Child, I live for Thee" (227), by Madame Bischop; "Grange Fell" (256), by H. B. Richardson; "Winter," a portrait (262), by Joseph M. Jopling; "Cornelius Agrippa showed the fair Geraldine in a mirror to the Earl of Surrey" (295), Miss Lucy Maddox Browne; "Diving into Secrets" (301), Mr. A. C. H. Luxmore; the "Pass of Dwygyfylchi, North Wales" (312), by C. Woodman; "Donnez moi du feu" (495), by Louis Lelois; "Mavourneen" (497), by Miss Henrietta Cockran; "Villanella (501), by M. C. Jalabert; "Before the Bull Fight" (509), by M. J. G. Vibert; the "Traveller and the Guide" (526), "Daybreak" (189), and "Dawn" (201), by Mr. G. Simeon; "Sketch in a Spanish Church" (561), by J. B. Burgess; "Saint Giles'-in-the-Fields" (574), by Townley Green; "A Frieze of Masks" (606), by H. Stacy Marks, A.R.A.; "Birds" (607), by Mrs. C. Rossiter; "Interior of the Mosque of Kaid Bey, Cairo" (649), by Frank Dillon, with many more charming works, which fully deserve notice.

The number of original works issuing from the French press is naturally small at present, but there are many examples of a class of books which has become remarkable during late years, namely, illustrated editions of old works, or of popular compilations in natural history and science, and many of these are remarkably beautiful. Amongst the most remarkable of this class of works published of late is "Mœurs, Usages, et Costumes au Moyen Age," by M. Lacroix. This is a companion volume to the popular edition of the great work by the same author, with other writers, on the arts of the middle ages, which has been published in an English form with the original plates. The new work, like the preceding, is profusely illustrated with wood-cuts, 300 in number, and admirable chromo-lithographs, by Kellerhoven. The illustrations are of seignorial and ordinary life of the middle ages, derived from contemporary documents, and have therefore historic as well as artistic interest. This beautiful work is from the press of MM. Didot, and is equally remarkable for its cheapness as its beauty. The same firm has issued "Pompeii et l'Alhambra," by M. Delagrièze; and "L'Homme et la Bête," by M. A. Mangin, the former being illustrated with steel, and the latter with wood engravings. MM. Hatchette have published "L'Atmosphere," a description of the grand phenomena of nature, by M. Camille Flammarion, a work in one large volume, illustrated like that of M. Lecroix, with a profusion of wood-cuts and many chromo-lithographs. This work was presented to the Academy of Sciences by its secretary, M. Elie de Beaumont, with high eulogium, especially with respect to that part which treats of late discoveries in meteorology. The value of this book is enhanced by the fact that the illustrations are not all from one hand, but contributed by thirteen or more eminent French artists, including MM. Silbermann, Cicéri, Girardet, Achard, Berchère, and Weber. The same firm publishes another beautiful work, "Rome: Descriptions and Souvenirs," by M. Francis Wey, also profusely illustrated; "Les Races Humaines," by M. Figuer, a picturesque description of the various races on the globe, illustrated with coloured and other plates. MM. Mame et Fils have produced a magnificent volume containing the "Chanson de Roland," with an historical introduction, a translation in modern French, and a *fac-simile* of the Oxford manuscript; and a fine edition of the select letters of Madame de Sévigny. These works are also illustrated, and that most artistically, but in a different manner to the preceding, the plates consisting of admirable etchings by the well-known artists, Chifflart and V. Foulquier. In spite of the absence of colour, an original etching must be placed in artistic value before either wood-cut or chromo-lithograph, brilliant as are the latter. M. Rothschild, of Paris, is publishing in parts a description, by M. Frehner, conservator of the Louvre, of the bas-reliefs of Trajan's column, of which casts were taken by order of Louis Napoleon, with splendid illustrations; and announces the appearance of "The Musée de France," a collection of the antique monuments in the public and private collections of the country, the illustrations being on wood and steel, and in chromo-lithography and etchings. These are but a few, though, perhaps, the most remarkable of the illustrated works coming from the French press.

So many female artists have of late years attained high positions in France—Rosa Bonheur, Madame Henriette Browne, and Mdlle. Jaquemart, need only be mentioned—that their claims to be represented in the Academie des Beaux-Arts has been pretty generally recognised; the question is now before that body, and it is said that it is likely to be resolved in the affirmative. Should this be the case, there is little doubt that a strenuous attempt will be made to induce the Académie Française to follow the example of her sister institution, for it has long been felt that the exclusion of Madame George Sand, and some other eminent authoresses was both unjust and illogical. The death of the Père Gratry has just caused another vacancy in the latter academy.

The provincial academies and societies of France set a good example to others in the encouragement they offer to art and literature; almost every chief town in France has its annual or other exhibition, supported by voluntary subscriptions, and organised by societies who not only give prizes to artists exhibiting, but also purchase and cause to be purchased a considerable number of the works exhibited, a fair proportion of which go to enrich the public galleries of the towns in which the exhibitions are held. These local exhibitions are of especial value to young provincial artists, who are thus introduced to the world. The local academies in many cases offer premiums for works of art and literature; thus the Rouen Academy of Sciences will this year award a prize of 500 francs for the best work of art, whether painting, sculpture, or engraving, on a subject drawn from the history of Normandy; and offers one of 700 francs, to be awarded next year, for the best critical essay on the works of four painters of Rouen of the eighteenth century, Deshayes, Lemonnier, Lavallée-Poussin, and Barbier the elder, who were all members of the then Académie Royale of Painting.

Another small collection of paintings is announced for sale in Paris, for the last day of the present month. The works were the property of M. Paturle, and include, amongst others, two of Decamps' small oriental works, "Turkish Children playing with a Tortoise," and "Asses Resting;" "Les Natchez," by Eugène Delacroix; "The Bourgeois Flamands," a large work, nearly ten inches wide, by Meissonier; "Margaret in the Church" and "Margaret leaving the Church," by Ary Scheffer, with reproductions by the same painter of his "Faust in his Study," and "Margaret at her Spinning-wheel;" "Animals flying before a Storm," by Troyon; "The Decameron," by Winterhalter; and works by Isabey, Lehmann, Leopold Robert, Ulrich, Van Os, and other modern painters.

NOTES ON MANUFACTURES.

The woollen industry of Greece, according to the description given by Mr. Barrington, Secretary of Legation at Athens, appears to be of a purely domestic order. Almost every household which counts amongst its possessions sufficient sheep or goats for the purpose of "manufacture," taken in its literal sense, works up at home the result of the animal shearing, and what is not required for the wants of the house is conveyed to the nearest fair, and there exchanged for whatever the producer may be most in need of. At the National Industrial Exhibition, recently held at Athens, there were specimens of almost all descriptions of woollen fabrics produced in Greece, and the characteristic plainly enough illustrated was the evidence of their market being limited. Apart from the question of price, the varieties were few in number, and the apparent conventionality of their pattern indicated the observance in their make of certain traditions, along the groove of which consumers and producers are alike content to travel. The stuffs designed for wearing apparel are used solely by the country people and those who adopt the national costume. The only other goods likely to meet with any demand are carpets, and these, we are informed, were excellent of their kind—strong, durable, and of fast, though not usually brilliant dyes. But the only general sale they seem to have is in short lengths, somewhat roughly stitched together in the form of mats or rugs, and the long pieces on view in the exhibition were probably made for the occasion, as an evidence of what could be, rather than what is, done in this line. The carpets in general use are very narrow, and though there are pieces, which come from Eubœa, to be found in the market, from two to three times the customary width, their cost for covering an equal area would be very nearly double. At present, there does not exist much impulse to develop this latter branch of industry into any material importance. Women are almost, if not quite, exclusively employed in those districts where this work is chiefly carried on; their number is not large, and a very small proportion devote themselves to making the superior qualities, whilst fewer still are employed with any view to a general market. The most that one woman can make in a day seems generally stated at three-quarters of a yard, and the work is principally done in the winter-time, when other occupation is wanting. These gay-striped carpets—for the patterns are almost invariably variegated stripes, running crosswise—are also largely used for sacks and bags. A piece of any given size is simply folded across, and strongly sewn together along the sides, the edges at the ends being of course left open, and bound and fitted with some kind of cord for drawing them together. It seems a high priced material to be put to the purpose, but there is no doubt that the result is very substantial, and lasts a long time, and it is also certain that ordinary sacking would not stand the rough usage to which it is sure to be exposed in the country, were produce of all kinds is principally conveyed on the backs of animals. The difficulty of estimating what can be considered as wholesale prices is enhanced by the circumstance that woollen goods—like almost everything else in Greece, even fluids—are as often sold by weight as by measure. That prices are, however, high is self-evident, when the extreme narrowness of the material is taken into account, and these, combined with costliness and scant measure, are of course traceable to the same cause, namely, the absence of the power-loom, and the restricted size of the machine capable of being employed. To be set against this, however, is the durability of the goods, which, though possibly rough in aspect, are carefully and strongly constructed. The thick materials employed for strong jackets and overcoats are, when first turned out from the loom, two to three times as broad as the samples sent; but their subsequent treatment, which consists in their being beaten over and over again in water, reduces them to the width shown, after which they are said to shrink no more, and to resist any amount of wet. Something of this description is essential to the shepherd, who is a good deal exposed during the rainy season to the chances of being without any other roof than what he can improvise in the hill-side, and it is rare to see him at any time without his heavy, stiff-looking, capote over his shoulders. In the fabrication of the fez caps, which are knitted by hand, and then brought to a cloth-like appearance by a water process, the finest merino wool is used. This is imported from Austria and Russia, and the former country also supplies a considerable quantity of ready-made caps; and, notwithstanding the heavy import duty, the Austrian manufacturer is able to undersell the Greek; but he produces a somewhat inferior article, especially in respect of the dye; and the native maker bestows more minute care in the manipulation and finish of his goods, so as to ensure durability. Whether equally perfect results are attainable by machinery is an open question; but, should such be the case, the much diminished cost of production ought to allow foreign-made caps competing favourably with the Greek, even with the duty against them.

Enamelled cloth enters into many uses as a substitute for leather. It is light and pliable, and at the same time firm and durable. It has all the appearance of leather, with nearly its durability. Its most important use is that of a covering for carriage tops, for travelling-bags, and trunks. It is extensively employed in the manufacture of cushions and upholstering of a similar nature, and not rarely is it worked worked up into rain-proof coats and pants. The following is the process of manufacturing the black enamelled cloth, which enters mostly into consumption. The foundation of the article is cotton-cloth of the best quality, made expressly for this manufacture. It varies in texture and width according to the kind of goods for which it is intended. The cloth is taken from the bale, and wound round upon a large iron cylinder, and looks in that position very much like the huge rolls of home-made cloth seen by the ancients in the garrets and chambers of New England farm-houses when weaving was in fashion. It is now ready to receive its first coat, so it is slowly passed through the machine, across and between the huge iron cylinders, from the smaller of which, at the top, it receives its first coating of composition—a black, disagreeable-looking substance, composed of oil, lamp-black, rosin, and other ingedients, boiled together till about the consistency of melted tar. From between the cylinders, dressed in its black coat, the cloth is carried and wound upon a huge wooden frame, resembling in shape the old-fashioned reel. By an arrangement of spokes upon the arms of this huge wheel, each layer of cloth is kept separate, so that two portions of the cloth will come in contact. The frame, with contents when filled, is passed into what is called the "heater," an apartment kept at a high temperature, for the purpose of drying the coating or composition. After remaining in the heater a sufficient length of time to complete the drying process, it is removed and passed through the hands of workmen, who make all the rough places smooth. It is laid on long tables, and the workmen alternately sprinkle with water and rub with pumice-stone, till the whole surface is made perfectly smooth. The cloth is then wound upon the cylinder again, as at first, and passed through the machine to the reels and into the heater, and again under the pumice-stone. The cloth is passed through the machine five times, or till the required thickness has been laid on. After the last scrubbing down, the fabric is taken to another department, through the heater. It is now represented as a piece of cotton cloth, with a thick, shining coat of black, very much resembling patent leather. But it has not yet received its leather finish; so in another department it is passed through the enamel machine, which consists of another set of huge rollers, one of which covers its surface with regular indentions resembling the grain of a feather. The cloth is carefully measured, and rolled up in packages of suitable size, put up in boxes, and is ready for the market.

The *Leisure Hour*, in an article on "Brummagem jewellery," says:—"Birmingham is now the chief seat of the manufacture in England, for even London depends greatly there for its supply of jewellery for the middle classes. In the item of rings alone, as many as 30,000 wedding-rings have passed through the Birmingham Assay-office in a single year. And the progress of the trade has been marvellous during the last twenty-five years. The discovery of gold in Australia and California, and a growing habit of personal decoration—for vanity as well as superstition and love, tell largely on Birmingham business—have had so great an effect on it, that it now, directly and indirectly, employs more hands than any other in the midland capital. The term "Brummagem," sometimes given to inferior jewellery, is hardly a fair one, as articles of every variety of excellence, according to the prices allowed for them, are produced in Birmingham, while it really does much to make the beautiful and tasteful accessible to 'the million.' The subdivision of labour, and, yet more, the use of machinery, have greatly helped to affect this. An article was formerly made by one man; the gold was beaten out by him to the thickness required, and hammered into the proper form, the edges were filed that they might join correctly, and it was then soldered and completed. Now, many persons are employed, and many articles of a kind produced together; the gold is rolled by steam to the proposed gauge, blanks are cut out and struck to shape on a die by the screw-press, and the several parts have then only to be put together and 'finished.' In the 'gilt toy' branch, the aim is to produce good and cheap imitations of fine and costly jewellery, and the die and the press easily effect this. A locket worth from fifteen to thirty shillings in gold can be manufactured in gilt metal for a penny; and one, which some time since had a considerable run, and was made with hinges and clasp, in the shape of a book, with good likenesses of the Prince and Princess of Wales, was sold wholesale for about a halfpenny.

The Committee of Science and Arts, of the Franklin Institute, have made the following report on the artificial fuel made by Mr. R. F. Loiseau's process:—1. Anthracite small coal and dust were mixed with 7 per cent. of clay, and compressed into cylindrical moulds about 4½ inches in diameter, and 4 inches deep, or else into spherical masses about 3 inches in diameter. 2. The moulded masses are placed for a few minutes in a bath of benzine, in which resin has been dissolved, and from which they are removed, and dried by an exposure to the current of air. The object of coating them with a film of resin is to prevent the absorption of moisture and consequent softening of the clay; the solution in benzine penetrates the mass of coal and clay to a depth of about ¼ in., and so efficiently closes the crevices, that samples immersed in water for twelve hours were found dry in the interior when broken up for examination. Both the anthracite and bituminous fuels were burned in a furnace measuring 9 inches in diameter and 7 inches in depth. Each variety of fuel burned freely, and was completely ashed, but the intensity of the combustion was less than that produced by anthracite or bituminous coals of small size burned in the same furnace. These comparisons were made with a moderate, and also with a strong draught. The average amount of ash obtained from the anthracite artificial fuel was 16 per cent., and from the bituminous artificial was 18·5 per cent. The per-centage of ash is larger than in ordinary coal, as the clay is not consumed, but the other advantages of the artificial fuel, in point of durability, cleanliness, and cheapness, more than compensate this small disadvantage.

The increase in the prices of textile fabrics is shown in the Board of Trade returns. The export of cotton piece goods in 1871 reached nearly 3,411 million yards, being an increase of nearly 144 million yards, or above 4 per cent. of the quantity in 1870. But the value, which was over 53½ millions sterling, showed an increase of little more than £200,000, or not quite 0·4 per cent. In the item of woollen cloths we see, on the contrary, an increased value. The quantity exported—namely, above 35½ million yards—presents an increase of more than three million yards, or 9·7 per cent.; but the value, which exceeded 5½ millions sterling, showed an increase of £819,453, or 17 per cent. In the export of worsted stuffs, which approached 308 million yards, and was of the value of nearly 18 millions sterling, both the quantity and the value show the large increase of more than 30 per cent. over 1870. The exports of linen piece goods was not quite 217 million yards in 1871, showing a decrease of nearly six millions, or 2·6 per cent.; but the value—namely £6,708,735—presents an increase of nearly £16,000.

A very light and apparently durable material has been invented, says the *Builder's Weekly Reporter*, by Mr. J. Erichsen, of Copenhagen. The process of manufacture is to boil a quantity of best quality pasteboard in anhydrous coal-tar, Limmer asphalte, powdered silicate of soda and potash, and liquid flint, or other silicious soluble earth. It is then passed through rollers, then sanded, and afterwards rolled again. When fastened to the boards it is coated with Erichsen's India mastic, consisting of anhydrous coal-tar, Limmer asphalte, Portland cement, Farnham rock, or other soluble silicious earth, all boiled together and well stirred.

GENERAL NOTES.

Social Economy as an Educational Subject.—A little book on this subject, by Professor Thorold Rogers, forms another of the "Primary Series" published by Messrs. Cassell and Galpin, Ludgate-hill, a series intended to carry the elementary principles of the most important subjects into elementary schools. The subject is treated in the present volume in the clearest and most pleasant manner, and, as a school book, it will doubtless find its way into the school-room.

Exhibition of Ancient Musical Instruments at South Kensington Museum.—H.R.H. the Duke of Edinburgh, K.G., presided at a meeting of the Committee for promoting this Exhibition, on Wednesday, the 7th February, held in the board-room of the South Kensington Museum. There were present the Earl of Wilton, Lord Gerald Fitz-Gerald, the Hon. Seymour Egerton, Right Hon. Sir John Pakington, M.P., Sir Digby Wyatt, Mr. Henry Cole, C.B., Mr. Redgrave, R.A., Mr. Arthur S. Sullivan, Mr. Henry Leslie, Professor Ella, Mr. George Grove, Mr. R. Thompson, Mr. S. Arthur Chappell, Dr. E. Rimbault. The Secretary to the Committee, Mr. Alan S. Cole, attended.

Magnetic Mining Safety Lamp.—A patent magnetic lock has been adopted in some of the Staffordshire collieries, with a view to prevent miners and other persons working in the collieries from opening their lamps with forged keys and other implements. The lamps are self-locking by being screwed round, and they cannot be opened except by the aid of a powerful magnet, which is kept in the possession of the lamp-keeper. The cost does not exceed one shilling per lamp, and the invention is applicable to any kind of lamp. The simple locking arrangement is enclosed within the lamp, which is readily opened as above-mentioned. The magnet weighs about a quarter of a hundred weight. This seems to be a most important invention, and an improvement upon the Davy lamp.

Ventilation of Collieries.—Sir Goldsworthy Gurney, some years since, endeavoured to apply a steam jet for this purpose, but it was not adopted, after many trials. Mr. G. L. Scott, of West Gorton, has revived the idea, which has been tested practically by Messrs. Mayall and Seddon, in the Lower Moor Colliery, at Oldham. The result was satisfactory, as an air current, with an average flow of 22,792 cubic feet per minute, was obtained by this ventilator.

Silver Coinage Question.—In connection with the silver coinage question, it deserves notice that new coin has been exported for the use of foreign countries, where its quality and manufacture are appreciated; but it is unfair, as the expense of coinage is defrayed by the British public, who pay part of the legitimate expenses of a foreign State, in such cases. If the worn coin returns to this country it can be exchanged for new coin, whereby the British taxpayer incurs loss by wear and tear which occurred out of the United Kingdom. As a remedy, it has been suggested that the export should be prohibited, or that an export duty on specie, equal to the expense of coinage, might be more effective. It might not be impolitic to empower the British Mint to manufacture for certain foreign States their own coinage at a remunerative rate.

Sea-water Bread.—Dr. Rabuteau has lately communicated to the Paris Academy of Sciences the result of experiments made by him relative to the action of chlorides on the human economy. The able physiologist, in studying the alkaline chlorides and proto-chloride of iron, found that these chlorides had a highly salutary and invigorating action on the functions of the organs, and especially on the secretion of the gastric juice. He found, moreover, that the protochloride of iron, in its quality of a ferruginous salt, was anti-chloratic and anti-anemic, with the advantage of being more easily absorbed than other salts of iron, and Dr. Rabuteau proposes, therefore, to substitute it for them in therapeutics. The valuable qualities of the chlorides led Dr. Rabuteau to fabricate bread with sea-water, and he found that, while the flavour was excellent, the bread possessed other qualities of great importance. If sea-water, says the doctor, were not so abundant, it would be the most precious of mineral waters, and by introducing its principles into bread we have food rich in chlorides.

M. Guizot and the Paris Academy. — The biennial prize of 20,000 francs has been awarded this year by the French Academy to the illustrious statesman and author, who has accepted the award on the condition of establishing a triennial prize of 3,000 francs. In a letter to the permanent secretary of the Academy, M. Guizot says:—" Letters, indeed, present unparalleled rewards to those who, after having cultivated them with the confident ambition of youth, seek, at the end of a tumultuous existence, a dignified repose in a labour which is always so sweet. Will you submit to the Academy my intention to consecrate the amount of the biennial prize to the foundation of a prize of 3,000 francs, to be awarded by the Academy every third year for the best work published during the previous three years, and treating either of one of the great epochs of French literature, from its birth to our own days; or of the life and works of one of our great French writers or poets, philosopher, historian, orator, or learned critic. I trust the Academy will associate itself with my desire to encourage love and respect for our national literature, and to perpetuate the honour which it has deigned to confer on me." If we remember rightly, M. Thiers also devoted the amount of a grand prize, awarded to him by the Academy a few years since, in like manner. The number of donations and bequests in the hands of the French Academy—for the award of prizes of various amounts, and at various intervals, for the encouragement of young authors and the reward of great literary artists—is very large, and would form a curious list.

Telegraph to South Australia.—A letter in the *Times* of January 25th, says:—" On the 6th January, Adelaide was in telegraphic communication with 'Alice Springs,' north of the Macdonnell ranges, a distance, from north to south, of 1,100 miles. From Port Darwin, where the submarine cable is already landed, the land line reaches the Roper River, towards the south, about 150 miles, so that only between 300 and 400 miles remain to be finished before London will be in direct telegraphic communication with Adelaide, Melbourne, and Sydney."

The Library of the Luxembourg. — The French government has determined on opening the library of the Luxembourg to the public in the evening. This will be a great boon to students and literary men, and the experiment will deserve attention. It is not stated in what manner the rooms are to be lighted, but the method lately introduced in one of the new galleries at South Kensington, in which the light is outside the window, and furnished with a powerful reflector, would seem to remove all possibility of accident, provided, of course, that the gas-pipes themselves are all without the walls. This plan has also the great advantage of not interfering with the temperature or dryness of the air within. The Luxembourg Library is especially rich in journals and reviews — literary, judicial, official, and, above all, political; in the last division it is unrivalled. The books number about 40,000, principally on contemporary history, theology, belles-lettres, art, and science.

Balloons.—M. Dupuy de Lôme gives an account of a trial made by him, on the 2nd of February, for steering a balloon, which he had begun to construct during the siege of Paris. This balloon fulfils all the conditions laid down by him and accepted by the Commission of Examination. Its shape is a lengthened ellipsoid, with a capacity of about 3,500 cubic metres. It is made of white silk, covered internally and externally with a varnish composed of collodion and glycerine, which renders it impermeable by pure hydrogen gas. It is covered with two nets, the cords of which are so arranged as to give the greatest possible stability to the car, however much the balloon may oscillate. During the whole of the ascent, such was the steadiness of the car, the passengers could walk backwards and forwards in the car as well as on the ground. This wonderful stability was not disturbed even by the partial contractions of the balloon. The balloon is furnished with two screws and a rudder, intended to produce speed and direction. Filled with hydrogen extracted from water, it started, carrying 14 persons—M. Dupuy de Lôme and his assistants, M. Zedé, captain of a frigate, and a crew of eight men for working the machinery. The wind, when they started, was strong, but by giving the screw a rotation of 25 turns a minute, they were able to produce an actual velocity of 50 kilometres an hour, and cause a deviation of 10 to 12 degrees from the direction of the wind sufficient to enable them take any desired course. By means of a simple arrangement, he could determine, at any moment, the course he was taking, and lay it down on the map, and thus note his exact position. The success in this respect was so great that when the time came for stopping or descending, M. Zedé was able to point out Mondecour as the name of the village beneath them. A descent was readily and easily made, without shock or dragging on the ground. This was greatly facilitated by the working of a small balloon inside the other, an essential part of M. Dupuy de Lôme's invention, in which, by means of a pump, he injects air to compensate for the loss of gas caused by the opening of the valves. The trial was highly satisfactory; the stability of the car, an important condition, exceeded all his hopes. His experiments have been long and very expensive, and M. Dupuy de Lôme, in addition to 40,000 francs placed at his disposal, has expended more than 25,000 francs besides. He waits, before proceeding further, the decision of the Minister of Instruction.

Proposed Token of Gratitude from the French People.—It will be remembered that a beautiful model of the Hôtel de Ville was presented to the Lord Mayor of London by the Prefect of the Seine, in commemoration of the aid sent to Paris after the siege. This was the act of the municipality of Paris. A subscription has now been opened in Paris for a national present to the people of England, for the relief sent to France during the war, and after the siege had terminated, and it is proposed that it should take the form of a grand painting, to be executed by a French artist, chosen after competition, the names of the subscribers to be bound in rich volumes, and enclosed in a beautiful piece of cabinet-work.

The Clavecin and the Pianoforte.—By permission of the Lord President of the Council, a course of six lectures on the most celebrated and influential composers of Italy, France, England, and Germany, for these instruments, in connection with the general history of music of the 18th and 19th century, and illustrated by performances on the pianoforte, was commenced on Monday afternoon, the 5th inst., and will be continued on Mondays the 12th, 19th, 26th February, 4th and 11th March, 1872, at half-past two o'clock precisely, by Mr. Ernst Pauer, in the lecture theatre, South Kensington Museum. These lectures have been prepared so as to be useful for educational purposes. The student will become acquainted with the characteristic features of the life of each composer, and the position he holds in regard to the general history of music. The gradual development of pianoforte literature and pianoforte playing will be illustrated by many examples. The influence of one composer on those coming after him will be traced; all technical specialities will be explained, and the different schools will be classified. Each lecture will last two hours.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

February 21st.—"On Prison Labour, as an Instrument of Punishment, Profit, and Reformation." By F. J. Mouat, Esq., M.D., late Inspector-General of Prisons in Bengal.

February 28th.—"On the Production of Jewellery by Machinery," by W. G. Larkins, Esq., the editor of the Society's *Journal*.

March 6th.—"On the *Goliath* Training Ship." By Capt. Bourchier, R.N.

March 13th.—"On the British Trade with France during the last Ten Years, in its relation to the General Trade of the United Kingdom." By Leone Levi, Esq., Professor of the Principles of Commerce and Commercial Law in King's College, London.

March 20th.—"Notes from a Diamond Tour through South Africa." By Thomas Wm. Tobin, Esq.

March 27th.—*Passion Week.*

INDIA CONFERENCE.

March 8th (Postponed from February 23rd).—"On India as a Field for Private Enterprise"—Most suitable districts; situation and approach, described separately; soils, climate, sources of labour supply, &c.; staple crops to be grown with greatest advantage; indigenous products and minerals; tabulated statement of cost of cultivation of tea, cotton, &c., and probable profit of each; indigenous timber; live stock; form of government under which the settler will live in India. The Conference will be opened by Frederick Campbell, Esq., of Assam.

CANTOR LECTURES.

The Second Lecture, on "Mechanism," by the Rev. Arthur Rigg, M.A., was delivered on Monday evening, February 12th. The remaining lectures will be given as follows:—

SYLLABUS.

Lecture III.—Monday, 19th February, 1872.

Motions produced by Sliding—Forms of Teeth on Wheels—Teeth for Velocity—Teeth for Power—Cams—Screws—Worm Wheels—Examples.

Lecture IV.—Monday, 26th February, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies—Cam Pullies—Shafts not parallel—High Velocity Cords—Fusees—Illustrations.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links—Cranks—Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. Arthur Rigg, "On Mechanism."
Entomological, 7.
British Architects, 8.
Medical, 8.
Asiatic, 3.
Victoria Institute, 8.
Anthropological, 8.
London Institution, 4. Professor Odling, "Elementary Chemistry."
Royal United Service Institution, 8½. Capt. Dawson, R.N., "Naval Guns and Naval Gunners."

Tues.....Civil Engineers, 8. Discussion upon Mr. Leslie's Paper on "The Gorai Bridge, Eastern Bengal Railway."
Statistical, 7¾.
Pathological, 8.
Zoological, 9.
Royal Institution, 3. Dr. W. Rutherford, "On the Circulatory and Nervous Systems."

Wed.....**SOCIETY OF ARTS, 8.** Dr. Mouat, "On Prison Labour, as an Instrument of Punishment, Profit, and Reformation."
Meteorological, 7.
Geological, 8.
Royal Society of Literature, 8½.
Science and Art Department (South Kensington Museum), 2½. Professor Guthrie, "Elementary Physics and Chemistry."

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."

Fri.......Royal Institution, 9. Mr. H. Leslie, "On the Social Influence of Music."
Quekett Club, 8.

Sat.......Royal Botanic, 3¾.
Science and Art Department (South Kensington Museum), 2½. Prof. Guthrie, F.R.S., "Elementary Physics and Chemistry."
Royal Institution, 3. Mr. Wm. B. Donne, "On the Theatre in Shakespeare's Time."

Journal of the Society of Arts.

No. 1,005. Vol. XX.

FRIDAY, FEBRUARY 23, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Council have received the following report from the Committee to whom the consideration of this matter was referred, and have adopted the same. The Committee consisted of the following:—F. A. Abel, F.R.S., John Anderson, LL.D., Prof. Ansted, F.R.S., Andrew Cassels, Edwin Chadwick, C.B., Sir Daniel Cooper, Bart., Capt. Donnelly, R.E., Sir William Fairbairn, Bt., F.R.S., Capt. Douglas Galton, C.B., F.R.S., Prof. Goodeve, Prof. Guthrie, F.R.S., W. Hawes, F.G.S., Lord Henry G. Lennox, M.P., W. H. Perkin, F.R.S., Dr. David S. Price, Samuel Redgrave, Warren De la Rue, F.R.S., Seymour Teulon, Sir Joseph Whitworth, Bart., F.R.S., Major-Gen. F. Eardley-Wilmot, R.A., G. F. Wilson, F.R.S., and Sir Digby Wyatt.

Report.

1. Your Committee, having considered the propositions submitted by Capt. Donnelly, are of opinion that it would be of public advantage if the Society of Arts were to supplement the existing examinations of the Science and Art Department, by organising examinations in the science and technology of the various arts and manufactures of this country.

2. These examinations should be conducted by a Board of Examiners, capable of testing the practical knowledge and skill required in the application of the scientific principles involved in each art or manufacture.

3. Your Committee are of opinion that the scheme of examinations proposed by Captain Donnelly, and which is appended, may with advantage be adopted, with such modifications as may from time to time be found from experience desirable. (See Appendix.)

4. The Council should give notice annually of the subjects which would be taken up the following year. In making their selection, the Council may find it advantageous to include those Arts and Manufactures which are to be the subjects of the International Exhibitions of the year.

5. Your Committee recommend that communication should be opened with the various Guilds, Companies, Chambers of Commerce, and large manufacturers, with a view of obtaining their assistance in carrying out the scheme.

6. Your Committee would further recommend that a conference should be called in the Society's House at an early day, to which all parties likely to co-operate should be invited.

By order of the Committee,
P. Le Neve Foster,
Secretary.

Appendix.

Outline Scheme of the Technical Examinations proposed by Captain Donnelly, R.E.

If the Society of Arts approve of the idea of instituting technical examinations, the course of proceeding should, I think, be as follows:—

1. The Council should decide what Arts or Manufactures should be the subjects of examination each year.

2. They should then appoint a Committee of, say, three or five gentlemen conversant with the science and technology of each such Art or Industry. This Committee would then frame the syllabus of examination.

3. In framing the syllabus, it should be an instruction to the Committee that it is essential that the candidate should possess, on the one hand, such an elementary knowledge, at least, of science, as will prove that he understands the scientific principles of which his art is an application, and, on the other hand, such a knowledge of the application of those principles in his trade as will show that he is practically conversant with the various processes and manipulations of the factory or workshop. The theoretical knowledge must not be a mere "cram" of empirical dicta, nor the practical knowledge a mere committal to memory of descriptions of manufactures picked up from text-books.

4. The Committee would therefore lay down—

(*a.*) What branches of Science it was essential that the candidate should possesss a knowledge of, as a preliminary to his technical examination.

(*b.*) What branches of Science it might be of advantage to him in his industry to possess a knowledge of, though they were not essential to his technical knowledge.

(*c.*) A more or less detailed syllabus of the matters which would form the subjects of the technical examinations.

5. As respects (*a*) and (*b*), the examinations of the Science and Art Department provide the requisite machinery. It would only be necessary for the Committee to determine what were the essential subjects, and what number of marks (or classes) in those subjects it was essential the

candidate should have obtained in order to *qualify* in this branch of the examinations (*a*); and, having qualified, what number of marks he might count in certain other branches of science (*b*).

6. Under these heads are included also mechanical and free-hand drawing, painting, and designing for manufactures, for they, as well as most subjects of science, are included in the examinations of the Science and Art Department.

7. As respects the syllabus (*c*), the Committee should frame one on which the examination would be based. The syllabus should give the various heads of the technical examination—the technical examination being framed to test the candidates' knowledge of the practical application of scientific principles to his art or industry. Eventually the Committee, or one or two examiners appointed by it, would set the examination paper or papers. These would be worked under the superintendence of local committees—either those organised in connection with the Society of Arts or with the Science and Art Department—immediately after the examinations of that Department in May. The candidates' papers would then be returned to London for examination. In addition to these papers, it might be advisable, and it would be quite practicable, to have a return of the candidate's employment in his trade, certified by his employer, somewhat in the form appended, which is a modification of the Whitworth candidates' "Workman's" form. Under these circumstances, the Committee might find it desirable to define precisely the amount of practical experience the candidate must have had in his art or industry to enable him to obtain a certificate.

8. When the candidate has satisfied the examiners on these points a certificate should be awarded. These certificates should be of three grades, according to the proficiency of the candidate:—

(1.) The elementary grade, or what may be termed the "workman's" certificate.

(2.) The advanced, answering to the "foreman's" certificate.

(3.) Honours, answering to the manager's certificate.

9. Each grade may further be subdivided into two classes—first and second class. In addition to the certificates, prizes and medals should be given in each grade.

10. It is to be hoped the various Chambers of Commerce, Trade Companies, &c., may assist in offering prizes in the industries in which they are interested. Independently of this, however, it may reasonably be expected that the certificates themselves will carry sufficient weight to make them valuable objects of competition.

11. If the Society of Arts has not the funds for carrying out this scheme, I would suggest an application being made to the Royal Commission for the Exhibition of 1851 to provide, or assist in providing, funds for the examinations in those industries which form the subjects of their Exhibitions; and that it should be announced that any other industries would be taken if its representatives provided sufficient funds. It would thus depend on each industry itself whether there will be technical examinations for it annually, biennially, triennially, or only decennially, in connection with the International Exhibitions.

Form with Heads of Information to be supplied by Candidates in the Technical Examination of the Society of Arts.

It will be necessary for this Form to be returned not later than the———

1. Name in full.
2. Age last birthday.
3. Address in full.
4. State here where you commenced to work, and when; whether you were apprenticed, and if so, to whom; and what workshops or manufactories you have been employed in—if you have been employed in more than one—up to the present time.
5. What is your present rate of wages, and what has it been for the last two years?
6. What is the precise nature of the work you have been employed on latterly? If there has been any special or noteworthy piece of work done in the workshops or manufactories on which you have been employed, mention it. And state what, if any, specimens of your work can be seen, and where.
7. Are there any specimens of your work that you could send to be inspected if required? If so, state what they are, their weight and size.
8. I hereby certify to the accuracy of the preceding statement.

(Candidate's Signature.)

9. Having filled up the preceding form, the candidate must have it certified by his employers; or, if he should be out of employment at the time, by his last employers; or, in case he cannot obtain such certificates, it must be certified by some person of position who can speak to its correctness. In the latter case, an explanation must be given why the employers' certificate has not been given.
10. I hereby certify that, to the best of my belief the foregoing particulars are correct.

(The employer is requested to give any information as to the candidate's ability that he considers may be of use to the examiners in forming their judgment.)

N.B.—The preceding form, filled up by the candidate, must be handed to the employer, who is requested, after stating his own opinion himself, to put the form under cover and send it, directed to the Secretary, Society of Arts, John-street, Adelphi, London.

11. Opinion of employer.

(Signature of employer.)

The Council have decided to call a Conference of manufacturers and others likely to co-oporate in the matter, such Conference to be held shortly after Easter. The Council propose, in case the scheme shall meet with sufficient support from the Conference, to make a beginning of the system this present year, and to take up as the subjects the manufactures of paper and cotton. With this view they are forming two Special Committees, respectively to draw up the detailed rules for these examinations, and to settle the necessary programme.

COMPLETION OF THE PUBLIC POSTAL TELEGRAPH SYSTEM OF THIS COUNTRY.

The following minutes of information have been directed by the Council to be published:—

The force of the facts and the reasonings set forth in the memorial of the Council for the completion of the system of postal telegraphs in this country, by the compulsory purchase of the ocean telegraphs, has been extensively and satisfactorily acknowledged, much more so than might be anticipated. From only one Chamber of Commerce has any exception to it been received, and that without any reasons given in support of the exception. It appears, nevertheless, to be desirable to state, more fully than could be done in a formal document, the urgency of early action, and the largely increasing costs to Arts, Manufactures, and Commerce of all delay in the application of established administrative principles to the matter in question.

It is to be borne in mind, as a matter of experience, immediately applicable to the present position of the question, that competitions of several capitals and establishments that may be sufficiently dealt with by one, end only in reduced returns or in waste to the shareholders induced to make the venture, or to the public, and usually to both. This is displayed in railway competitions, in water-works competitions, and in competitions of the means of communication under consideration. In such cases, the second or third competing company, introduced with the promise of free competition, being met, for self-protection, by the first companies by reduced rates, the new competing enterprise, instead of taking, as the shareholders were led to expect, the whole or the greater part of the traffic, gets only a small part of it. If it be a fourth competing company it would get only a fourth part; if a fifth, a fifth part; and hence, being burthened with its heavy separate establishment charges, whilst failing to receive the mass of traffic, it fails to make the return promised to the shareholders, though it does not fail to make the payments required by contractors, &c. Becoming tired of mutual sacrifices for the benefit of the public, in the end the competitors coalesce, and, in violation of their promises, establish a combined monopoly against the public, and restore and maintain high rates. Instead of cheapness, the competitions of multiplied capitals for the public service have been productive of comparative dearness.

The working of the different principles in question are presented in strong and unmistakable contrast in telegraphic communication, as well as in railway communication, on the Continent, as compared with those that have hitherto prevailed in England. Under the principle of unity of management of railways as a public service, the fares are nearly one-half lower than those which the principle of competition has produced in England. Under the principle of unity of management as a public service, the rates for postal telegraphs, in Switzerland, Belgium, and Germany (and for arrondissements in France), are about one-third those arrived at in England by the competing inland telegraph companies at the time they were taken over by the State. Under the system of competing inland telegraphs, the companies were not likely to make any considerable extension of stations beyond the number of about two thousand, to which they had attained. As a public service, the stations have been augmented to between five and six thousand, and are in course of much greater extension. The public are, however, yet paying an inland shilling rate, which may be considered as a penalty for the governmental delay to adopt the principles when they were first demonstrated in the Society, instead of the sixpenny rates of the postal system of Germany, or the equivalent half-franc rates of Switzerland and Belgium, which have more than replaced the produce of the first double rates.

The results of competition in ocean lines has been similar to that of the competition in land lines. When the first Atlantic telegraph was projected, the shareholders were promised 25 per cent. of profit—a payment considered to be not too great for the extraordinary risks then encountered. It is now pronounced, on impartial authority, that, after all the experience that has been obtained, fairly estimating the existing risks, upwards of 12 per cent. is not too high a remuneration for the private capitalist, though it is more than double what would suffice to the State. After the first two Atlantic cables were got into work, the net dividends obtained were about 11 per cent., whilst they were being worked at a little more than one-third of their carrying power. They might, of course, have been worked at lower rates, but the general defence of high rates by trading companies is, that the restoration of the old rates is uncertain, and that, at the best, there is a loss for a time. It was nearly a year before the produce of the franc messages of Belgium were made good by the half-franc messages. A company cannot undertake interruptions to dividends or possible non-replacements by experiments, but a government may. At the last meeting of the Anglo-American Company, Sir James Anderson, who commanded the *Great Eastern* at the laying of the Atlantic cable, and who is practically well acquainted with the subject, declared that messages at a shilling a word would ultimately pay, but he thought it might require as much as two years to achieve that result, which could not be done by the company—implying that it might be achieved by the government, as for the reasons stated is most likely. Whilst the two first cables were being worked at within half their carrying power, and were yielding about half the first-promised dividend, a third capital, or a third competing cable, the French Transatlantic cable, was brought forward, at lower but, as might have been expected, with non-paying or ill-paying rates, but with the effect of reducing the return of the two first companies to nearly one-third of the dividend originally promised to the shareholders. The usual course of a combination, to maintain high rates against the public, followed. A simultaneous accident to the shore ends of the two first working cables gave a ground of utility for the introduction of a third cable; but, otherwise, whilst the other two might have done double work, it was a mere waste—a waste that might have been avoided by the government taking them at that time, as demonstration required. The waste was proved by the least perfect cable doing the entire work during the interruption of the other two.

The directors of the Anglo American Telegraph Company declare indeed that "the three cables of the Anglo and French Companies are more than sufficient in capacity to carry, without delay, the whole traffic between Europe and America, even if that traffic were largely increased." This being so, and the capacity being proved for a time to be equal to more than a double traffic, the intrusion of a fourth cable into the field of service can only be characterised as an unjustifiable waste, at the expense of the public, or of the shareholders, or of both. But if this fourth cable were accepted and paid for, as is proposed by the two companies, there is nothing to prevent, and much to induce a fifth or a sixth enterprise of the sort; and it is indeed stated that a fifth cable is in actual preparation. What then is urgently needed is a decisive public step, by an early authentic declaration, that shall put a stop to such enterprises at the public expense.

It were unnecessary to examine the promises of new companies, or the grounds for any exception to the common results—forced reduction of rates for a time, and another coalition to avoid further loss, ending in additional burthen upon the field of service, of augmented establishment charges, and other cables in conditions of forced purchase.

On an objection made against the government having a monopoly of the cables, it is to be observed that it really need not have any, for it might be left open to any parties who might choose to be at the expense of separate offices, separate officers, separate ships, and separate land lines of destination, to compete with the lower rates paid for the public service, if persons thought fit to do so. But, in truth, for the government not to utilise the existing public internal offices, and its ships and scientific corps, for the public service, would be to maintain a pernicious protectionism for private adventure, and for the creation of multiplied irresponsible monopolies at the expense of the public, by exactions on its necessities of intercommunication. By tradition, the government has the monopoly of the service of distributing penny letters and halfpenny cards; but it might very securely leave it open to any private enterprise to get up twelve thousand separate establishments, with twenty-five thousand collectors, supposing it were possible for a trading company to do the same, or any part of the same work.

The maintenance of the existing system is the maintenance of burthensome restrictions—of inefficiency and of excessive charges on multiplied, unnecessary, and, therefore wasteful establishments, arising from the very conditions of trading companies conducted independently from the public postal system, whether those companies be competing or not. As trading companies, they cannot make branch extensions, whatever may be their inherent benefit for the public, unless they yield a direct trading profit on separate establishments. The branch extensions of the ocean telegraphs to the colonies, that are now prevented, or that would be gained by putting them on a public footing, at the simple cost of the service, would probably bear the like proportions to those of the extensions now going on in the inland lines of the postal system. For the sake of completeness, it may be expedient to extend branches, even at some loss on the particular lines, as in the letter-post there are places where the carriage of each penny letter costs several shillings; and, indeed, it is understood that the whole of the penny letters in Ireland are carried without any profit to the State, whilst a surplus of revenue is obtained as a general result. Considerable branch extensions are needed for the service of the Royal Navy, and for the Army and the Civil Service in India and the colonies. Though the statement of the expenses of the late diplomatic correspondence by telegraph with the Commissioners on the *Alabama* claims are, no doubt, greatly exaggerated, they are, nevertheless, such as to show the restrictions which the expenses of the present system impose on quick, and full, and free communication, on colonial as well as on foreign affairs. The delay in the account of the assassination of Lord Mayo was due to the want of a branch line of cable. Of the messages from India, only about two per cent. are social messages, only about eight per cent. are official messages, and the rest are messages confined chiefly to great commercial houses on very large transactions,—the whole bearing a very small proportion to those that would be sent under a public system conducted on correct principles. The messages on the Atlantic lines are stated to be of the like description. The existing restrictive system puts this country in anomalous and inferior relations with the Continental states, as was experienced at the recent congress of the officers of governmental departments at Rome. At that congress there was a great reluctance to admit representatives from the trading companies of this country, and, as being representatives of a repugnant system, they were refused votes. Great as had been the reductions of the telegraph rates in the several states as compared with ours, the congress recommended, by 19 votes against 2, that in consequence of the rapidly extending advantageous use of telegraphic communication, the rates should all be generally reduced still lower. The congress pressed upon the competing ocean telegraph companies that they should also reduce their rates in proportion; but this the companies declared their inability to do, under their necessities of making trading profits. The Continental States having communication with India or other of our territories, feel it to be a grievance that whilst they reduce the rates within their territories mainly to the charge of the service, their communications should be clogged with excessive rates within our territories, levied mainly for trading profits. The feeling of the congress was entirely in accordance with the economical views expressed long ago on the subject in the Society, confirmed by subsequent experience,—and in that feeling, the extension of competing lines into the field of public service, would be discountenanced, as detrimental to it, and would conclude that the field should, as soon as practicable, be cleared of the inherent obstructions of those which exist.

From experience of the uncertainties and losses arising from the competition of several capitals and establishments in a field of service that might be supplied by one, or from a perception of the gains derivable from unity of administration, an agitation has been got up in the Atlantic sub-marine and other telegraph companies for amalgamations. But it is important to observe on the principle of the amalgamation of such companies, that as the foundation of the grant of their privileges by the legislature was expressly the condition of open competition, to ensure to the public low rates, they cannot fairly, on the failure of that condition, claim the opposite—the condition of monopoly—of monopoly against the public to maintain high rates. If the condition of open competition as a security is to be abrogated for the condition of monopoly, it should only be for the condition of monopoly for the public, in the hands of officers directly responsible to it. And this return to correct economical legislative and administrative principles will be found to be the best for the shareholders.

At the time when at last the telegraphs of the inland trading companies were taken by the government, there was a negociation pending between the directorates for an amalgamation. If that negociation had succeeded, it would have arrested the most material progress in telegraphic communication, inasmuch as the companies could not have extended their separate stations, for a trading profit, much beyond the two thousand stations they then possessed, inasmuch as, under the unavoidable burthens of separate establishment charges, such extensions must have been mostly of "suckers" instead of "feeders" of the profits of the concern; whilst the public would have been deprived of the more than double number of stations they have obtained (though as yet it is considered in little more than midway progress), by the utilisation of the existing postal stations, and the services of the postmasters and other officers. Neither would the companies have been in a position to have advanced beyond a uniform shilling rate, nor did they then pretend to advance beyond that, and the advance to a uniform sixpenny rate, which is now anticipated from the public service, was hopeless from any practicable amalgamation. A considerable extension of stations, which is often of as great importance as the reduction of rates in the case of the ocean telegraphy, would also be hopeless from any amalgamation of the trading companies, as would be the like reduction of rates that are obtainable from a public service. Amalgamations are only half measures, more in the interest of directorates, in retention of their positions and patronage, than they are in the interests of the shareholders, whose interests are the best promoted by certainty, and by a sale at such prices as it is worth while for the public to give.

On one incidental objection made to the proposed purchase of the telegraphs, namely,—an assumed augmentation of the government patronage,—it is to be observed that it is fallacious to suppose that the patronage of the large establishments under directorate trading companies is not frequently used for political purposes;—but this objection has been obviated on the part of the government by the great measure of giving the first appointments to the postal service, as well as to other branches open to competition, thus giving them to the advancement of education and to merit. This, in itself, forms one ground for the change proposed.

It is to be observed that the supplies of cables, for extended lines, would be open to the competition of those engaged in their construction.

It may be averred in conclusion, that so certain are the known broad general facts, and so clear are the principles involved, that if the permanent officers of the departments immediately concerned be duly consulted, their opinions cannot fail to be in the main in accordance with the conclusions on the measure in question, as set forth in the memorial which has been submitted to the Prime Minister by the Council.

But be this as it may. After the example of the very important report of Mr. Scudamore, submitted to Parliament, which served as the foundation for the legislation in respect to the inland telegraphs,—a report which has been so largely verified by the increasing results in progress,—the Council have considered that they were expressing a common desire for authentic information, in submitting to the Premier a suggestion of the expediency of obtaining early a like report in relation to the compulsory purchase of the ocean telegraphs, as to the expediency and the practicability of action on the matter without delay. It might also be submitted as desirable that a report should be obtained, for the public information, from the Royal Engineers sent as delegates by the India-office to the Telegraphic Congress at Rome, on the conclusions bearing on the subject, elicited by the facts and discussions at that congress, and on the expediency of putting the ocean telegraphs on a public footing, and the branches needed, with a view to our Indian relations, naval and military as well as civil. And the like request might be made as to the desirability of information as to the expediency of branch extensions of telegraphs to colonial and other naval stations, to quicken the action of the Royal Navy as well as of our mercantile marine.

We ought not to overlook the important contributions derivable to science, to meteorology, and the laws of storms, by the complete extension of telegraphic communication all over the world as a public service, that, for the reasons stated, must continue to be lost to science so long as the ocean telegraphs continue to be conducted merely as commercial speculations, and confined to direct profit-yielding branches, and messages mainly.

It is confidently submitted that the measure proposed, which is doubtless one of easier accomplishment than that of the purchase of the inland telegraphs of the trading companies, commends itself to the immediate and special support of those engaged in the Arts, Manufactures, and Commerce of our colonies, of our Indian possessions, and of the American continent, for the removal of the existing clogs, and for the prevention of increased clogs of expense, particularly in competition with the advanced administrative arrangements on this subject of the continental states.

By order of the Council,

P. Le Neve Foster,

Secretary.

FOOD COMMITTEE.

The following communication, with the specimens accompanying it, will be brought before this Committee at its next meeting:—

5, Smallegade, Frederiksberg, Copenhagen,
December 16th, 1871.

Attention having been drawn by Professor Panum, of the University of Copenhagen, to the amount of nutritious matter contained in blood, and usually entirely lost, I have been endeavouring, and with success, as I think, to solve the problem of fixing blood in forms suitable for food, and at the same time capable of preservation, viz., (1) as sausages, puddings, cakes (being mixed with fat, meal, sugar, salt, a few spices), to serve as a much cheaper compensation for meat, and intended more especially for the use of the poorer classes; (2) as blood-chocolate, more especially suitable to be used in hospitals and otherwise in medical practice, in which latter form it has been recommended by Professor Panum, at a meeting of physicians at Copenhagen, October 24th, 1871, and is now being employed at the hospitals of Copenhagen, the attention of physicians being directed to its effects.

In these different forms it would be suitable for the victualling of vessels on long voyages, of besieged towns and fortresses, and, especially in the chocolate form, of soldiers on long marches, travellers in uncivilised tracts, &c.

I take the liberty of sending samples of these manufactures to the Society of Arts, in the hope of being, if possible, honoured with a notification of its views on the subject.

With the greatest respect,

C. Nielsen.

To the Secretary of the Society of Arts.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

ELEVENTH ORDINARY MEETING.

Wednesday, February 21, 1872; Captain E. Du Cane, R.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Alexander, Robert H., 30, Lombard-street, E.C.
Arnold, Henry, 18, Philpot-lane, E.C.
Atkins, Charles, 1, Water-lane, E.C.
Carnegie, A., 16, Bishopsgate-street, E.C.
Chadwick, John Oldfield, 65, Moorgate-street, E.C.
Cox, Rowland, 3, Great Winchester-street-buildings, E.C.
Forshaw, Thomas, the Bower, Bowden, Cheshire.
Geiselbrecht, J. C., 8, Leadenhall-street, E.C., and 7, Eton-road, Haverstock-hill, N.W.
Hughes, Joseph, the Arbour Farm, Hyde, near Manchester.
Joyce, Frederick, 57, Upper Thames-street, E.C., and Waltham Abbey.
McLaurin, Peter, Langholm, Dumfrieshire.
Routledge, George Ford, 20, Cannon-street, E.C.
Sacre, Edward, 26, Parliament-street, S.W.
Turner, John Wylde, 13, Somers-place, Hyde-park-square, W.

Wadsworth, John B., Mayor of Macclesfield, Highfield-house, Macclesfield.
Walthew, John, Mayor of Stockport.
Ward, Henry, Rodbaston, Penkridge.
Waterlow, W. B. (Mayor of Reigate), High-trees, Redhill.

The following candidates were balloted for and duly elected members of the Society:—

Connolly, George, 69, Cornhill, E.C.
Crowe, W. Leedham, 24, Cornwall-road, Westbourne-park, W.
Cutler, Samuel, Providence Iron Works, Millwall, E.
Dickinson, Arthur John, Tar and Chemical Works, Trundley-lane, Deptford, E.
Fair, John, Argentine Consulate, 6, Great Winchester-buildings, E.C.
Field, Lieut.-Col. George Thomas, R.A., Royal Arsenal, Woolwich, S.E.
Gilbert, Sir John, Vanbrugh-park, Blackheath, S.E.
Green, Frederick, 19, Onslow-gardens, S.W.
Holland, Samuel, M.P., Glanwilliam, Merionethshire.
Hudson, Hubert E., Battle, Sussex.
Ord, George Rice, Streatham Hill, S.W.
Pearson, John, Mayor of Liverpool.
Walton, Charles, Manor-house, East Acton, W.

AND AS HONORARY CORRESPONDING MEMBER.

Wiszniewski, Prince Adam, 12, Rue de Beaune, Paris.

The paper read was:—

PRISON LABOUR, AS AN INSTRUMENT OF PUNISHMENT, PROFIT, AND REFORMATION: AN EPISODE IN THE PRISON HISTORY OF LOWER BENGAL.

By **Frederic J. Mouat, M.D., F.R.C.S.,**

Late Inspector-General of Prisons, Lower Bengal; Justice of the Peace for Calcutta; and exercising the powers of a Magistrate in all the Prisons of Bengal, &c.

1.—Introduction.

The proper punishment of criminals has engaged the time and attention of earnest and thoughtful men, in a measure commensurate with its great political and social importance, ever since the publication of the revelations of the philanthropist who is, and ever will be regarded as one of the greatest of English worthies, and one of the purest and most disinterested of the benefactors of mankind.

In spite of all that has been said and written on the subject since John Howard lived and died, and of the large amount of practical experience which, in these days of printing and publicity, has been accumulated and spread abroad, prison discipline is still one of the unsettled problems of our time.

It would be out of place in the Society of Arts to dwell long upon theories of crime and punishment, or to enlarge upon the details of prison management which go to the formation of a well-regulated and effective system of gaol discipline. It is sufficient for my purpose to assume as proven:—First that the immediate object of imprisonment is the punishment of the offender, by his compulsory removal from society, and the consequent deprivation of all the enjoyments, rights, and privileges of liberty; and, secondly, that the end of imprisonment is the protection of society, partly by its deterrent effect on others, and in part by the reformation of the criminal himself.

Chief among the means designed to effect these objects, the law has provided that labour shall form an integral part of every sentence of rigorous imprisonment. It is with this branch of prison discipline that I propose to deal to-night, as it is that which fits more closely into the purposes of the Society of Arts.

My intention is to submit to you the results of fifteen years' experience in the direction of the prisons of the oldest and most important presidency of India. To enable you to judge of the degree of importance which you may be disposed to attach to this lengthened experience in so wide a field, I shall proceed, in a strictly logical and inductive manner, to place before you the means of observation which my official position afforded me, the results of that observation on the particular question under consideration, and the conclusions formed, after much study and practical acquaintance with this confessedly-difficult and disputed question.

2.—Historical Retrospect.

To understand the present state of the convict labour question in Bengal, it is necessary to take a brief retrospective survey of the history of the prisons of that province. This is instructive in many ways, which will appear as I proceed.

Prior to 1838, no regular system of indoor labour for convicts existed in Bengal. The most hardened offenders, and those sentenced for long terms, worked in chains on the public roads. The sickness and mortality among them were frightful; there was no systematic attempt to maintain discipline; forbidden indulgences of all sorts were readily procurable by those whose friends could bring them; those only were compelled to work who could not purchase immunity. The supervision of the convicts was entrusted to officers who had no knowledge of prison management, and whose only care was to make roads.

Within the prison walls, matters were little, if at all, better, so far as discipline was concerned. The menial offices of the gaols were performed by convicts of suitable caste, and similar functions in public offices were assigned to prisoners. Not a few were employed in the households of the officers in charge of the gaols; in fact, as regarded the punishment and prevention of crime, the whole system was more or less one of abuse. The bulk of the prisoners were idle, and loitered away their time on the station roads. All who could afford to bribe the gaoler and his subordinates led a life of ease and indulgence. The poorer prisoners were, on the other hand, harrassed and tormented, and occasionally driven to acts of violent resistance. In these circumstances an attempt to exact a little more work from the prisoners in Alipore gaol resulted in an outbreak, in which the governor of the prison was beaten to death.

The attention of the government was thus directed to the prison system in practice, and on the suggestion of Lord Macaulay, at that time legislative member of the Council of India, a committee was appointed to examine into the whole question of prison discipline in India. This committee consisted of some of the most distinguished men who ever took part in the government of that empire. Lord Macaulay was a member of the committee, and its secretary was the present Governor of Jamaica, one of the ablest administrators of our times. Among the members surviving at the present time are the Right Hon. Sir Edward Ryan and Sir Charles Trevelyan, both greatly distinguished in the history of Indian administration, the latter still active in all good works in this city.

The committee collected a valuable body of evidence, which was published at the time, and produced a masterly report, from which dates all improvements in the management and direction of Indian prisons.

Lord Macaulay's committee remarked that "the sentence of labour is sometimes set aside by allowing the labour to be merely nominal, and at all times an uncontrolled power of alleviating the sentence of the law is possessed by subordinate functionaries, whose only duty is to carry those sentences into execution. This power is recognised in the magistrate alone, but there is no doubt it is exercised, more or less, according to the vigilance of that officer, but still everywhere exceeded by the gaol darogahs (gaolers).

"When exercised by the magistrate, it is, we believe, always with an honest, though it must often be with an erroneous regard to the crime, the general character of the prisoner, or the peculiar effect which a particular kind of work would have upon him.

"When exercised by the gaol darogah, it is, we believe, never with any regard to the crime or the character of the prisoner, but either from a popular respect to his caste or character, or from a knowledge of his having the means of paying for the favour."

Among the remedial measures suggested by the committee were the cessation of out-door employment, and the strict enforcement of indoor labour. They considered that the immediate object and ends of imprisonment would best be accomplished by the infliction of as much personal pain as could safely be inflicted without injury to health. They consequently set their faces against industrial pursuits, and advocated the employment of convicts sentenced to labour in dull, monotonous, and wearisome tasks, such as stepping upon a tread-wheel, turning a capstan or hand crank, and such like unprofitable and aimless occupations.

The tread-wheels and cranks were only partially introduced, and were speedily abandoned. They were found to be injurious to health; to be an unprofitable use of labour, that might be turned to good account; to be attended with no moral benefit to the criminal; and to be founded on an erroneous estimate of the influence of pain to the individual as likely to deter other persons from entering upon criminal careers.

It will scarcely be believed, but it is nevertheless true, that in a note on the gaols of India, prepared for the government of India three years since, a return to this unwise and exploded system was gravely recommended by an able but inexperienced under-secretary, it is true—yet it was adopted by the government.

In 1843, the introduction of remunerative industry in the prisons of Bengal was sanctioned by the government, at that time administered by the late Earl of Ellenborough, and a circular order on the subject was issued, in which officers in charge of gaols were directed to bear in mind that the labour imposed was to be apportioned in fixed tasks, and to be sufficiently severe to keep the prisoners actively occupied throughout the day, with necessary intervals for rest and meals.

When the prisons were placed under my supervision, in November, 1855, industrial pursuits were carried out in 59 of those institutions. I found that, as in 1838, but in a somewhat diminished degree, the labour was regulated by the magistrates according to their several fancies, without order or method; that the control of the gaols was practically in the hands of the subordinates; that task work was rarely or never exacted; that much of the work was of the lightest description; and that there was no system or definite object in the regulation of the industry of the prisoners. I endeavoured at once to change all this, as I shall presently show, but it would not be right to withhold from you that, since I left India, a great deal of controversy has arisen as to what is there termed my system of prison management. It has been alleged to have failed because hard labour was not exacted in all the gaols of Lower Bengal, and because punishment was sacrificed to profit. In this conflict, the judicial element of punishment, whatever that may be, is stated to have been lost sight of.

It is evident that two distinct questions have been so mixed up in this controversy that, as usual in such cases, the truth has to some extent been lost sight of. The system should be separated from its working and each be made to bear its own burden.

I am quite prepared to defend the system itself; indeed the direct purpose of this paper, on an important and cardinal element of that system, is written partly with that intention; but I am not prepared to defend the imperfect manner in which I was compelled to carry it out. Against this I protested in the strongest language that a subordinate without insubordination could employ; but it was in vain for fifteen long years. It is, therefore, as idle as it is incorrect to charge against the system that for which no system can fairly be held responsible. A building may be planned in the most perfect manner, and its design be on the most correct scientific principles, yet, if the materials used in its construction are defective, it may tumble down. What sensible man would think, in such a case, of charging upon the plan the collapse which was due to the execution. My first administration report, dated the 25th of November, 1856, closed with the following words:—

"I cannot conclude this, my first general report, on the jails of the lower provinces, without bringing prominently to the notice of the Lieutenant-Governor the cordial co-operation which I have experienced from most of the officers in charge of the prisons under my superintendence.

"In no single instance have I experienced the slightest active opposition to any measure of reform suggested; and yet such measures are provisionally distasteful, and regarded with mistrust and dislike when first proposed.

"It is true that I have, in some instances, had occasion to point out blemishes and defects; but instead of being surprised that such should exist, I am astonished at the results which have been obtained, in spite of a corrupt and inefficient subordinate agency, and a plan of construction of prisons which in many cases invites escape, defies classification, renders penal servitude impossible, and unites every quality that is undesirable in a place of incarceration."

In 1867, having then had twelve years' experience of the work, after summing up briefly the urgency of the introduction of the cellular system, and showing that by it alone the dreadful sickness and mortality of prisons in Bengal could be effectually checked and controlled, and an effective system of discipline be introduced, I wound up by stating that "I dread to lift the veil that at present conceals the immoral relations of Indian prisoners. So long as these relations continue, our jails will continue to be training schools of vice and crime, and all attempts to reform prisoners must be unsuccessful." Those relations are inseparable from collective imprisonment in all countries: they are merely intensified in India, from physical and moral causes.

When I surrendered my charge in 1870, the buildings for all purposes of discipline were rather worse than better, for most inner partition-walls, and such like means of separation, had been removed with good effect, to diminish sickness and mortality. They merely acted as cholera and fever traps, and were of no earthly use as aids to discipline by effective separation.

The establishments of the prisons were so reduced as to be absolutely insufficient, and efficiency was, in everything relating to the gaols, sacrificed to an unwise and singularly injudicious system of economy—the vain desire to reduce all the presidencies and provinces of India to a uniform standard of cost, without the smallest reference to varying local conditions that cannot be disregarded in so extended a country, and among people as varied as their soil and climate. The Punjab pattern was apparently that preferred, and I have no reason to suppose that it was unsuited to that recent addition to her Majesty's possessions in Hindostan. It was, however, about as applicable to Bengal, the oldest province of India (and that which makes up for the financial deficiences of all the others, while deriving no advantage from her own prosperity), as would be the absurdity of enlisting an army in the delta of the Ganges to hold in check the wild tribes of the border land on the most northerly frontier of India. It will be difficult for an English audience to believe, but it is a simple, sober fact, that for some eighty or more subdivisional prisons, or lock-ups, as they are there called, there were no establishments at all. A few policemen to see that the prisoners did not run away, and to escort them to and from the court and central stations, with one of the subordinate clerks of the court, on an addition to his salary of ten shillings a month, to supply them with food, was all the agency allowed to those places; and yet in them were confined all prisoners sentenced to less terms than 14 days' imprisonment, and all the more heinous offenders in the outlying districts until they were committed for trial, or to undergo their sentences at the sudder stations of the zillahs—corresponding to the county towns in England. In these sub-division lock-ups, some 25,000 persons were confined, or passed through, in the year 1869 alone. A good deal of virtuous indignation has been expended on the absence of even the semblance of an attempt to introduce some element of punishment beyond the mere shutting up in such places. I simply ask, what was possible in such circumstances?

Upon this and most of the other defects, which on my departure were supposed to be original discoveries, and to be due to the absence of a judicial element in the administration of the prisons of Bengal, I harped as perseveringly and as unsuccessfully as *Shylock* in his agony dwelt on his ducats and his daughter. I must, most respectfully and most emphatically decline to be held responsible for a state of matters which I did my best to mend. I pointed out the disease, and I exposed its evil fully and fearlessly; the application of the remedy did not rest with me. As to the alleged sacrifice of punishment to profit, and the iteration with which this *crambe repetita* has been served up, if it really existed, t was due to the action of the government itself.

If there was any falling-off in the earnings of a jail, the ruling authority was down sharp on the officer in whose prison it occurred. It was vain, therefore, for me to preach, and to attempt to enforce the principle, that no prisoner should be employed in such light and intermittent labour as could be no punishment. How often, and how wearily did I report that there was too much light and nominal labour in many of the jails. It was not in human nature to expect that the officers in charge would bring down the censure of the government upon themselves for a defective balance-sheet. From the first to the last day of my tenure of office, I was not armed with authority to enforce obedience to my orders, and I felt that, in too many cases, it would be a mere waste of time and temper to attempt the compulsory making of bricks without straw.

But I do not blame the local government under which I served for its action in the matter. With a radically defective construction of prisons, and with inadequate establishments, the balance-sheet was the only reliable test of good or bad management—and on that, I think, it correctly laid great stress. It is, moreover, the best test, if not the only one, of the successful application of any industrial system.

To make punishments stinging in such places, by the mere employment of prisoners in such apologies for hard labour as can be exacted with the only subordinate agency which prison officers can obtain or employ, is, I am convinced, an amiable delusion.

The revival of the obsolete doctrine of making prisons a terror to evil-doers by anything short of the employment of torture of body and mind, is an anachronism; and in India it is, in addition, a mischievous delusion. There is already an unquiet spirit abroad among the people, which needs the most delicate and careful handling; and when one has has had such recent and painful experience of the little hold we now have on the affections of the people, and of the rapidity with which the most grotesque fancies take possession of the public mind, I confess that I look upon all sudden and ill-considered obliterations of the ancient ways with some degree of apprehension. I do not believe it to be by any means impossible, by injudicious measures of severity—even if they were correct in principle, which I cannot and do not admit—to convert the gaols of India into another greased cartridge, to be followed by another serious explosion. There is no part of the British Empire in which empirical schemes of civilisation are so dangerous as they are in India. The princes and the people are loyal, and I believe, are becoming sincerely attached to the British Crown, but they must be governed, more or less, in their own way, and their feelings and prejudices must be respected, even when they have broken our laws, and become the inmates of our prisons.

Bengal has been singularly fortunate in the selection of the men appointed to rule over her since she has attained a separate government, and glad am I to have an opportunity of bearing public testimony to the sound and sensible views, the constant devotion to the promotion of the happiness of the people subjected to their rule, and the eminent ability of those under whom it was my good fortune to serve.

Yet the system is not sound which admits of perpetually recurring perturbation, by the practically uncontrolled action of any one man who may be afflicted with original views, and have no hesitation in undermining the work of centuries, or reversing the policy of his predecessors, while his own tenure of office of a lustrum will not admit of the reconstruction, on a firm and durable basis, of any of the political and social edifices which he unwisely destroys. Incessant change of rulers, and of plans and principles of rule, is the greatest defect of Indian administration, and is fatal to progress and good government, unless controlled by a sound public opinion. The remedy for this is to bring the enlightened public opinion of England to bear upon Indian questions, and to obtain for India some more direct representation in the imperial legislature than she enjoys at present, as well as to introduce into the Indian Councils themselves the most advanced of the natives, in sufficient numbers to exercise some degree of guidance over their deliberations.

3.—EXHIBITION OF GAOL MANUFACTURES IN CALCUTTA IN 1856.

With a view to ascertain the progress actually made and the exact nature of the results obtained, I suggested in February, 1856, the holding of an Exhibition of Gaol Manufactures in the Town-hall of Calcutta. The suggestion was approved, and the exhibition was held in November of the same year. Thirty-six prisons in the Lower Provinces and ten in the North-Western Provinces contributed to the exhibition. The articles exhibited consisted chiefly of cotton cloths, hand-woven carpets, blankets, horse clothing, saddlery, gunny cloth, paper, carpentery, iron work, bricks and tiles, bamboo and reed fabrics (chairs, mats, &c.), pottery, shoes, and a few other things of minor importance. With a few exceptions, they were the ordinary manufactures of the prisons, the exceptions being fabrics of finer qualities, made as samples of the skill attained by convict workmen, but for which there was no local sale.

Some of the convicts were members of different crafts, and proficient workmen, prior to imprisonment. The greater number were agriculturists, who had no knowledge of any handicrafts, and were entirely taught in the gaols. The Sonthals, an aboriginal tribe of Lower Bengal, became skilled weavers in the prisons; the Thugs obtained celebrity as carpet weavers, dyers, and tent-makers in the industrial prison of Jubbulpore; and numerous other prisoners, entirely ignorant and uninstructed, attained remarkable skill and efficiency as printers, lithographers, paper-makers, brick-makers, potters, carpenters, blacksmiths, and masons.

A mere glance at the exhibition showed that, under proper management, gaols might easily be converted into schools of industry, and thus fulfil one of their most important functions—the inculcation of habits of order and industry, and the indoctrination of the ignorant, idle, and dissolute in the means of earning an honest livelihood on release.

Having brought together so large a collection of prison manufactures, I was anxious to ascertain their commercial value, their absolute and relative value as fabrics, and the demand that existed, or was likely to arise for them. I was also desirous of knowing if there were any new and profitable channels of industry susceptible of opening out and development by means of convict industry. I accordingly addressed the Chamber of Commerce of Calcutta, and solicited the aid of its skilled knowledge, to render the first exhibition of prison industry in India, and probably in the world, practically useful. My appeal was responded to with the cordial readiness and liberality which have always distinguished the merchants of Calcutta in objects of public usefulness. A committee was appointed, consisting of the President of the Chamber, the Consul-General of America, and some of the leading merchants of the city. They examined the exhibits very carefully, and furnished an interesting report, which is contained in the official record on the table. It may possibly not be deemed unworthy of republication in the *Journal of the Society of Arts*, as one of the first fruits of the Exhibition of 1851 in a novel and interesting direction, and as a document entirely unknown in England. It seems to me to be desirable to preserve the early history of all such steps in the ladder of progress in a form more available for permanent reference than an official report, of which there are very few copies in existence, and those altogether inaccessible to persons interested in such subjects.

The members of the committee were agreeably surprised by the extent and variety of the exhibition, and by the quality and perfection of workmanship which several of the articles exhibited. In submitting the report of the committee to the Government, I made the following remarks, in a direction which I believe has been more than once advocated in the Society of Arts, which holds so honourable and distinguished a position in relation to one of the most remarkable features of modern action in the regulation and development of industry. After briefly referring to the suggestions of the Chamber on the special subject of prison industry, I said:—"But I am strongly of opinion that it is still more desirable to extend the proposals of the committee to the formation of a great trade museum in Calcutta—a gigantic undertaking, yet one which has become a a necessity of the time, and would be of infinite use in the development of the industrial and commercial resources of this the greatest producing country in the world.

"No one can have watched the increase in the export of raw material from India during the last twenty years, and have seen the vast quantities of silver absorbed in their purchase, without being convinced that the resources of British India are susceptible of an extension of development of which but a faint estimate can now be formed. To enumerate those at present known would be a work of supererogation, yet the information regarding them is scanty, and confined to a few enterprising speculators.

"To bring together the products of different parts of the country, to collect exact information regarding the mode of their production, the quantities in which they can be obtained, the implements used in their production, and such particulars regarding them as should spread abroad more exact knowledge than is at present possessed, could not fail, in my humble opinion, to make known many articles of commercial value, hitherto disregarded because unknown. It would also lead to improvement in the preparation of those already well known, such as might considerably enhance their market value.

"No one can doubt that improvements in the ordinary means of transit, the extension of railways, and the introduction of the law of limited liability, would give an impulse to Indian commerce such as it has never yet experienced."

The exhibition was held in November, 1856, and the report above quoted was written in March, 1857. The late Lord Canning, one of the greatest and wisest proconsuls and statesmen who ever ruled over the Indian Empire, saw and expressed high approval of the exhibition above referred to. I have reason to know, from personal communication with him, that, if the Sepoy revolt, which broke out shortly afterwards, had not engaged his close attention for the remainder of his stay in India, the questions of prisons and commerce would have been dealt with by him, and who can doubt with what results.

The wants of Indian commerce have not been fully met by the Indian courts of the various exhibitions since held, or by the departments of the India-office which is devoted to it, under the able and indefatigable guidance of Dr. Forbes Watson, excellent and creditable as it undoubtedly is.

To return from this digression, which naturally arose out of the subject, and for which I crave your pardon. In my report I laid down the principles of action which should regulate the industry of prisons, and I followed them up, as far as the means and agency at my disposal permitted, during the whole of my tenure of office; they were, that prison labour should be penal, profitable, and reformatory; that it should be strictly intramural work, controlled and directed by special officers; that every prisoner sentenced to labour should be made to repay to the State the whole cost of his punishment in gaol; that all unprofitable labour should be discontinued; that the criminal law should be amended, to the extent of preventing the commutation of labour by payment of a fine, which degraded labour in a manner peculiarly injurious in India; and, in short, that prisons should be made, as much as possible, schools of industry, as combining, more completely than can be effected by any other system, the punishment of the offender, with the protection of society.

How far I was able to carry out the programme of 1856 I will mention presently.

The answer of the government to my report on the Gaol Exhibition contained the following passages:—"The Lieutenant-Governor desires me to present to you his warm acknowledgments of the very able manner in which the exhibition was prepared and conducted under your guidance and management; and his honour can bear testimony to the very interesting and successful appearance presented by the collection of manufactures when exhibited in the Town-hall."

The thanks of the government were communicated to the committee, and instructions were issued to all officers in charge of gaols to profit by the suggestions of the committee, and to devote increased attention to the industrial department of prison management.

It must be remembered that exhibitions had not then been vulgarised, and turned into toy shops, nor had they departed from the intention of their illustrious founder that they should be schools of practical instruction, of cultivating taste, and of the promotion of commerce by the application of science to the arts, which, in their thousand ramifications, minister so much to the comfort, happiness, and progress of mankind.

From 1856, the subject was never lost sight of, either by myself or by the Government of Bengal, to the end of the tenure of office by Sir William Grey, in March, 1870, as my inspection and administration reports, and the orders of the government show. They are all on record, and deserve, I think, to be better known in England than they are at present.

While men at home have been talking about it, and the Howard and Social Science Associations have recently recorded resolutions as to the principles which should govern prison labour, the thing has been done in India with an amount of success which, I venture to think, entitles us to some little credit as prison reformers, working in a more extended and difficult field than exists in the United Kingdom.

That ignorance of what has been done in India should be very general among those unacquainted with that country is natural enough, because the information is locked up in official reports, of which few copies are sent to England, and fewer still read, even by those whose duty it is to become acquainted with them.

4.—BENGAL GAOL ACT OF 1864.

In 1864, an Act was passed by the Local Legislature of Bengal, entitled "An Act for the Regulation of Gaols, and the Enforcement of Discipline therein." In this Act power was given to the local government to prescribe rules for prison management. The prison rules were previously scattered through a number of circular orders emanating from different authorities. There was no logical uniformity of plan or system in them, many of them had fallen out of knowledge and practice, and for several of them there was no sanction of law.

In the Bengal Gaol Code of 1864, drawn up in accordance with the Act, there is a special section directed to the labour and employment of convicts. The rules of that section contain a classification of the different kinds of work carried on in prisons; the apportionment of labour with reference to the length of sentence; the promotion of prisoners from one class of labour to another, as the reward of good conduct; the regulation of the labour by task work; the punishments to be inflicted for idleness, bad work, wilful destruction of material and implements, &c.; and the other details needful to carry out the systematic use of labour as a means of enforcing discipline. This introduced uniformity of system, and placed prison industry upon a sound basis. Had the construction of the prisons and the provision of establishments by the government been such as to give full effect to the intentions of the gaol code which I drew up, the prison system of Bengal would have been in advance of that of other countries. As it is, I believe it is not behind any of them.

Having thus disposed of these preliminary matters, before proceeding to the consideration of the special points contained in the title of my paper, it may be as well to show, as briefly as possible, the nature and extent of the means of acquiring a knowledge of the subject of prison discipline which my official position afforded me.

5.—EXTENT AND NATURE OF THE PRISON DEPARTMENT OF BENGAL.

My jurisdiction and authority extended over the country included in the Lieutenancy-Governorship of Bengal. In my circle of supervision were fifty-nine gaols, and some eighty lock-ups, or sub-divisional places of detention. In the gaols, which, with a single exception, the European Penitentiary at Huzamburgh, were composite institutions, containing prisoners under trial, civil and revenue defaulters, and convicted criminals of all classes and sentences; the numbers confined ranged from fifty, and sometimes under, to more than 2,000 in the Alipore gaol. In them were confined the criminals of a singularly varied population, little, if at all, short of forty millions of people, including the European and other prisoners of the metropolis of British India. Through these prisons there passed annually, during the whole of my incumbency, an average of not less than 80,000 prisoners, and there were constantly present between 16,000 and 18,000.

The numbers sentenced to rigorous imprisonment, of which hard labour is a condition, constantly present in each year, were as follows:—

1856	16,585
1857	15,664
1858	16,121
1859	15,057
1860	16,162
1861	14,894
1862	15,472
1863	15,106
1864	15,225
1865	18,012
1867	17,245
1868	16,671
1869	17,387
1870	17,371

Of the above, 10 per cent. were employed as gaol servants; 2½ per cent. were engaged in the later years as convicts' warders and work overseers; about 5 per cent. were unable to work, on account of old age, infirmity, or constant sickness; and all convalescing from acute disease, or physically unfit for hard labour, were occupied in light and almost nominal tasks, chiefly in the gaol garden.

Taking one year with another, less than 80 per cent. were employed in handicrafts, or in remunerative prison industry. Of this number, very nearly two-thirds had short sentences, in which it was nearly impossible to teach them any trade or handicraft. The majority of all prisoners sentenced were from the agricultural classes, to whom the teaching of handicrafts was of little use, as they would not follow them on release.

In the above enumeration, I do not pretend to have given the absolutely exact figures, or to have produced the details of each class, my object being merely to give you a rough idea of the amount of human material upon which I had to work.

6.—NATURE OF THE INDUSTRIAL OCCUPATIONS FOLLOWED IN THE GAOLS IN LOWER BENGAL.

The handicrafts and other remunerative occupations introduced were classified as follows in the gaol code, the classes representing the severity of the labour:—

First Class.—Oil pressing, lime grinding, flour grinding, paper pounding, pounding bricks for mortar, paper polishing by hand, printing (press work), bookbinding (press work), digging and carrying earth, drawing water, cleaving fire wood, sawing wood, scavengering and carrying away night soil, tile and brick making, bowing wool for blanket weaving, blacksmiths' work, stone breaking for metalling roads.

Second Class.—Masonry, paper making by hand, blanket weaving, gunny weaving, cotton-cloth weaving, carpet weaving, supplying masons with materials, storing grain, carrying or pumping water, carpentering, compositors' work.

Third Class.—Tailoring, dyeing, folding and stitching books, reading proofs and lithographic writing, spinning twine or thread by hand, leather work, sizing and drying paper, weeding and removing decayed vegetation.

Almost all the work referred to was hand-labour, and the implements used were of the simplest and rudest construction.

To render imprisonment useful to the agricultural classes, and, through them, to benefit the country at large, of which the general agriculture is of a most primitive description, I strongly urged upon the attention of the government the desirability of establishing penal agricultural colonies, on the plan of those of Algeria and Corsica. No action was taken on my suggestion up to the time of my leaving India, but as a special agricultural department has since been instituted, it is not improbable that something may, ere long, be done. If judiciously managed, it may be the instrument of much good, and a far better means of rewarding good conduct in gaol than remission of sentence, and it should repay the whole of its cost, a condition which I think should be exacted from all systems of prison labour, and be regarded as the test of their efficiency. There is no evading this test. All others, being based on that most fallible and unstable of all foundations, human testimony and judgment, are thoroughly unreliable. Instead of "V.G." and other mysterious marks on the arm of a convict, I should prefer to see a record of the money value of the labour performed by him, and from this I should judge of his conduct in prison. He may sham piety and obey the prison rules from motives of self-interest, without their proving that he has derived any moral benefit from his confinement. He cannot feign a day's weaving, printing, tailoring, or carpentering if he has not performed them, and their honest performance cannot fail to benefit him. But I am anticipating.

7.—Financial Results of Prison Labour in Bengal.

The first of the conditions of prison labour which I have promised to elucidate is its economical aspect. This is best determined by its balance-sheets or financial results, but as the limits necessarily imposed upon me prevent my giving you the details of the figures in each branch of industry, which are preserved in minute detail in my reports, I shall submit to you only the gross results.

The net profits realised from the labour of the convicts actually employed in handicraft, after deducting the cost of production, were, in round numbers, as follows:—

	£.
1855-56	11.019
1856-57	12,300
1857-58	10,841
1859-60	14,065
1860-61	23.124
1861-62	54,542
1862-63	30,604
1863-64	54.542
1864-65	32.988
1865-66	35,543
1866	14.287
1867	41,168
1868	56,817
1869	46,588
1870	45.274

In all, nearly half a million of money. In 1866, the accounts were made up for only eight months, to introduce the calendar in place of the official year, which ended on the 30th of April.

If the limits of time and space permitted, I could show you in minute detail that each skilled prisoner employed in handicrafts, striking the average of all the gaols, earned considerably more than he cost; that five of the prisons under my charge were at various times self-supporting, and that one of them, the great industrial prison at Alipore, a suburb of Calcutta, has repaid very considerably more than its cost for the last ten years continuously. Likewise, that 40 per cent. was earned of the whole cost of the prisons of Lower Bengal, including the maintenance of all classes, those under trial as well as the thousands injudiciously but strictly legally sentenced to simple imprisonment, or compulsory idleness—a provision of the criminal law which I hold to be as senseless as it is mischievous.

It will not be easy to convey to you an idea of the difficulties under which this was accomplished, for the majority of the gaols in Lower Bengal exhibited, as I have already stated, almost every possible defect of construction and arrangement, and the establishments were cast down to so dangerous an extent, as to render it impossible to work any scheme of discipline with the extreme care and attention to details necessary to render such places efficient instruments of punishment. Had my constant and earnest appeals to the government for proper and secure prisons and adequate establishments been attended to, the gaols of Lower Bengal would long since have been entirely self-supporting, and have ceased to be a burthen to the taxpayer. Had I even been allowed, as I more than once advocated, to expend the money earned in the prisons in remedying their most crying defects, the same result would have been attained, without additional charge to the Imperial revenues. Prisons must be maintained at the public charge in whatever way the prisoners are employed. To make crime repay its cost, even if it were not attended with direct benefit to the criminal classes by teaching them habits of order and industry, seems to me to be not only reasonable but right.

Of all false economies, I believe there is none more mischievous than that of attempting to save expense by building insecure and unsuitable prisons, and depriving them of the establishments without which it is impossible to enforce order and maintain discipline, without resorting to punishments inconsistent with humanity and civilisation. Such prisons not only set aside the intention of the law in the punishment of crime, but render nugatory the enormous cost of the judicial and police agency maintained for the detection of crime, and the trial and conviction of criminals.

In speaking of relaxations of discipline, introduced from a view to economy, Archbishop Whately remarked that, "all the vulgar opinions on the subject are founded in error. Economy is not the end of punishment, nor is the system pursued truly economical."

All my proposals for measures which would directly diminish crime and strengthen national virtue, by preventing the contamination inseparable from all collective systems of imprisonment, were met by objections on the score of expense, implying, as the same sound authority puts it, that "morality is less important than money, or that vice is a less evil than taxation."

True it is that "even if the suppression of crime could be purchased at a dear rate, the sacrifice of public revenue would be repaid at an usurious interest by the increase of public morality.

"A cheap punishment, which increases crime and punishes criminals, is, in the end, less economical than a system which represses crime and greatly reduces the number of criminals.*"

Yet this was strictly the manner in which this great question was dealt with in India while I was there. I then urged, and I still maintain, that prisons which, from defects of construction and arrangements, are such as to become, *ex necessitate rei*, training schools of vice and crime, are worse than useless. They are a scandal and a reproach.

Central or convict prisons, for which I pleaded earnestly and incessantly, were at last sanctioned, and three of them were in course of construction when I resigned my office. The plan adopted by the government of India is not such as any person acquainted with the subject could approve or sanction, and I am of opinion that to build such places is a mere waste of public money.

8.—Economical Objections to Convict Labour.

Before dismissing the subject of the economical advantages of convict labour, I ought, perhaps, to say a few words upon the economical objections which have been raised to industrial employment in prisons.

Prison labour, when devoted to industrial pursuits, must undoubtedly, to a certain extent, come into competition with free labour of the same class, and I maintain that it has a perfect right to do so.

Prisons are a charge against the public revenues, and it is just and proper that this burden should be lightened as much as possible. It would be wrong in principle, and opposed to all sound maxims of economy, that the interests of individuals (or of small sections of the community) should be protected at the cost of society at large. It should, however, not be forgotten that the criminal, had he not taken to evil courses, would himself have competed with others of his own class or trade in the labour market. To teach him an industrial pursuit that will enable him to gain an honest livelihood on release is merely to restore him to his natural position; and surely it is an unmixed gain to society that by this process he should be converted into a profitable producer from an unprofitable consumer. Is it not also quite certain that society is itself responsible for some of the evils inflicted upon it by crime and ignorance—twin children of an unnatural parent—and that it is bound, by every principle of morality and self-interest, to repair the injury by every means in its power.

The only industry that was seriously objected to in connection with the gaols of Lower Bengal was the spinning of jute and hemp by the introduction of machinery in the Alipore gaol. The main ground of objection to it was that it interfered with a branch of industry which needed encouragement and protection. The commercial infant which requires such dry nursing must be a puny, sickly child, which it would be of no permanent interest to the commercial family to rear. But the history of the jute trade showed that this was not a sound objection, inasmuch as the whole of the private jute mills and gaols together were only able to work up a small portion of the raw material exported. Gunny weaving was, moreover, an established occupation of the prisons for some twenty years before the jute mills, which they were said to injure, were called into existence.

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* Archbishop Whately.

The merchants of Calcutta are an enlightened and liberal body of gentlemen, and some among them, who had objected strongly to the introduction of machinery at Alipore, admitted, when they visited the gaol and saw it at work, that its employment was unobjectionable on economic grounds.

The fact was, that the introduction of machinery to spin yarn in the gaol was due to the action of the jute companies themselves. The labour of hand-spinning was too light for prisoners sentenced to hard work; the yarn was in consequence purchased in the open market, and woven in the prison. The establishment of jute mills affected the hand-spinning of the bazaar so considerably as to render it almost impossible to obtain yarn except from the mills. The mill-owners imposed such a price upon it as to render it impossible to work it up in the gaols without loss. Occasionally they refused to supply it at all, when some 1,500 prisoners were suddenly thrown out of work at Alipore, sometimes for weeks together. This was so serious a contingency, and acted so injuriously upon the regulation and discipline of the prison, that I represented the matter strongly to the government, and obtained sanction to render the gaol independent of the fluctuations of the markets, and of the caprices of the jute companies.

The only other branch of prison industry that was objected to was the printing press; but this objection was never very strongly urged, as the printing at Alipore has always been restricted to work for the government. Few dispute that the State has a right to utilise the labour at its disposal in its own service, and thus to diminish the cost of the prisons to the public.

I may, perhaps, be permitted here to explain why I added printing to the industrial occupations of the Alipore gaol, and extended it until it has become the most important branch of prison industry in Lower Bengal. It was with no mere intention of diminishing the cost of printing to the government; it was entirely in the interests of prison discipline, and with a view to its ultimately becoming a powerful instrument of national progress. Printing, in its various departments, includes a larger amount of skilled and unskilled labour than any other kind of prison occupation. Its educational influence is very great; the work can be guaged to the nicest degree of accuracy; and those trained in the prison press have no difficulty of procuring employment on release. But, above and beyond all this, the time is rapidly approaching when the government of India must deal with the question of the education of the masses of the people committed to its charge. No progress can be made in this direction without the supply of simple elementary school books by the million for the million. The gaol presses, with their steam appliances, can alone meet this demand at such rates as would bring the books within the reach of the people at large, but which would not remunerate private industry.

I know of no way in which those who have injured society by their crimes can better repair that injury than by helping to diffuse, throughout the length and breadth of the land, the light of knowledge. Ignorance and crime are so intimately associated, that to dispel the one is practically to diminish, if not, in numberless cases, to remove the other. I trust, therefore, that, although my connection with the prison department of Bengal has ceased, this great object will not be lost sight of when the time for its accomplishment shall arrive.

9.—Disciplinary Aspect of Prison Labour.

Having thus disposed, I am afraid very imperfectly, of the economic relations of prison labour, I come to the consideration of its influence as a means of enforcing discipline.

It may appear somewhat singular to raise such a question at the present time, yet I am disposed to think that much of the opposition to the general introduction of industrial occupations in gaols is founded on the belief that they are not penal in character, do not afford hard labour, and, therefore, do not fulfil the supposed intention of the law. Lord Macaulay and the Bengal Prison Discipline Committee of 1838 considered that the labour of prisoners should be dull, monotonous, and wearisome; and many persons suppose that nothing can be regarded as penal labour that is not associated with severe and sustained muscular action.

Upon this subject Bentham has written wisely and well. He says that "an occupation is a series of acts of the same kind, or tending to the same end. An occupation considered in itself may, in the first instance, be painful, agreeable, or indifferent, but continued beyond a certain length of time, it will always become disagreeable. This is true of all tasks without exception, and particularly so of those which are pleasant at first, but ultimately become more disagreeable than those which are naturally disagreeable. . . . . To render the sum of a man's occupations agreeable, he must be able to pass from one to another, according to his taste; all compulsory occupation is, therefore, painful."

Now, an inseparable condition of all prison labour is that it *is* compulsory; that it not only compels the convict to do that which must be distasteful to him, but prevents his occupying his time in any employment which might suit his fancy, or be otherwise agreeable. "The net value of the pleasure which an individual loses by a forced occupation is equal to the sum total of all the pleasures which he might have been able to procure had he been a free agent." Judged by this standard, all prison occupations, when continued from day to day in fixed tasks, for ten weary hours, in dull, monotonous succession, must be regarded as penal, however slight may be the actual muscular power exerted in each step of the labour. Those which involve great muscular exertion can only be continued for short periods, with intervals of rest. They leave a large margin of unoccupied time, which is about the worst feature that can characterise any description of prison occupation. Hence, in my humble judgment, the tread-wheel, the crank, the shot-drill, and all such aimless tasks, are not only a waste of power that may and ought to be devoted to some useful end, but they tend to brutalise and degrade the individuals subjected to them. Again, the dogged resistance to authority and the feelings of resentment caused by all such descriptions of labour are destructive of the feelings and influences which lead to reformation. Of two descriptions of labour which act equally in producing physical exhaustion, that which results in some useful work, is, I am convinced, of far more use as an instrument of reform than that which ends in nothing but a weary frame and an angry heart. Some years since, when it was objected to my system that it was not deserving of the name of labour, I instituted a series of experiments to determine the exact amount of muscular power exerted in various prison manufactures. Time will only allow of my mentioning one of them—the weaving of gunny cloth, in which some hundreds of prisoners were daily engaged.

Each convict in the Alipore gaol, when fairly skilled as a gunny weaver,—an amount of proficiency acquired in a few months—is required to weave twenty yards of gunny cloth in an ordinary working day of ten hours.

Each yard of such cloth requires an average of 365 threads for weft, necessitating 7,300 pulls of the beam for the full task. Direct experiments showed that each pull requires an amount of muscular force equal to lifting a weight of eight pounds a foot from the ground. The daily labour of each weaver was thus found to be equal to raising a weight of several tons a foot from the ground. Several other descriptions of prison industries were found to be equally severe, some of them so much so as to be used only as corrective labour for breaches of gaol discipline. The labour which appeared to be the lightest in the prison was found to be in reality a severe task. It was the placing of a sheet of paper, with care and exact adjustment, on a press cylinder for printing. This proceeding had to be repeated at least 1,500 times a day, or once in every twenty seconds. The individuals so employed were tolerably well tired at the end of each day's work.

There is, then, I am of opinion, no sound or tangible objection to the employment of convicts in handicrafts on the ground of their not providing the hard labour required by the law.

10.—USES AND ABUSES OF PRISON LABOUR, AND IMPRISONMENT GENERALLY.

The character of the labour assigned to convicts must depend upon the objects which it is intended to fulfil. If it is intended simply to be a means of coercion, and to harass and worry, without any thought of benefiting or humanising those who have offended against the law, the more it is an exercise of mere brute force the more effectually it will answer that end. But are such measures justifiable, and ought they to be the purpose contemplated by the legislature in the provision of labour contained in the criminal law? I have no hesitation in declaring my conviction that they are not only not justifiable, but that they are in excess of the necessities of the case.

Bentham has classed the circumstances associated with imprisonment—which he terms inconveniences—under three heads, viz., the necessary inconveniences, the accessory inconveniences, and those which must be regarded as abuses.

The necessary inconveniences are, the loss of liberty, with all the consequences arising from this loss—disruption of family and social ties, destruction of business, a compulsory state of existence in all matters, and the necessity of conforming to strict regulations, in which no freedom, even of will, can be exerted.

The accessory pains are, a compulsory dietary, uncomfortable means of repose, total exclusion of society, even to seeing friends or relatives, forced association with all sorts of persons, absence of the means of communicating with the outer world, and enforced labour in uncongenial pursuits, or compulsory idleness.

Most of these are justifiable, and all in excess of them are abuses. Now, it appears to me, that the necessary and accessory inconveniences of imprisonment are in themselves sufficiently severe, and as much as society has a right to impose.

Beccaria, who is one of the most logical writers and thinkers on this subject, remarks that, "If it can only be proved that the severity of punishment, though not immediately contrary to the public good, or to the end for which they were intended, viz., to prevent crime, be useless, then such severity would be contrary to those beneficent motives which are the consequences of enlightened reason, which instructs the sovereign to wish rather to govern men in a state of freedom and happiness than of slavery. It would also be contrary to justice and the social compact."

Since Beccaria wrote, the system of severity and repression of crime by the infliction of pain, have been tried in different countries, and I am not aware of a single one in which they have diminished crime or reclaimed criminals. It is not difficult to understand why it should be so, for pain is a sensation, and has no connection with the moral sentiments.

If a punishment be in excess of the degree of severity sufficient to deter others from the commission of crime, it is not only unjust but hardens men, and thus defeats its own intention. To torture or torment an individual guilty of a breach of the criminal law, will not undo the crime he has committed, and can have no beneficial influence on other men, for he cannot communicate the sensation of suffering which he experiences to others in such a manner as to enable them to realise it.

"Punishments are to be estimated, not by the sensibility of the individual, but by the injury done to society, and in all cases those penalties are least likely to be productive of good effects which are more severe than is necessary to deter others."* It is the certainty rather than the severity of punishment that influences the criminal classes; hence the evil effects, in my humble judgment, of any such tampering with judicial sentences as characterises most of the schemes of prison discipline in force at the present time—and in particular that grave abuse, the ticket-of-leave system.

Habitual criminals, and those who are familiar with prisons, are usually the best-conducted prisoners. They know exactly how to feel the pulse of the chaplain, and to impose upon the visiting justice; to obtain the requisite number of marks to place them in a higher class; and ultimately to earn the remission of their sentences. This has always caused me to mistrust the mark system, and to set my face strongly against any diminution of sentence as the reward of mere good conduct in gaol.

The best, the surest, and the least fallible of all the proofs of amendment is afforded by the labour test. So long as a prisoner works well, completes his task in the regulated time, and acquires skill as a workman, I am satisfied that his imprisonment is attended with benefit, and that he will not be likely to return to gaol on the expiry of his sentence. The discipline, then, of well regulated labour, I hold to be the system most likely to secure the proper purposes of imprisonment, viz., the just and humane punishment of crime, and the protection of society. Assuming, if you agree with me so far, that the proper penalty for the commission of crime consists in the necessary, and most of the accessory inconveniences of imprisonment, in what way does gaol labour act as a measure of discipline? The answer is easy and obvious. By occupying the whole of the prisoners' time in works of usefulness, which, from their regularity, continuance, and the impossibility of evading any portion of the daily task from any other cause than sickness, must be extremely distasteful, and in entire opposition to the ordinary habits of criminals. That they effectually take all desire for mischief out of those employed in prison-workshops was seen at Alipore, and in every other Bengal prison in which task-work was exacted.

In former times, when work was spasmodic and irregular, and no fixed or continuous tasks were performed, the moment the wards were closed at night, and the prisoners placed in the dangerous association which is destructive of all moral feeling, there commenced a continuous buzz of conversation that lasted well into the night. Now, when the day's work is at an end, although the same soul-and-body-destroying association exists, when the convicts are counted and the doors locked, the silence of sleep steals over the whole place, and scarcely a sound is heard to break the stillness of night. Tired nature needs the repose that is at once sought, and as much good is accomplished as is possible with a construction and arrangement of prison wards which it is impossible to condemn too strongly.

11.—OBJECTIONS TO EXTRAMURAL CONVICT LABOUR.

There is still another question connected with prison labour as a discipline, which it is necessary to consider briefly:—Is it desirable to employ convicts in great public works, in preference to engaging them in industrial occupations?

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* Beccaria.

The question was so ably handled by Capt. Du Cane, in this Society, in May last, that I feel some diffidence in dissenting from the conclusion arrived at by an officer of so much experience and knowledge of the subject. If the sole purpose of prison labour is to supply hard work which is at the same time remunerative, and will recoup to a considerable extent the maintenance of the convicts, without any ulterior object, there can be no doubt of the soundness of Capt. Du Cane's conclusion. From such premises, no other conclusion could logically be deduced. But I hold that the mere provision of hard and remunerative labour, of which the reformation of the convict forms no element, and from which there can be no inculcation of the principles calculated to restore him to society a better and a wiser man, is not, and never ought to be, regarded as the chief end of prison labour.

Such of the public works as can be performed within the prison walls, and in which the skill can be acquired that will enable a prisoner to earn an honest livelihood on release, as carpentering, smith's work, masonry, and such like operations connected with building, are not only unobjectionable, but fulfil all the cardinal conditions of prison labour. As carpenters, blacksmiths, brick-makers, and masons, many of our Bengal prisoners attained remarkable skill, and large sums of public money were saved by their employment on prison buildings. But, when the work has to be performed outside the gaol walls, when it consists of mere muscular efforts, such as are required to excavate docks and canals, to build bastions, and construct breakwaters, I consider the employment to be open to many and serious objections. From the beginning to the end of his sentence, until he obtains the privilege of intermediate imprisonment, the horizon of the prisoner should be bounded by the barriers of the gaol. He should be cut off from all sight and sound of the world without, and he should be subjected rigorously to the necessary inconveniences of imprisonment. Few of these conditions are fulfilled by sending him out to work in gangs, and I know of no system of vigilance in supervision that will prevent his communicating with his friends, if he has any, and obtaining indulgences which are inconsistent with the compulsory state in which he ought to live.

These objections appear to me to be fatal to all schemes of employing convicts on public works, especially where free labour is procurable at a more moderate cost than must be incurred by the use of compulsory labour. The objections to such employment are stronger in India than in England, from the untrustworthy subordinate agency that must be relied on. The conclusions on this point arrived at by Lord Macaulay's committee should not be set aside, for I hold them to be unassailable.

12.—Reformatory Aspect of Prison Labour.

The last branch of my subject relates to the reformatory influence of prison industry.

The chief indications of reformation must be sought in the conduct of the prisoner while in gaol, and in his proceedings and course of life on the expiry of his sentence.

It has been remarked in those of the industrial prisons of Lower Bengal which are well managed, that the convicts as a body are orderly, cheerful, and perform their allotted task with alacrity and ease; that breaches of gaol rules in them are comparatively few, and of no great gravity; that the punishment registers do not contain many entries; that the prisoners are earnestly anxious to obtain the promotion to minor prison offices of trust which are the rewards of industry and good conduct; and that they are equally solicitous for the privilege of intermediate imprisonment. The two latter boons ought never to be extended to prisoners whose names have appeared in the punishment registers.

Among the prison offices referred to are not those to which is assigned the discharge of the menial offices of the gaols: these are regulated according to caste and other conditions, and for the work performed there is no money value assigned, although it is attended with a considerable saving to the State.

The internal watch and ward of the prisons in Lower Bengal is chiefly entrusted to well-behaved convicts, and is a feature of Indian gaol management, which deserves to be tried at home. However strange it may appear, and however much opposed to all preconceived ideas on the subject, I am satisfied that the proceeding is correct in principle, and years of careful trial, among European as well as native prisoners in India, have proved that it is successful in practice.

The inculcation of self-respect and self-control is a moral force of great power, and so long as moral agencies are, I think rightly, regarded as the most effective instruments of human government, their application to the management of prisons and prisoners is sound and sensible. Prisoners are but men and women after all; and, in many respects, are really neglected children of a larger growth. The same springs of action move them that move others who have not been subjected to the same temptations, or whom education, the cultivation of home feelings, religious instruction, and the thousand other incentives to virtue, which are so frequently wanting in the criminal classes, have restrained from falling into crime.

Count Romford was surely not wrong when he laid down as a principle that, to make men virtuous, it was necessary first to make them happy, instead of reversing the process, which is the general rule of action.

How much of drunkenness, depravity, abandonment of home, and all their deplorable consequences are due to the absence of the brightness, cheerfulness, and comforts of a home, the noble band of men and women in England who labour among the poor can tell you. Judge not, then, too harshly those who have not enjoyed advantages for which we can never be too thankful; and when ignorance and poverty, with their destructive allies, the gin-shop and the receiver of stolen property, have produced their natural results, and consigned the child of misery to the prison, do not withhold from him the means of cleansing himself from the pollution of his criminal career, and of acquiring habits of self-restraint and self-control, which will prove far stronger barriers against relapse than bars and bolts, and stripes and fetters. *La morale vaux deux fois la physique* in peace as well as in war.

No prisoner in Lower Bengal can obtain the office of prison warder or work overseer without passing through a certain fixed period of his imprisonment without reproach, the proportion bearing a direct relation to the length of his sentence. The restraint and control which he must have exercised to secure this result cannot fail to be followed by good effects when he once more becomes master of his own actions.

The reformatory results of prison industry in the Alipore gaol, the chief prison of Lower Bengal, may be stated in a few words.

In the year 1835 that prison contained an average of 2 000 inmates. The net earnings of the prisoners, many of whom were sentenced for life, were valued at £250—a mere fraction of their cost. The prison had a large and expensive outer and inner paid guard, and yet its discipline was so bad, and the prisoners so desperate, that the prison was considered a source of public danger, and the officer in charge, the late Mr. J. H. Patton, of the Bengal Civil Service, recommended the immediate transportation of its inmates. Upon an attempt to increase the amount of work, the prisoners rose upon and murdered the magistrate of the district, who was also the governor of the gaol. They had previously cut off the nose of one of the native officials.

When the Sepoy revolt of 1857 broke out, and room was required at Alipore for the confinement of mutineers in transit to the Andaman Islands, I accompanied the survivors of the Alipore tragedy to Aracan, where they were sent. From their own lips I heard the strangest tale of mismanagement and ill-directed, capricious severity and softness that it has ever been my lot to listen to. The statements of these men, some of whom had spent nearly half a century in prison, and had nothing more to fear from concealment, forcibly impressed me with the conviction of the utter inapplicability of mere measures of severity to the treatment of convicts. These men were none of them timid Bengalees, but a stalwart manly race, many of whom had been noted gang-robbers in their day, and none of whom had any fear of death.[*]

The same Alipore gaol, in 1867, had become a well-organised, although singularly ill-constructed industrial prison, containing more than 2,000 prisoners; its outer walls were guarded by 30 Sepoys, and its inner guards were nearly all well-behaved convicts. It was a model of order and regularity, and the net earnings of the prisoners were estimated at £25,000. The breaches of discipline and consequent punishments were few; and yet the convicts, in every department, executed tasks in excess of the work performed in a full day's labour by skilled artisans of the same class in a free state. What unreasoning severity, and the large amount of power entrusted to corrupt subordinates had failed to secure, was easily accomplished under the mild but strict government of the late amiable and excellent Dr. Fawcus and his deputy-superintendent, Mr. F. H. Dobson, the best prison officer I have ever met with.

Of the industrial system in preventing relapses, I have no reliable statistics, and there are no Prisoners' Aid Associations in Calcutta to trace the prisoners after release. But it is well-known to the authorities at Alipore that no skilled workman ever returns. Large numbers are known to be earning an honest livelihood in and about Calcutta. From causes not necessary to explain in this place, a sense of disgrace is not yet largely associated with imprisonment in Bengal. Skilled native workmen, trained in gaol, have, in consequence, no difficulty in obtaining employment elsewhere.

From facts within my personal knowledge, I am able to state that various industrial establishments are indebted to Alipore for well-conducted and efficient workmen, who are probably known to their fellow artisans but not to their employers. I have myself aided many well-conducted convict artisans to obtain employment, and, with the exception of two or three Europeans, who lost their situations from drunkenness, none of them had abused the trust placed in them, up to the time I left India.

In a copy of a native newspaper sent to me a short time since, I find mentioned authenticated instances of individuals trained in the gaols under my charge, who have obtained honourable employment, and are not likely to relapse into crime. Better evidence of the benefits of the industrial system in Bengal it would be difficult to produce, until properly constructed prisons are no longer conspicuous by their absence.

13.—CONCLUSION.

Having thus shown you the means of acquiring information which I possessed, and the results obtained from the system adopted, imperfectly and incompletely as I was able to carry it out, I think I am in a position to lay down a few principles of general application. Before doing so, however, permit me to assure you that it is a fallacy to suppose that experience acquired in India is not applicable to the circumstances of prisons in England. The great principles of human action are based upon eternal truths, which are universal in their application. Their universality is, in turn, a test of their truth.

Convict management in the East is surrounded with difficulties unknown in Europe, and requires, in consequence, a tact, a decision, and an exercise of judgment that prison officers at home are, fortunately, seldom called upon to exercise. You have all, doubtless, recently read how the removal of a few threads from the persons of Brahmins led to an outbreak attended with bloodshed. But few of you can know the thousand other apparently equally insignificant incidents that render Indian prisons a species of powder magazine, ready at any moment to explode, from a little want of knowledge and tact, and even a pardonable error of judgment. Just before I took charge of the Prison Department of Lower Bengal, the injudicious manner adopted to take away a few brass drinking vessels, which had been used as weapons of offence, caused outbreaks which were also attended with loss of life. Yet the act was right in itself, and was subsequently enforced without resistance by a different mode of manipulation.

I know of no better training-school for all kinds of administrators than India affords, as the history of that magnificent dependency of Great Britain shows. It laid the foundation of the future fame of the great Duke of Wellington, as his own dispatches show; and no less an authority than De Tocqueville declared that England owes her place in the opinion of the world to the manner in which she has conquered and governed India. Indian experience ought not, then, I respectfully submit, be altogether disregarded in the discussion and treatment of English questions.

The conclusion at which I have arrived on the subject of prison labour are as follows:—

That the State is bound to provide secure and properly-constructed prisons for convicts, with adequate establishments.

That all prisons should be made schools of industry, and should be rendered self-supporting by the introduction of remunerative labour.

That the industrial system is well-calculated to secure the immediate object as well as the end of imprisonment.

That the conversion of gaols into schools of industry is not only consistent with the maintenance of strict discipline, but is the most rational and humane means of enforcing it.

That the utilisation of convict labour in handicrafts is a perfectly legitimate employment of such labour, and that there is no sound economic objection to the adoption of the principle by the State.

That the necessary and accessory inconveniences of imprisonment are in the imprisonment itself, when properly and strictly carried out on the separate system, and that convict labour should not be used or regarded as a punishment, but treated as an alleviation of punishment, except to the very moderate extent in which labour may be used as a measure of gaol discipline for breaches of prison rules.

That the labour should be strictly confined to the prison precincts, and should, in no circumstances, bring the prisoner in contact with the outer world.

That as punishment and reformation stand very much in the same relation to each other as curative and preventive measures in medicine, all sound systems of prison discipline should subordinate the former to the latter, because the infliction of pain or cure can only affect the individual, while reformation or prevention may influence the many, and the major in all such cases should be preferred to the minor.

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[*] Nearly twenty years after the outbreak at Alipore, which caused the murder of the officer in charge of the gaol, the Consul-General of France visited that institution, and states that at the outer gate of the prison he was presented by the magistrate who did the honours, with a revolver and a thick stick. Armed with these instruments of protection, and escorted by a guard with drawn swords, he examined the prison, which he describes, and, among other things which he witnessed, notices particularly a bandit chief, chained to the wall of a cell. He was a man of about thirty years of age, of great stature, and a fine countenance, whose fiery glance of scorn and anger at the *cortege* as it passed was difficult to sustain. The first revolver fired in anger in India was in the Alipore gaol, by a magistrate whose life was menaced, a little before M. de Valbezen's visit. This second attempt was followed by the crenelation of the inner walls of the prison, to enable the guards to fire in safety upon the prisoners. That occurrence preceded my taking charge of the prisons by a very short time— some two or three years. —*Les Anglais et L'Inde*, par M. E. de Valbezen, pp. 206—209; 3rd edition.

Lastly, and above all, that the more widely our prison systems depart from the great leading principles of Christianity, the more likely they are to err, and the more certain they are to end in failure.

Are we not told on the highest of all authority, that "there is joy in heaven over one sinner that repenteth, more than over ninety and nine just persons which need no repentance." And are we not bound, by every means in our power, to endeavour to turn the hearts of the disobedient to the wisdom of the just?

DISCUSSION.

Mr. Wm. Tallack said it was a great encouragement to that section of the public who were devoted to prison improvement, that two gentlemen who had given so much practical attention to the subject as the Chairman and Dr. Mouat should each have so decidedly expressed themselves in favour of the general adoption of reformatory and remunerative prison labour, as distinguished from penal idleness. Probably all would agree with the principle laid down by Dr. Mouat that remunerative labour was not the main object; for, after all, the prevention of crime and the reformation of the criminal must be first kept in view. But if these two objects were found compatible, and not only so, but thoroughly dependant upon remunerative labour, then the subject became still more important. It would be found, he believed, that those who had adopted this principle to the greatest extent were most thoroughly in favour of it. He had been assured, by one gentleman in particular, Mr. Gideon Haynes, the warder of a State prison in Massachusetts, whose inmates numbered from six hundred to a thousand, which was not only self-supporting, but brought in a clear revenue of between £4,000 and £5,000 to the State, after paying all costs and salaries, that the reformatory effect of prison industry was greater than that of all other agencies put together. He stated that 80 per cent. of the men who entered his prison were ignorant of any trade, though half of them could read and write, thus showing that intellectual knowledge was not so useful as practical handicraft and skill. He had similar testimony from the governor of the State prison of Maine, which was also self-supporting, and a source of revenue. In England, there were two main obstacles to the introduction of such a system. The first applied mainly to county and borough gaols, and consisted in the short terms of imprisonment, or rather the large number of criminals who were sent to gaol sover and over again for short terms, but who were never in gaol long enough to be taught any useful industry. It was therefore astonishing to him that governors of gaols did so much in making prison labour remunerative, though the extent to which they did so was shown by the fact that our 20,000 prisoners cost about 12s. a week, whilst they earned, on an average, less than 1s. In some of the prisons, however, more particularly Wakefield, Salford, Durham, and York, the annual earnings of the prisoners varied from £5 to £10 per annum, which was certainly more than could be expected, considering that at least three-fourths were not in prison for more than six months, if so long as that. He was glad to find that the magistrates of Liverpool had lately memorialised the Home Secretary against this mischievous practice of repeated short sentences, the results of which were shown in the fact that, in the borough gaol alone, in six months in last year, there were 390 prisoners, every one of whom had been in that gaol upwards of 50 times, whilst some had visited it upwards of 70 times. The second obstacle which he referred to was the imperfect skill of those who taught the prisoners. From a great deal of observation on this matter, while he was able to bear testimony to the admirable manner of the majority of the governors of prisons, he believed it was no unfair charge to make against a large number of the prison officers that very little care was taken to select men who had any practical knowledge of their business. He had been informed by a warder in a convict prison that, in one prison alone, hundreds of pounds worth of shoe leather was wasted through the ignorance and clumsiness of the officers who professed to teach shoe-making. He had heard of similar instances from other quarters. Those prisons which were most successful in producing a remunerative return, particularly Wakefield and Salford, depended mainly on mat-making, which was very easily taught; but while he agreed with the general principle that it was quite proper for prisoners to be productively employed, and that their so doing would not compete unfairly with honest labour, he must admit that when a great portion of their labour was devoted to one trade, such as mat-making, it was a real injustice to those following that calling, and there was the more reason for complaint because it was a trade very well fitted for, and much followed by, the blind. He was glad to find, therefore, that in some gaols the governors were introducing a larger amount of variety. It was often urged that prisons must be places of punishment, and that if prisoners followed pleasant occupations, it would be offering them an inducement to come in again. That was a specious objection, but not a solid one. When going over Devonport gaol, some two years ago, the governor told him of an instance in which he had called the attention of a prisoner, who had been leaving, to the value of the work which he had done whilst in gaol, telling him that he had not only earned sufficient to pay for his own cost, but had also partly contributed towards salaries and other expenses. The man was so much struck by the folly of his conduct, that he expressed his determination never to come there again, and he had kept his promise. He believed it would be as stinging a punishment almost as could be conceived, if, for instance, a skilled artist or mechanic were obliged to labour for a long time in gaol, and shown, at the end of his term, the amount of money which his labour represented, and which had been forfeited to the State by his misconduct. He quite agreed that prisoners should not be employed in gangs, but should be separated, and this for several reasons which need not be specified, but principally to avoid the demoralisation which always followed their association. In Belgian and other prisons abroad, the separate system was carried out thoroughly; and he believed it was a great boon to a prisoner, that when he left the prison he should not be recognised by his former companions. Besides, the separate system had been found so much more efficacious, that the terms of imprisonment had been considerably shortened. He did not refer to the silent system described by Dickens in his "American Notes," which tended to drive a man to despair. In the Belgian prisons the convicts were visited several times a day by the officers, and were thus not separated from the good, but only from the evil.

The Rev. W. C. Osborn said he was not a stranger to the subject under discussion, his whole life having been spent in connection with prisons. He had been told by a gentleman from India, Mr. Thornton, who took a deep interest in the work, that he had found the same difficulties which the lecturer detailed; but he had also assured him that he had established one gaol in India on the silent system, and he prided himself on having established that almost in opposition to the Bengal authorities. He did not think any name connected with this subject ought to be more honoured than that of the late Mr. Crawford, though, since his death, he was sorry to say, they had been retrograding. They had introduced into their gaols several instruments of torture, such as the crank, which first came under his notice in Pentonville prison. When it first came into his hands he took it to pieces, and he found that it was a cruel machine. After it had been in operation a few weeks it was found perfectly impracticable, and it was soon put an end to. He was very glad of it. He most heartily approved of the high and exalted views which the lecturer had developed, and he gave him his most hearty thanks.

Mr. Christopher Cooke desired to call attention to some interesting charts in the British Museum, showing the labour carried on, from 1798 to 1801, in the gaol at Dorchester. These charts were published officially, and it appeared from them that the system answered very well, and that very considerable sums of money were earned by the prisoners. There were two books also to which he desired attention, as bearing on this subject, one, Mr. Dickens' "American Notes," which had already been mentioned, and the other the work of Mr. Geo. Coombe, who, in 1838, went through a great many prisons in America, and inquired particularly with respect to this system, which both he and Mr. Dickens highly approved of. Mr. Coombe stated that in one place the convicts had the appearance of tradesmen in a well regulated manufactory. Since that time he had been over Milbank Penitentiary, in 1842, in company with Mr. Myall, who expressed his opinion in the most decided manner as to the benefit of the system. He was an experienced man, and said that the effect on the prisoners was most excellent, both whilst in gaol and after they left. He had seen in the *Standard* a suggestion that the convict prison contemplated by the present government should be built at Dartmoor, but, in his opinion, Bagshot-heath would be preferable, as the land might be got equally cheap, and the convicts might cultivate it.

Mr. Annesley De Renzy said he had had some experience of prison discipline in India, and might, therefore, make one or two remarks. There could be no doubt whatever that it was desirable that convicts should be employed remuneratively, but it was also right that the difficulties in the way of employing them in that way should not be overlooked. Reference had been made by Dr. Mouat to the results obtained in the Alipore gaol under his care, but 60 per cent. of the other gaols under his care had not yielded satisfactory results. Although the government were anxious to employ the prisoners on remunerative labour, still, notwithstanding all their endeavours, the results were very unsatisfactory, and there were numerous difficulties in the way of any effective alteration. He believed 90 per cent. of the convicts in the gaols were peasants, men who could drive the plough, feed sheep, or do scavengering work, but when they came into gaol what were they to do with them? Dr. Mouat would have them taught printing, and so on, but how could it be done. In the great gaol at Lahore, where the carpet manufacture had been developed to a great extent, only five per cent. could be taught, and the others remained idle or employed in labour of the lightest possible kind. The first speaker had referred to the scarcity of skilled instructors in prisons in England, but he should like to know where they were to get them in India. A peasant came into gaol, and was set to learn carpet-making. He first of all had to be taught to spin thread, then a certain task was given to him, but it was impossible to regulate the amount of work he was capable of doing. He had himself been a superintendent of a gaol, and he knew the difficulty which arose in this way. A convict was found fault with at the end of the day for not having done a sufficient quantity of work; he said he was a peasant, and not used to that kind of work, and could not learn, and it was impossible to inflict punishment on him for that. Manufactures, therefore, could not be carried on in gaols to any great extent without establishing a gross system of tyranny. What was wanted in India was skilled labourers, men accustomed to do the ordinary work of peasants; men who could dig well, good agricultural labourers. There was a sufficient number of smiths and carpenters, but navvies and such like were very much wanted. Prison discipline ought to aim at turning out good labourers by the strict enforcement of ordinary labour. In the Punjaub, the raising of water was an admirable means of employing convicts, because it was a kind of labour in which the amount of work done could be ascertained. Where there was a difficulty in ascertaining whether a convict was putting his full amount of energy forth, it was impossible to punish him.

Mr. Wm. Botly could not help expressing how much he felt indebted to the reader of the paper, which came very opportunely at the present moment, to strengthen the hands of the individual members of Parliament who last week brought in a Bill on this very question, with regard to advancing the cause of industrial education in prisons and schools. The previous speaker had referred to great difficulties in the way of accomplishing this desirable object, but certainly they were not insurmountable, for, by Dr. Mouat's account, they had actually been overcome, and if nothing was to be attempted but that in which there was no difficulty, very little good would ever be attained at all. The question of the reformatory schools was, in some degree, connected with this subject, especially when it was said you could not teach a man this, that, or the other thing. It only showed that you should begin earlier. He remembered visiting Mirfield Reformatory, near Leeds, and finding, on inquiry, that not more than from two to four per cent. of the boys returned to bad habits; and only that forenoon he had paid a visit to the reformatory for between 800 and 900 boys at Anerley, when the teacher informed him that not more than about one per cent. turned out badly.

Mr. Rakhal Das Roy said he had had some experience of prisons in India, and was able to state that the industries referred to in the paper entailed a great deal of labour, so much so, in fact, that he had repeatedly known instances of men being flogged because they had not accomplished their allotted tasks. That showed that the labour was quite severe enough to be felt as a punishment. With regard to the favourable results at the Alipore gaol, it must be remembered that almost all the prisoners there were long-term convicts, who had an opportunity, therefore, of thoroughly learning a trade; but in the case of a man sentenced to two months' imprisonment, to attempt to teach him carpentering or anything of the sort would only result in failure. Looking at the question from a moral point of view, he must cordially support the industrial system. The object should be not so much to punish the prisoners as to reform their characters, and to enable them in future to earn a living honestly. Prisoners in India generally belonged to the poor and agricultural classes, but if they were sentenced to 12 or 13 years' imprisonment, they had an opportunity of learning a trade, and he had known many cases of men leaving prison and earning an independent living for themselves. The system was very beneficial, therefore, looking to the future as well as the present, and he believed it to be eminently useful to the country. He was sorry to hear that the present Lieut.-Governor was going to make a change, and hoped that before so doing he would consult those best qualified to give an opinion, not simply by a theoretical knowledge of the subject, but by a practical acquaintance with the working of the present system. If prisoners were taught useful occupations, they, in some degree, reduced the charge on the public funds, and this, even though to a small extent, was better than nothing.

The Chairman, in proposing a vote of thanks to Dr. Mouat, said it was quite clear that the history of prisons in India had not been much unlike that which it had been in England. Dr. Mouat had commenced his labours when the prisons were in a very bad condition, and he had succeeded in vastly improving them, even if with very inadequate means; he had not been able to accomplish all that he wished. In England it took a century or more of public agitation, both in and out of Parliament, to get the prisons into the condition at which they had now arrived, and in so doing public opinion, which did not exist in India, had played an important part. Every one seemed pretty well agreed on the principle that prisons should be conducted on a system of industrial occupation, but there was no doubt, also, that for what might be called the more penal part of prison discipline, there was also a place, though there was no doubt that the main part of the employment should be of an industrial character. Some fault had been found with the system of employing prisoners in association, and no doubt this plan had its disadvantages, but, at the same time, prisoners must be employed at work which could be found for them; it was impossible to pick and choose exactly what they should do. There was a very common saying that in all village schools children should be taught to cook. That was all very well, but who was to eat what they cooked? And in the same way a difficulty would arise what to do with the produce of the prisoners' labour, if they were all employed in their cells at all sorts of manufactures. It was evident that Dr. Mouat was not aware of one or two changes which had been introduced into English prisons, because he referred to the ticket-of-leave system, and spoke of the absurdity of allowing prisoners to shorten their sentences by their conduct and by getting over the chaplain. Perhaps the meeting "would be surprised to hear" that prisoners could not shorten their sentence in any degree by their conduct, and the chaplain had no voice whatever in deciding when the prisoner should be released. What was done was precisely what Dr. Mouat recommended, the period of release depended on their industry, of which a very accurate account was kept. It had been the labour of his life to prepare a yearly report on this subject, giving every detail of the prisoners' work, value, cost, &c., and it was published at great expense, but people would not read it; and this fallacy about the chaplain and so on still prevailed, in spite of all his efforts to destroy it.

Dr. Mouat, in returning thanks, said he had derived his knowledge on the subject from inmates of gaols in India who had formerly occupied the like position in England. He remembered one specimen of the class who had been in seventy-five prisons, and in whose mind the whole geography of the world was mapped out according to the character of the gaols in which he had been an inmate, in different parts of it. He described the gaols of Bengal as a disgrace to the British government, inasmuch as he had not such good food and clothes, so good a chaplain, nor so many privileges as elsewhere, particularly in China and the colonies. It was quite new to him if the period of the sentence did not depend on what the prisoner did while in gaol, and he was very happy to hear it.

The Chairman said it did not depend on his good conduct, but it did depend on what he earned.

Dr. Mouat said he desired to lay down the principle that by no good conduct, and that no earning of marks under the ticket-of-leave or any other system, should there be any diminution of a judicial sentence. There should be no abatement of the sentence when once pronounced, but the man sent to prison for five years should remain for five years, and when he came out he should have no ticket-of-leave, but should be free to go where he liked and do what he liked; indeed, every effort should be used to replace him in his position in society, for he never could have a fair chance so long as he was under the surveillance of the police. He entirely agreed with Mr. Tallack that nothing could be more mischievous than repeated short sentences, and was under the impression that in England, as in India, there were provisions for dealing with habitual criminals, and that when a man committed the same crime a certain number of times, an accumulated penalty attached to it. The Indian criminal code, which was an admirable one, due chiefly to the labour of Lord Macaulay, provided that when a person repeatedly committed the same crime, he came under a new category altogether, and the sentence was framed, not so much with regard to the crime *per se*, as to the fact that he was making a livelihood by criminal courses. He agreed also with what had been said as to mat-making, which, no doubt, had been largely introduced into prisons on account of its being easily learned; but inasmuch as it was an occupation peculiarly fitted for the blind, he thought they should not be subjected to undue competition, either inside a prison or without. It was no doubt a matter of importance that former prisoners should not be identified, and this was illustrated by an anecdote he heard in Dublin. The late Lord Carlisle, when Lord Lieutenant, took great interest in the question of prison discipline, often visited the Richmond, Mountjoy, and other prisons, and had a large acquaintance with the prisoners. On one occasion, when walking in the Phœnix-park, he recognised an old acquaintance, working with some other men, and went up and spoke to him. The man, however, cut him dead, saying, "Excuse me, my Lord, I have not the honour of your acquaintance." He knew, in fact, that his being recognised by Lord Carlisle would not tend to his credit with his fellow-workmen, from whom he had succeeded in keeping any knowledge of the disreputable portion of his career, and, as Lord Carlisle himself admitted, the man was quite right in declining his acquaintance. In reference to Dr. De Renzy's remarks, he must admit that it was undoubtedly difficult to find properly remunerative employment for the large body of persons in Indian gaols. It was quite true that the large proportion were of the agricultural class, but he had never advocated turning clod-hoppers into carpenters, or to employ any man in an occupation by which he could not earn a living afterwards. He had constantly pressed upon the government the advisability of establishing agricultural colonies, for no boon would be of greater value to India than a knowledge of an improved system of agriculture. He was glad to have heard the remarks of Mr. Rakhal Das Roy, whom he remembered as a very able prison official in India; but with reference to punishing men for not getting through their allotted labour, he had always been down very heavily on any officer who had punished a man for an insufficient task, if the man was unable to perform it. To punish a man under such circumstances was an abuse which he would never tolerate. As long as a man was unskilled and not able to do a full day's work, it was not expected of him, and some men no doubt were never able to learn some branch of occupation. He always impressed upon the officers that in such a case the man should be put to something else, and if, from deficiency of intellect, natural clumsiness, or any other cause, there was no trade he could learn, he was never punished on that account.

Mr. Hyde Clarke writes:—It is one confirmation of the statement of Dr. Mouat, as to the relation of the prison labour of Alipore gaol to the manufacture of jute and gunny bags, that in the day's papers appears the prospectus of an Indian Jute Company. This company has yielded large returns for some time, and it expects to pay its 15 per cent. dividend. Its operations, like those of the other jute companies in Calcutta, depend on the co-operation of the prison labour of Alipore gaol, and they have not suffered by its competition.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The Marquis of Ripon presided, on the 16th inst., at

16, Bruton-street, over a meeting of the Royal Commissioners for the Exhibition of 1851. There were present the Earl Granville, Sir Alexander Spearman, Mr. Ayrton, Sir Francis Sandford, Mr. Edgar Bowring, Mr. Gibson, Dr. Lyon Playfair, Mr. Thring, and Major-General Scott (Secretary). Mr. Cole attended the meeting. His Royal Highness the Duke of Edinburgh and his Royal Highness Prince Arthur were elected members of the Commission. The following resolutions were passed with reference to the representations made by the deputation from the Metropolitan and Provincial Association for the Defence and Advancement of Trade Interests, who attended the last meeting of the Commissioners:—

1. Her Majesty's Commissioners are desirous that persons engaged in the production of such articles as are comprised in the manufacturing division of each Exhibition should be associated with them in the selection of objects in that division.

2. Her Majesty's Commissioners consider that the exclusion of works of fine art from the Exhibition, by reason only that the material employed for them is not one of the classes for the year, is inadmissible.

3. Her Majesty's Commissioners do not agree with the deputation, that either the interests of art or those of the public would have been injured by the proposed sales of manufactured objects, not in the Exhibition itself, but in the annexes, in accordance with conventions entered into with the French and Belgian commissions. As, however, the French and Belgian commissions have most liberally relinquished the rights accorded to them, her Majesty's Commissioners, with the view to reconcile conflicting interests as far as possible, will adopt the rules, as respects sales, laid down for the Exhibitions of 1851 and 1862.

February 19th, 1872.

General Scott presents his compliments to the Editor of the *Journal of the Society of Arts*, and requests that he will be good enough to cause the following letter to be inserted in an early issue of that paper:—

(Copy.)

2, Hyde-park-street, W., February 17th, 1872.

Sir,—I have the honour to acknowledge the receipt of your letter of the 16th inst., conveying to me the decision of her Majesty's Commissioners of the Exhibition of 1851, upon the remonstrance of the deputation from the Association for the Defence of Trade Interests, which I had the honour to introduce to the Commissioners on the 14th December last.

On behalf of the deputation, I beg you to convey to the Royal Commissioners my thanks for the consideration they have given, and for the decision taken on the more important points submitted to them.

I have the honour to be, Sir,
Your obedient servant,
(Signed) William H. Smith.

Major-General Scott.

Musical Arrangements.—Her Majesty's Commissioners will appoint a committee to select, for performance in the Royal Albert-hall, new compositions of merit which may have been published before the 1st March, 1872. They are therefore desirous of receiving from the Musical Academies and schools of the United Kingdom and of foreign countries, the names of musical compositions of all kinds, which are considered by them of sufficient merit to be worthy of performance in the Royal Albert-hall during the International Exhibition of 1872. The works should be the productions of living composers, published before the 1st March, 1872, and may be of a vocal or instrumental character—such as oratorios, cantatas, sonatas, overtures, glees, songs, dance music, &c. It is requested that the information may be supplied, on or before the 31st March, 1872, to Major-General H. Y. D. Scott, C.B.

Jewellery.—With a view of learning the opinion of jewellers, in respect of the appointment of a Committee of Selection for Jewellery, her Majesty's Commissioners have decided to hold a meeting, on Wednesday, February 28th, at 12 noon, in the east lecture-theatre of the Royal Albert-hall. It is under contemplation to request each intending exhibitor to nominate six persons, and from the total number of names submitted, her Majesty's Commissioners will select three laymen and three persons engaged in the production of jewellery, to constitute the committee which will approve all specimens of jewellery to be exhibited. Intending exhibitors are asked to come to the meeting prepared with the names of six gentlemen nominated by them.

REFRESHMENTS AT THE EXHIBITION.

Sir,—I was glad to see the sensible letter in last week's *Journal* upon this subject. May I make a further suggestion, to the effect that the establishment of what I would call a middle-class dining-room would be of great benefit —something between the rough-and-ready, though plentiful, dinner at a shilling, and the dinner at two shillings and threepence.

If the present accommodation is not sufficient, there is surely some vacant ground, where the Messrs. Spiers and Pond could erect a temporary contrivance, like that at Wimbledon.—I am, &c.,

A Member.

EXHIBITIONS.

Special Loan Exhibition of Ancient Musical Instruments at the South Kensington Museum.—The arrangements for this exhibition, which will be opened in June, 1872, are now in active progress under the direction of H.R.H. the Duke of Edinburgh, who is the chairman of the Executive Committee appointed to carry out the work. The exhibition will include instruments noted for their decorative, archæological, ethnological, or intrinsic technical merits. Possessors of musical instruments have been invited to communicate with the secretary of the Musical Instruments Committee, South Kensington Museum, and either to offer instruments on loan for the exhibition, or to supply information regarding ancient musical instruments that may appear to them suited for the exhibition.

CORRESPONDENCE.

THE WEAK POINT OF THE METRIC SYSTEM.

Sir,—Mr. Chichester Fortescue tells us that the Government Bill on weights and measures will legalise, though not compel, the use of the metric system. This is so far well, though it would have been better to fix a date, however remote, for its compulsory use. Its triumph is, in fact, assured since the German adhesion. There are now 200,000,000 of people using it, and another 200,000,000 are being slowly brought under its influence, whilst the imperial system is very nearly confined to these islands, for we must remember that the Winchester measures, and not the imperial, are used by all English-speaking people in America, and that our hundredweight and ton are disused in the United States. Amongst ourselves, too, science is fast going over to the metric system, whilst many occupations are finding the necessity of decimalising in some way or other.

At this juncture, then, it is very important to consider in what form we should adopt the system, for we are by no means bound to all the details, if experience has shown that they might be improved. Now, one thing has been felt everywhere, viz., that the kilogramme, and not the gramme, is the proper fundamental unit of weight for practical life. Surely, then, we might mend this. We ought to be able to say to the people at large who are past their school-days, "The system is merely this, that you have certain units of length, capacity, and weight, which are all divided in the same way, calling the tenth part a deci, and the hundredth part a centi, of the unit. Now, to make this simple statement true, we require only to replace the word kilogramme by some monosyllable which would be recognised as a contraction of it, and so keep our connection with foreign tables. Several such words might be thought of, the chief difficulty being on the score of euphony; let us say klog (or klogger), as resembling kilog., which is actually in wide use on the Continent, instead of kilogramme, and from klog we might form deci-klog, centi-klog, to supersede hectogramme and detragramme. Five new words would then suffice for the needs of most people, namely, metre, litre, klog, deci-, centi-, and these would be the definition:—A cubic decimetre holds a litre of water, which weighs a klog.

The rest of the system might be left to take care of itself. It would be taught to school-children, and would be soon acquired, so far as useful, by others. Probably, of the upper units, only kilometre, hectare, and hectolitre would establish themselves, the rest could be expressed numerically, as 37 metres, or 20 litres.

We ought to ask the Chancellor of the Exchequer to give us a coin for the tenth of a florin, bearing a square centimetre, divided into square millimetres. The eye would lead us to call it a chequer, a name historically connected with the revenue, and familiar also to the peasantry, and it would be a valuable instrument of education. No other new coin is wanted for the decimal system, only the slight modification of the value of the farthing, and of pence, expressed as farthings. If we could contract the word into "fa," so much the better.—I am, &c.,

Metricus.

THE INDUSTRIAL CLASSES ABROAD.

(*Continued from page* 252.)

JAMAICA.

Not many English workmen are employed on this island. Those that are employed are chiefly foremen or leading hands. The purchase power of money is not much less than in England, for the necessaries of life. Beef, 6d. per lb.; mutton, 9d. and 1s. per lb.; salt fish, 6d. per lb.; brown sugar, 3d. per lb.; white sugar, 7½d. per lb.; rice 4½d. per quart; yam, 8s. per cwt.; bread, 8lb. for 1s. 6d.; country vegetables cheap; good sized fowls, 2s. each; pork 9d. per lb. Luxuries are much more expensive. Eggs, 1½d. and 2d. each; ham, 1s. 6d. per lb.; bacon, 1s. 6d. per lb. Clothing is also expensive. Workmen coming to the island generally come on an agreement for three years. Their passage is paid out, and the return passage guaranteed, provided they return at the end of their term. Platelayer gangers get from £104 to £120 per annum. They generally live in the country parts, where living is cheaper than in the towns. Mechanics generally get from £104 to £130 per annum and overtime. Good board and lodging can be obtained for £60 to £72 per annum; out of this a good profit is of course made by the landlord or landlady. There is a great advantage to be enjoyed by the men in this island. They contract with or "farm" (as it is called), the best doctors in Kingston for £6 8s. per annum, irrespective of the amount of sickness they may have, and the attention they may require. If married, the wife is attended for a further sum of £3 4s., and the same sum for each child. If a mechanic, getting £130, is provident, and abstains from drink, he can save £50 a year with the greatest ease, even though living in lodgings, without counting overtime, which is paid at time and a-quarter; Sundays double time. It is usual in Jamaica for clerks and others to live together in a small house, and keep their own servants. This plan should be much less expensive than living in lodgings. The climate of Jamaica is good, and even in the plains not more trying than other hot climates, if the men will only keep out of the sun, and abstain from the national drink, rum. This can be obtained so cheaply, that it is within the reach of everybody. New rum is next door to poison; and, as the demand for old rum is greater than the supply, new rum has to be converted into old by various means. There is not the slightest doubt but that a large per-centage of deaths from yellow fever have been caused by nothing but the drinking of new rum. The climate in the hills of Jamaica is superb, and equals, even if it does not surpass, England. There is not the slightest difficulty for Englishmen to labour in the fields all day. At Christiana, in the parish of Manchester, there is a white settlement; all the families are doing well. They cultivate their own land, and grow ginger chiefly, but also sugar and vegetables for their own use. There is one man there who began as a watchman, and is now the owner of large property, having paid for it all but something like £60. In this part of the island there are large runs of land unoccupied. Much of it has been escheated by the governor. This would prove of the greatest benefit to worthy, hard-working agricultural labourers, who had small means, and who could be assisted to emigrate from England, where the supply of labour is greater than the demand. In Jamaica such men are required, and could not fail to do well.

VENETIA AND SOUTHERN ITALY.

In Venice there are no statistical works respecting workmen and their wages. From the fall of the ancient republic to the present period, they are wanting. The chambers of commerce in past times were deterred from stating the truth to the Austrian government by the fear of imposts and abuses, and the Austrian government was, therefore, unable to compile a correct statistical work on Venetia. Mr. Consul-General Perry, however, informs us that the Royal Institution of Arts and Sciences, by means of a work published under their auspices, has, fortunately, enabled him to do so. As regards the moral state of the workmen, he observes that they are of good morals, sober, and provident; they take much pride in their work, but they study little, are unacquainted with drawing and chemistry, and are somewhat prejudiced in favour of the technical processes of ancient date. Now, however, they frequent the schools for drawing and chemistry, which, in towns and villages, are adjacent to the manufactories or workshops. In general they execute varied, different, and new works with good will; they are of various and multiform genius; and, above all, the system of dividing labour, as done in England, is not in use. Here, the same workman does many things, and passes from one trade to another which has an affinity with it, and, moreover, he contents himself with very low wages.

There are good dwellings for workmen, but at present they are few in number, and the labouring classes generally live in poor, unwholesome habitations, damp, with bad odours, and badly furnished. In the great manufacturing districts of the provinces, the workmen, on the contrary, inhabit wholesome, dry dwellings, contiguous to the manufactories.

There appear to be no other industries in which the English workman would be employed than those of ironfounders, ship-builders, and glass and earthenware manufactories. The English workman would find certain advantages, viz., food is cheap and good; the air is salubrious; the dwellings in the provinces are good, clean, and dry; and in Venice a company has been instituted, and is in operation, for building houses for the labouring classes; much benevolence in the proprietors of the establishments in general; and kindness and general good feeling on the part of the native fellow-workmen. The disadvantages would be, low wages; little order in the workshop; uncertainty as regards the permanency of the work, from those eventualities which in all countries lead to the partial or total suspension of labour.

There are certain industries in which the foreign workman is much better paid than the native, for his superior ability in a particular work, with which the Italian is little acquainted. Thus, for example, in the art of glass-making, in making bottles according to the usage of France, French workmen are well paid in the Italian glass-works, and in one of them, at Ludi, in the Lago Maggiore, all the workmen are French, who return to their country when the work of the furnace is completed, and come back when it is again resumed. Foreign workmen are also employed in the iron works, also in the woollen manufactories, in the manufacture of wax and composite candles, straw hats, furniture, and in the working of precious metals, mining, &c. In general the foreign workman is considered to be more cultivated and more patient than the native, but less sober, less tranquil, and more exigent. The low rate of wages in Venetia, and generally in the other States of Italy, must be attributed to the circumstance that living is cheap, and necessities are few, and that the Italian workman is little addicted to drink, very industrious, modest, and fond of domestic life.

Mr. Consul Severn notices the great changes caused by the siege of Rome, by which the Roman people not only regained their political rights, but also have the means presented to them of cultivation, of education, and even of commerce. The present government of the King of Italy has already set up an agricultural society, which is now actually working with English machinery; and, as regards the brigands, under the new order of things they have disappeared. No doubt means will be also found to work the great mines of asphaltum, sulphur, and even borax. And, as regards the adulteration of wine, which was a disgrace to Rome, the government has now adopted a plan which will be sure to effect a great improvement. A square (*consolazione*) is selected for the sale of wine, which is to be tasted by official judges before it is submitted for sale. Nothing less than six-gallon casks is allowed, and no drinking permitted on the spot. In this way the scandalous power of the vintner will be undermined, and the poorer classes supplied with a pure, cheap, and good wine. With respect to education, the fine institution of San Michele, which had been converted into a political prison, is now restored to its original purpose of education. Every art and science, every profession, every trade, and even commerce, will now be taught by the best masters, and at the old price of 4s. 2d. a-month. The building will contain upwards of 6.000 children. And as to commerce, the restrictions being now removed of passports, of customs duties, and of spies, no doubt in a country where nature has been so bountiful, a fine commerce will spring up, for already the people begin to show signs of activity, as they have amongst them the industrious strangers from all parts of Italy with their commodities for sale, by which the stately dignity of the Romans is rather severely taxed. The duties on articles of food formerly levied at the gates has been abolished. The poorer classes begin to return to the good old customs; at night, the fine voices are heard again; and the gay October festivals on the Sundays and Thursdays has been resumed after a suppression of twenty years. In the midst of the very favourable changes, the Roman railways form the only subject of regret as regards the working classes, either that the charges are too heavy, or the responsibility for property does not exist; but the fact is strange that the wine is still conveyed in the old carts, and luggage is not trusted. Robberies are frequent on the lines, and even in the stations, and there is never any redress, in compensation or even explanation.

In Naples, the labouring classes, according to Mr. Consul-General Bonham's report, take very little animal food, living principally upon *pasta* (maccaroni) in various forms, bread, fruit, and vegetables. A foreigner requires more substantial food, and would find the small sum which suffices to feed a native insufficient. The necessaries which form the general subsistence of the Neapolitan working classes are very cheap, and, though wages are low, they are able to obtain a sufficiency of them. Cheap and wholesome wine can be obtained. Spirits are little used, and should be avoided. On wages of 2 francs 50 centimes a-day, an artisan can support himself, wife, and one or two children. For an Englishman, it is necessary that he should avoid excessive fruit-eating, and abstain from ardent spirits. As a beverage, nothing can be recommended so good as the common wine of the country, when taken in moderation; it is cheap, nourishing, and adapted to the climate; he will require his usual quantity of animal food. As to the exertion or exhaustion he may venture upon, during nine months of the year he may do nearly as much work as in England; during the remaining three months, viz., June, July, and August, he must endeavour to work in the shade, as exposure to the sun is to be avoided. Cold is never severe, and the expenditure for clothing is, consequently, less than in England. A working man cannot find healthy lodgings near his work. The ordinary lodgings inhabited by the working classes, called *bassi*, are damp, overcrowded, unventilated, and in every respect filthy. A great number of workmen reside with their families in villages outside the city and octroi limits, many as far distant as Torre del Greco, about eight miles from Naples. Work is paid for either by the day or by the job. The period of work is usually ten hours a-day, but ordinary labourers, bricklayers, masons, carpenters, and some others often work twelve hours. The average wage of a good first-class mechanic is from two to three francs a-day. Employers of labour are not inclined to give much more to English artisans than to natives; many have come out; but all, with few if any exceptions, have gone home again, not finding the wages sufficient for their requirements. In a few special employments, such as engineers in steam-vessels, directors of cotton factories, and perhaps a few others, Englishmen appear to get on; but, considering the price of lodgings and of various home comforts, such as tea, &c.—almost necessaries to an Englishman—probably it would be found that £20 a-month would not be worth more in purchase-power in Naples than £15 in England. Much is done to raise the condition of the labouring classes. There are day and night schools for working men, technical schools, and schools of design, all gratuitous, also savings banks and mutual aid societies, in existence in this city.

NOTES ON SCIENCE.

It is pretty well known that if a few drops of a solution of phosphorus in bisulphide of carbon be thrown upon paper, or any other inflammable body, this body will, after the lapse of a few minutes, take fire. Conflagrations on the most extensive scale can thus be caused, all the more serious from the secrecy with which the mischief may be done. An addition to our knowledge of the properties of the above solution has been made by M. Moigno, who, in *Les Mondes*, says, that when powdered chlorate of potash is first dusted over the paper or other body, followed by the application of the solution of phosphorus, a very violent explosion ensues, immediately upon the evaporation of the solvent, owing to the phosphorus being in such intimate contact with the chlorate. In trying this experiment, care ought to be taken that it be done with small quantities, so as to prevent the occurrence of serious accidents. The deadly nature of the solution of phosphorus may be evidenced by the fact that a person walking past a heap of straw or hay may eject a few drops of it on such a heap, and may be able to walk to a considerable distance before the solvent, which, however, is very volatile, has altogether evaporated, after which it bursts into flame.

The plating of metal by means of nickel has hitherto been very expensive. Adams's process is that which is usually employed in America, where nickel plating is much adopted, on account both of its good colour and the non-liability to tarnish of articles thus protected. A new method of electro-plating with nickel is due to Prof. F. Stolba, and it is expected will before long be very extensively practised. It possesses several advantages over the previously existing method. Instead of requiring, as in Adams's patent process, a bath of double sulphate of nickel and ammonium and an anode of cast nickel, in the new method, which is not patented, the salt of nickel employed may be the chloride, sulphate, or double sulphate of nickel and potassium, and it need not be chemically pure. In addition to this, a solution of chloride of zinc is required. This may be obtained by dissolving metallic zinc in hydrochloric acid. The articles that are to be plated having been freed from grease and dirt, a sufficient quantity of a concentrated solution of chloride of zinc is poured into the vessel in which the plating is to be effected, and from once to twice its volume of water added. This solution is then to be heated to the boiling point, and hydrochloric acid added, drop by drop, until the precipitate formed by diluting the chloride of zinc with water is re-dissolved. As much zinc powder as will cover the point of a knife is then added, by which the metal of the vessel becomes, in a few minutes, plated with zinc wherever it is in contact with the liquid. Enough nickel salt is then to be introduced to colour the liquid distinctly green, after which the articles to be plated, and with them some small cuttings of zinc, are to be put in, care being taken to afford a sufficient number of points of contact. The liquid is then to be boiled, when the nickel is soon precipitated, and the work is finished in about a quarter of an hour. If particular parts of the articles are not plated, the boiling must be continued, fresh pieces of zinc, and, if necessary, fresh nickel salt being added. It is important, if the coating of nickel is to be brilliant, that the liquid, on boiling, shall neither be cloudy from basic zinc salt, or acid from free hydrochloric acid.

At the last meeting of the Photographic Society, several photographs, taken in natural colours in the camera, were exhibited. They were produced by the late M. Niepce de St. Victor, and were brought to this country by his widow, who, it is stated, is attached to the household of the Ex-Emperor. Although the colours on these photographs are far from being brilliant, they demonstrate in an unmistakable manner the possibility, philosophically speaking, of obtaining photographs having all the hues of nature. These pictures, which possess great historical value, are the result of some of the most interesting experiments that have ever been made, and it might be well if they were made generally known among physicists, in order that further investigations may be made. M. Niepce started on the known basis that a plate of silver immersed in a solution of sulphate of copper and chloride of sodium (common salt), at the same time rendered magnetic by means of a battery, was chloridised, and became susceptible of receiving colour when it was exposed to light. Having conceived that there might be some relation between the colour which a body communicated to a flame, and the colour which light developed on a plate of silver which had been chloridised with the body that coloured that flame, he immersed his plate in a bath formed of water saturated with chlorine, to which he added a chloride endowed with the property of colouring flame with the colour he wished to be re-produced on the plate. For example, chloride of strontium, which gives a red or purple colour to flames when used for preparing a plate of silver, would cause the red and purple tints to be strongly impressed. In like manner would orange be produced by the employment of the chlorides of calcium or uranium, yellow by the chlorides of sodium and potassium, green by boracic acid and chloride of nickel, as well as by all the salts of copper, blue by the double chloride of copper and ammonia, and violet by the chloride of strontium and sulphate of copper. The result showed the correctness of M. Niepce's reasoning. All the colours of the spectrum have been obtained in the manner indicated. All the colours of his model (he usually employed for this purpose a doll dressed in gorgeously-coloured drapery) have been obtained by preparing the plate with a bath composed of dentochloride of copper alone; and a still better image has been got by immersing the plate in a solution of hypochlorate of sodium having a specific gravity of 1·35, until it assumed a bright pinkish hue. The plate was then covered with a solution of dextrine saturated with chloride of lead, then dried, and subsequently submitted to the action of heat, after which it was ready for exposure in the camera, when it became impressed with the colours of nature; but a very curious fact in connection with this is, that although the secondary colours—orange, violet, and green—can be reproduced if these colours are natural, they cannot be so reproduced if they are artificially formed by mixing two of the primary colours. In this case only one of them is impressed.

The cause of the brilliant colours that are to be seen in glass when it is being etched by hydrofluoric acid, has been investigated microscopically by Mr. H. F. Smith, who has described, in the *Monthly Microscopical Journal*, the result of his examination. When the acid was first dropped upon the glass, no action was evident, the appearance presented being simply that of a drop of water on glass. In a very short time, however, the drop became a little duller, but this dullness almost immediately cleared away, and several small particles, seemingly of glass, were seen floating in the drop. These appeared to be undergoing a process of fusion, the appearance being similar to that seen when a small portion of metal is thrown into some of the same substance in a state of fusion; it is tossed about for some time, and then finally disappears, and this was what appeared to be going on here. There were magnificent colours, which changed every moment as small portions of glass were liberated from the larger piece, and were undergoing the process of solution, leading to the supposition that they consisted of small glass prisms. Some of these particles were completely surrounded by a halo of colour, as if they had been thrown into a variegated solution. Although the principal colour was deep green, dark blue was also seen at occasional intervals. These observations were repeated several times, and always with the same results, with the exception that the small particles of glass floating in the drop of acid exploded now and then, causing a great commotion in the liquid, and throwing up little jets of finely-divided acid, behaving as if the small glass particles were hollow spheres. When these explosions occurred, bright flashes of light were visible, resembling closely the appearance of rainbows seen in waterfalls.

When lecturing "On the Identity of Light and Radiant Heat," at the Royal Institution, on the 2nd inst., Professor Tyndall said that heat was sometimes associated with ordinary matter, through which it creeps by the process of conduction; sometimes not associated with ordinary matter, but, like light, flying through space with immense velocity. In this latter form it is called radiant heat, which comes obviously and palpably from the sun, but was here entangled with light. Speaking of the spectrum falling upon bodies, he said that only where light was absorbed was heat produced by it, and the heat produced was the exact equivalent of the light absorbed. A black riband placed in the spectrum would grow warmer as it was carried from the blue end towards the red, but, if moved still further, even beyond where there were no rays competent to excite vision, it would be still warmer. Radiant heat was reflected from plane surfaces just like light, or from curved surfaces, by which it could be brought to a focus; lenses could also be used for this purpose. Like light, a ray of heat could also be divided by means of Iceland spar into the ordinary and extraordinary ray; and the fact of the polarisation of radiant heat destroyed many speculations once prevalent. He described and performed Faraday's experiment of the magnetisation by a ray of light, and showed that the same phenomena took place when a ray of heat was used instead of a ray of light. There were feeble rays of heat beyond the violet end of the visible spectrum, but as the spectrum was traversed the rays increased in power, and reached a maximum in the dark space beyond the other end; but the whole visible spectrum contained heat. The identity of light and heat was shown by a number of experiments, which were exceedingly satisfactory.

GENERAL NOTES.

Territory and Population of the Great Powers of Europe.—A few evenings since, M. De Quatrefages read a paper at the Paris Geographical Society, on the race of the Negritos, and M. d'Avezacare on certain episodes and dates in the life of Christopher Columbus, after which considerable sensation was created by M. Emile Levasseur, who exhibited a sketch-chart of the relative proportions of the population and territory of the five great powers of Europe, from the commencement of the eighteenth century to the present time. It resulted from the comparative figures, that the population of France, which in 1700 formed 31 per cent. of the whole, fell to 26 in 1788, to 20 in 1815, and, finally, to 17 per cent., in 1872; and if Italy be included amongst the great powers, the proportion would be reduced to 15 per cent. for France. At the present time, France possesses 528,000 square kilometres of territory, and a population of 36½ millions; while Germany has 544,000 kilometres of soil, and 41 millions of inhabitants.

Ostrich Feathers and Ostrich Hunting.—The following is an extract from a letter of an *estanciere*, or sheep farmer, on the pampas of the River Plate, South America:—"Now the warmer weather of August is setting in, the male ostrich is heard with its peculiar cry—woo-o-oo—collecting from seven to ten females for the spring. The first of the eggs laid by each bird is generally dropped in the open camp. Nests are invariably found near water, on a rising hillock, or in brushwood; the nest has much the appearance of a hen's nest, only on a larger scale. From 40 to 50 and even 70 eggs have been found in one nest, one egg lying on another, tier upon tier. I have often wondered how the male bird manages to hatch them all. Perhaps twenty eggs will lie at the bottom of the nest, the others on the top of these. When fresh, the eggs are of a yellow colour, with clear white spots, like wet lime, attached to the surface; when stale, the egg becomes quite white, and loses the spot-like appearance. I imagine the bird, when setting, disposes of its legs somewhat similar to a goose—*i.e.*, much as she flies: whereas the flamingo sets like a gentleman in a chair, with legs dangling, the eggs being deposited on an earthen mound previously made by the bird. At the time of setting, if the male bird is found on the nest it will be found with its head close to the ground, to escape observation, and will scarcely raise it until you are almost on the nest. Ostriches have been known to spring from their nests at the moment they have allowed the rider to pass over them. It is somewhat dangerous at times, when galloping on the pampas in camp on a young, spirited horse, to have a large ostrich, with outspread wings, suddenly spring up and run for a short distance off, when, if you dismount, you have to be cautious, as the bird may return to attack you. The young birds, like the partridge, run almost as soon as they are hatched, and when a fortnight old it would take a swift person to overtake them. The young follow the male, which has deserted its former mates, and devotes itself with much care and attention to bringing up the brood. Many fights occur between the males. They hold each other by their beaks, forcing each other backwards; of course the weaker one, in its retreat, has to run for it. I have seen in one brood following the male, birds of different ages—a few perhaps a fortnight old, others a month, and some even six months. The male is easily distinguished from the female, being larger and darker where the black feathers are around the neck. The feathers of the male realise more than those of the female; in town they are worth from 12 to 20 reals a pound (1 real = 5d.) equal to from 5s. to 8s. 4d.; in camp 6 to 10 reals, or from 2s. 6d. to 4s. 2d., according to where the camp lies, for the nearer to town the higher the price. Here I get only 6 reals, or 2s. 6d. a pound. Ostriches feeding near the house get tamer than those that do not approach habitations; but the same birds which are found occasionally feeding near the houses, if met with in open "camp" or pampa, are as wild as those that never come near our dwellings. They like to feed on the short, sweet grass, therefore their favourite resorts are where the maiden turf is kept well cropped by the sheep; there the ostriches are found mostly collected together—that is, if unmolested. In some camps, say Colonea way, if an ostrich is seen it is hunted down for its oil, or grease, and feathers. The ostrich is left more or less undisturbed hereabouts; at some estancias (*i.e.*, sheep farms) these birds are commonly shot; at others they remain entirely unmolested, where they become tamer, and occasionally collect near the houses. I seldom shoot an ostrich except to provide for my fowls. I like to see the birds near my house, and in spring time their nests are as plentiful as hen's nests in a farmyard, and the eggs most abundant. The birds are very easily decoyed by placing yourself on the ground, throwing your legs up in the air, and giving a low, whining whistle, in imitation of their young, when they will come near, sometimes even to 12 or 14 yards of you. One poor bird is butchered, (for I cannot call it shooting); the curiosity of others, notwithstanding their late companion's "biting the dust," becomes more excited, and thus they become easy victims. I have seen men kill several birds like this, one after another, as fast as they could load. I have myself shot two birds at one shot, the ball passing through the neck of each; but I seldom kill more than one bird the same day.

Interesting Discovery in Nova Zembla.—Discovery has been made of the house constructed by the Dutch explorers in Nova Zembla in 1596. The house was the work of the members of an expedition for the discovery of a shorter route to China and India across the Arctic seas, the general supposition being, at that time, that beyond Nova Zembla the coast ran off, towards the south-east, directly towards China. The best known of the expeditions undertaken during the latter portion of the sixteenth century was that commanded by Admiral Heemskerk, with whom the celebrated Barends sailed as pilot. It left Amsterdam on the 10th of May, 1593, and discovered Spitzberg, which was taken for a part of Greenland, and reached Nova Zembla on the 17th of July; after a most difficult passage, the ship doubled the south-east point of the island, and was shut up by the ice on the 26th of August, in a bay which the Admiral named Yshaven, in 76° north latitude. The ship was crushed, and the expedition was compelled to winter in that inhospitable spot; fortunately, there was a good supply of timber brought from Siberia by the rivers Obi and Jenisei. Having constructed a log-house, they covered it with planks from their ship, and set up a large hearth in the midst; but the cold was so intense that, although the fire was kept burning night and day, the ice on the counterpanes of their beds is said to have been two inches thick. The sun disappeared for 81 days, namely, from the 4th of November to the 24th of January. In spite of privations, the officers and men kept up their courage, and on Twelfth-day they ate pancakes in the Dutch fashion, and the master gunner was, by lot, named King of Nova Zembla. In the month of May the ice broke up, and the two largest boats being doubled with planks, on the 14th of June they put to sea, and, after a painful and dangerous voyage of 81 days in open boats, 12 out of the 17 men of the expedition arrived at Koba, in Russian Lapland, where they found a Dutch vessel, which carried them home. Barends died in the boat a few days after quitting Nova Zembla. The hut of the expedition has always since appeared in the Dutch maps, under the name of *Hel Behouden Huis;* but no ship had since touched the spot, and it was supposed that nothing remained of the structure. This, however, has proved a mistake. A Norwegian captain, of Hammerfest, named Carlsen, in a fishing expedition, reached the sea of Kara by the north, and on the 9th of September last he visited the Yshaven of Barends, returning to Hammerfest on the 4th of November, after having traversed the Straits of Vaygatz, thus making the tour of Nova Zembla. Captain Carlsen found the Dutch navigators' house fallen to ruins, and completely covered with ice, which had preserved most of the objects left there, of which he brought away 150. It appears that the house was built of fir timber, and covered an area of 32ft. by 30ft. Amongst the objects found are guns, sabres, halberds, lance-heads, tools, brass pots, a clock, a flute, wooden shoes, locks, a bell, supposed to be that of the ship, an iron chest, an earthern pitcher, also a few books, amongst which is a Dutch translation of Mendoza's description of China, and an astronomical treatise, the former especially being in an extraordinary good state of preservation. This collection, which has been buried in Arctic ice for nearly 300 years, will make a highly interesting addition to the museum of Amsterdam. It is much to lamented, however, that Captain Carlsen does not appear to have recovered the account of the voyage which was written by Barends, signed by all his companions, and, according to De Vere, hidden in the chimney of the hut.

CALENDAR OF MEETINGS.

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ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

February 28th.—"On Trinkets and their Manufacture," by W. G. Larkins, Esq., the editor of the Society's *Journal.*

March 6th.—"On the *Goliath* Training Ship." By Capt. Bourchier, R.N.

March 13th.—"On the British Trade with France during the last Ten Years, in its relation to the General Trade of the United Kingdom." By Leone Levi, Esq., Professor of the Principles of Commerce and Commercial Law in King's College, London.

March 20th.—"Notes from a Diamond Tour through South Africa." By Thomas Wm. Tobin, Esq.

March 27th.—*Passion Week.*

INDIA CONFERENCE.

March 8th (Postponed from February 23rd).—"On India as a Field for Private Enterprise"—Most suitable districts; situation and approach, described separately; soils, climate, sources of labour supply, &c.; staple crops to be grown with greatest advantage; indigenous products and minerals; tabulated statement of cost of cultivation of tea, cotton, &c., and probable profit of each; indigenous timber; live stock; form of government under which the settler will live in India. The Conference will be opened by Frederick Campbell, Esq., of Assam.

CANTOR LECTURES.

The Third Lecture, on "Mechanism," by the Rev. Arthur Rigg, M.A., was delivered on Monday evening, February 19th. The remaining lectures will be given as follows:—

SYLLABUS.

Lecture IV.—Monday, 26th February, 1872.

Motions produced by Cords, Straps, &c.—Limits to the use of them—Grooved and Smooth Pullies—Guide Pullies — Cam Pullies — Shafts not parallel — High Velocity Cords—Fusees—Illustrations.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links — Cranks — Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. Arthur Rigg, "On Mechanism."
London Institution, 4. Professor Odling, "Elementary Chemistry."
Medical, 8.
Royal Geographical, 8½. Mr. Delmar Morgan, "Palladin's Recent Journey through Manchuria."
Social Science Association, 8. Report of the Standing Committee of Repression of Crime Section on "The Traffic in Stolen Property."
Actuaries, 7. Mr. Wilfred Bordsen, "Observations on the Rate of Mortality in Infancy and Childhood."
Institute of Surveyors, 8. Discussion on Mr. Smith's Paper, "Land."

Wed.....**SOCIETY OF ARTS, 8.** Mr. W. G. Larkins, "On Trinkets and their Manufacture."
Royal College of Physicians, 5. Goulstonian Lectures. Dr. Hensley, "On the Mechanism of Respiration, Circulation, and Digestion."
Science and Art Department (South Kensington Museum), 2½. Professor Guthrie, "Elementary Physics and Chemistry."

Thurs...Royal, 8½.
Antiquaries, 8½.
Philosophical Club, 6.
London Institution, 7½. Musical Lecture.
Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."

Fri.......Royal United Service Institution, 3. Colonel Sir Robert A. Shafto Adair, Bart., "On the Strategy of Invasion, as exemplified in the American and Austro-Prussian Wars, and in the War of Metz; with Remarks on Centres of Defence, and the Training of National Forces."
Royal College of Physicians, 5. Goulstonian Lectures. Dr. Hensley, "On the Mechanism of Respiration, Circulation, and Digestion."
Royal Institution, 9. Mr. Siemens, "Measuring Temperatures by Electricity."
Geologists' Association, 8.
Philological, 8¼
Archæological Institute, 4.

Sat.......Royal Institution, 3. Mr. M. Conway, "Demonology."

Journal of the Society of Arts.

No. 1,006. Vol. XX.

FRIDAY, MARCH 1, 1872.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TWELFTH ORDINARY MEETING.

Wednesday, February 28, 1872; Captain Douglas Galton, C.B., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Leigh, John Studdy, 8, Old Jewry, E.C.
Magnus, Daniel, St. Benet-chambers, Fenchurch-street, E.C.
Rivington, Charles Robert, 1, Fenchurch-buildings, E.C.
Robertson, James (Mayor of Weymouth), Lansdowne, Wyke Regis.
Robson, Robert, 54a, Tottenham-court-road, W.
Rohde, J., Holly-hill, Wanstead.
Saunders, Herbert C., 3, Bolton-gardens, South Kensington, W.
Saunders, R., 1, Ironmonger-lane, E.C.
Wilkins, Thomas, Adelaide-chambers, 52, Gracechurch-street, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Benson, Henry, 50, Aldermanbury, E.C.
Boyd, William S., 13, Moorgate-street, E.C.
Brock, C. T., Warwick-house, Nunhead-lane, S.E.
Brooks, Herbert, St. Peter's-chambers, Cornhill, E.C.
Budget, H. H., 5, Monument-yard, E.C.
Bullock, George, 2, Holland-park, W.
Danberry, Henry, 67, Gloucester-street, Pimlico, S.W.
Dannatt, George, the Circus, Greenwich, S.E.
Eaton, William M., 16, Prince's-gate, S.W.
Emmens, Stephen H., Church of England Assurance Institute, King-street, Cheapside, E.C.
Evans, Owen, Broom-hall, Carmarthenshire.
Hartmount, Edward Hergberg, 8, Great Winchester-street-buildings, E.C.
Head, Albert A., Albion-road, Stoke Newington, N.
Herron, George R., 163, Bermondsey-street, S.E.
Horniman, Frederick John, Surrey-house, Forest-hill, S.E.
Macleod, William, M.D., Ben Rhyddring, near Leeds.
Muir, H. B., 19, Leadenhall-street, E.C.
Schlesinger, Dr. Maximilian, 25, Upper Bedford-street, W.C.

The paper read was:—

ON TRINKETS AND THEIR MANUFACTURE.

By W. G. Larkins, Esq.,

(Editor of the *Journal of the Society of Arts.*)

The desire for the adornment of the person is one of those curious bonds that unite humanity. It is equally strong at both ends of the human race—the dusky belle of a savage African tribe, who pierces the cartilage of her nose to hang therefrom an uncouth ring of gold, is actuated by, to say the least, no lower motive than that which induces some beauty, nurtured under that civilisation upon which we pride ourselves, to pierce the cartilage of her delicate ear, to hang therefrom a pendant of jewels; and the dandy of some Indian village, upon whose brown breast is tattooed the head of the lion, the fierce courage of which he desires to emulate, is about on a level with the swell of our own day of horsey proclivities, who sticks into his scarf an imitation of the head of that animal he would have us think he knows so much about. Vanity and superstition are the two great motives that induce the wearing of ornaments — a harmless vanity — perhaps a superstition that may be pardoned—but vanity and superstition, nevertheless. Out of this universal desire has grown up, as a compensation perhaps, an immense industry, or, I should say, a series of industries, by which thousands are enabled to earn their daily bread; and one can safely say this, that at no other time have articles of trinketry been so easily attainable as at the present time. If a person goes undecorated, it is his or her own fault, for lockets, and very well made ones, too, may be had for one penny. One, in the shape of a book, with a likeness of the Prince and Princess of Wales included, had a great sale a little while ago, its wholesale price being one halfpenny; and some brooches made in Germany are now being sold wholesale at the astounding price of three shillings a gross—a farthing each.

If the universality of the desire for personal ornament is a fact, no less a fact is its antiquity. The earliest records of mankind refer to the trinkets worn at the time; indeed, I am perfectly prepared to believe that, if there ever was a pre-historic man, woman, or child, he she, or it wore some kind of decoration of the period, considered to enhance the personal attractions of the wearer. It is also worthy of remark that the early forms of personal ornament are retained to this day, and, more than that, they are still the popular forms. The workmanship is better, the skill of the chaser and the engraver enriches them, but the circle, the oval, and the crescent, with the simple knot or tie, are the basis on which the larger portion of manufactured trinketry is formed.

Rings are, perhaps, the oldest form of trinkets—rings for the fingers, legs, and arms. A ring is used as the outward symbol of the married state, as symbolising eternity. At a very early period, rings were used as a medium of exchange, and are still, I believe, in Western Europe and the East, and as the money of African trades, for whom they are specially made of a mixture of copper and iron, and known as "manillas."

Though I by no means think that the slavish imitation of past productions is a thing to be encouraged, or that it is impossible in the present to produce any article that shall not be as original, as graceful, and as artistic as anything that has been produced before, yet I do think that designers would do well to study some of the examples of past times that have been preserved to us. There are numbers of beautiful forms, in the British Museum and elsewhere, that are well worth attention and reproduction.

Mr. J. S. Wright, in his paper on "The Jewellery and Gilt Toy Trades," read before the British Association, says:—

"The chief seat of trade formerly was Derby, where large quantities of common and medium jewellery were produced, Edinburgh and London manufacturing the finest goods. The trade has almost disappeared from the former places, and London now depends mainly upon Birmingham for the supply of articles suitable for the middle classes. Since 1836, the trade may be said to have been in a flourishing condition, but during the last twenty years its progress has been almost marvellous. The discovery of gold in Australia and California, the vastly increased wealth of England and her colonies, together with the desire for personal adornment, have united to give an unparalleled prosperity to this branch of industry, which now directly and indirectly affords employment to a larger number of persons than any other trade in Birmingham, whilst its increasing demand for novelties undoubtedly tends to develop in a larger degree the inventive and artistic faculties of a considerable portion of the inhabitants. With the exception of a few machinists (and in very busy seasons the workmen in the gun trade), the jewellers are the best paid of the Birmingham artisans. The rate, of course, varies considerably, but he is a poor workman who can only earn 25s. weekly; 30s. to 50s. may be considered the average of wages. Some obtain much more. Enamellers frequently gain as much as from £3 to £5 weekly. Boys are usually apprenticed at fourteen, when they earn 4s. per week, which is increased annually until they are twenty-one, when they generally receive 10s. or 11s., working, as a rule, from eight to seven, with intervals of an hour and a quarter for dinner, and half an hour for tea. Youths sometimes make a considerable sum by working overtime. It is somewhat singular, and contrary to what might have been expected, that only comparatively few females are employed in this trade; its cleanliness, and the delicate manipulation required, would appear to adapt it especially for women. Two branches only give them employment—one is the 'guard-chain,' and the other is the ordinary press work, when they cut out or form the 'roughs;' but a considerable number indirectly obtain their living in connection with the trade by making paper and leather boxes, which are largely used, not only to protect, but also to set-off the finished article.

"The jewellery trade furnishes a most interesting and important illustration of a peculiarity which places Birmingham in favourable contrast with every other large town and centre of industry in the kingdom—namely, the large number of small but independent manufacturers it supports. There are comparatively few large manufactories, most of the articles for which it is noted being produced in shops where five to fifty hands are employed. Probably nine out of every ten of the master jewellers, who are now carrying on business on their own account, were originally workmen. In one instance, at least, not less than twelve independent concerns are now in active operation, each employing a number of hands, the principals of these twelve concerns having all been employed as apprentices or workmen in a manufactory which itself has been established within twenty-five years.

"All that is needed for a workman to start as a master is a peculiarly-shaped bench and a leather-apron, one or two pounds' worth of tools (including a blow-pipe), and for material a few sovereigns, and some ounces of copper and zinc. His shop may be the top room of his house, or a small building over the washhouse, at a rent of 2s. or 2s. 6d. per week, and the indispensable gas-jet, which the gas company will supply on credit. With these appliances, and a skilful hand, he may produce scarf-pins, studs, links, rings, lockets, &c., for all of which he will find a ready market on the Saturday, among the numerous "factors," whose special business it is to supply the shopkeepers throughout the country.

"The causes thus indicated, which have so largely contributed to the establishment and prosperity of the jewellery trade in Birmingham, would, however, be insufficient of themselves to give it a permanent character. No doubt, success for a time largely contributes to the permanence of a trade; dealers in the various tools, stones, and materials required are drawn together, and this affords great facility to manufacturers, especially to those of small capital. Then the demand for novelty stimulates the ingenuity of the producer, and, by ensuring a continued supply of new styles, developes trade. There is no doubt it is the superiority of the workmanship that has continued the trade in its prosperous condition; and it is upon this superiority that reliance may be placed for its further development and permanent establishment in this locality."

France.

It is generally supposed that the greater quantity of mock jewellery comes from France. This is not the case at the present time. It used to be so, but for the last few years the manufacture has been steadily declining, and I think I may say that, whereas a thousand pounds' worth used to go to Paris for every hundred pounds sent to Birmingham, that now the reverse is the case, and Birmingham takes the thousands, whilst France takes the hundreds. The cause of this is easily divined. The manufacturers of France, with their undoubted artistic skill, cannot compete with our mechanical appliances The superior machinery that has been erected at Birmingham has brought the trade to us, and it ought to be a matter of congratulation that the progress of our own industry and manufacture is thus meeting with reward. The late unhappy war probably gave the final death-stroke to a manufacture that once was of great proportions. There is also another reason why France cannot compete with Birmingham, and that is this. A manufacturer, having ordered a die, and desiring to try the market with a few samples, has to pay dearly to the die-sinker for them, and is, therefore, unable to put them forward as cheaply as he might, were he able to stamp himself. Of course, if he is able to give an order for some large number, he can do the thing cheaply; but, should he run short of a particular pattern, he is unable to supply a small order. In this country, a manufacturer, having his own dies and presses, can do as he pleases, and can at once arrive at an approximation of the price it will pay him to sell at. I am afraid that France having once lost the trade, will never recover it. English manufacturers head the cards they affix their articles to with inscriptions in French, and even put French names to them, because of the reputation French jewellery once had, but the largest portion of that so labelled is nearly all made either in London or Birmingham. This reputation it is found convenient to keep up mostly because French artistic skill is so much higher than British; and although, at the present time, we are beating the French in the manufacture of both real and imitation jewellery, I do not think that in artistic skill we are any way near them. They certainly do turn out some beautiful designs, the result of the better acquaintance of their artist-workmen with works of art and design, and the result of the artistic education they receive. It seems to me, looking at the French trinketry, that they excel more particularly in combinations. It is, perhaps, one of the most difficult things possible to put in harmonious contact a variety of materials, of different colours, in many different ways, so that there shall not be a wearisome sameness. The British workman has, however, been so educated, that when once his mind is set upon producing anything in a certain manner, and his fingers get accustomed to work in a certain way, it is very difficult to get him to alter his manner, and manufacturers find it better worth their while to turn out thousands of an article all of one shape and pattern than to give their workmen a little license to vary and alter. Machinery has, of course, done much to increase this; and if it has cheapened production, it has, to a certain extent, fettered design.

One of the particular branches of manufacture that the French excel in, and we cannot touch, is that of the application of steel. This manufacture originated, I believe, in England, but was adopted by the French, who now supply us with the ornaments, the trade having dropped in England altogether. The steel ornaments are made up up of small nails or pins of iron, the heads of which are first of all hardened as steel, then facetted and polished. They are then rivetted to the ornament, which is fashioned previously.

Germany.

Germany manufactures a considerable quantity of jewellery. The principal exports to this country are very cheap imitations, in the form of earrings and brooches, &c. Among the specialities of the German manufacture are the articles made of the garnets of Bohemia. The Bohemian garnets are not of the finest, being somewhat black; still they make an effective ornament. The grinding and polishing of them gives employment to a large number of persons during the summer. When water is frozen in the winter, they are unable to continue the operations; therefore there are times when it is difficult to obtain this jewellery. The garnets are mounted by the working jewellers of Prague.

Silver filigree is another *specialité* of German export jewellery. Such a bracelet as the one on the table, which displays a large amount of work, it would be almost impossible to produce in England for the same price, on account of the dearness of labour. There is some taste in the design. Glass beads, and little glass brooches with a bit of tinsel upon them find a ready sale in the English market, roughly and coarsely as they are made. The agate earrings and brooches, sold wholesale at about 7½d. per pair, are ground and polished like the garnets; their chief fault, however, is the mounting. The German workmen have not quite the capabilities of turning out things cheaply and strongly. The characteristics of all German jewellery is that it is, as far as the metal work is concerned, thin and frail.

Vulcanite, to which I shall refer presently, comes principally from Germany. In some things, glass working, for instance, Germany can excel. Glass beads she makes in large quantities, as well as imitation pearls. The glass earrings on the table are sold wholesale in this country at 8d. per dozen pairs. The rococo work, of which there was a large quantity exhibited in last year's exhibition, is another species of ornament.

Ivory carving is another industry which the Germans have turned to account in manufacturing personal ornaments, and they can produce brooches and other things at a very cheap rate.

Some years ago there was a considerable quantity of iron ornaments imported from Berlin, where the manufacture of it by casting forms a large industry. They were sold just as they came from the mould, and had a rapid sale here at the time, and were very effective and delicate in appearance. By great care in the choice of iron, and other precautions, the founders are enabled to obtain the metal in a degree of fluidity necessary to fill the minute and sometimes delicate moulds. The public taste has herein altered, and it is doubtful if any could now be obtained.

Materials.

If the wearing of trinkets is a universal passion, the materials of which those trinkets can be made are almost endless in number, ranging from human hair through the animal, vegetable, and mineral world, down to the granite foundations upon which the world is built. Every metal has had its turn but one, for I have not heard that mercury, in its natural state, has yet been made into a brooch or ring. Various kinds of woods, ivory, bone, hair, pebbles, precious stones, glass, leather, paper, and the shells of mollusks, granite, and plaster, are among those in use at the present day; and what will or will not be turned to account, as the tastes of the public vary, or the ingenuity of manufacturers increase, I cannot say. There is no manufacture that affords a greater range of material, or of opportunities for the display of artistic talent in using it. And when we take into consideration the richness and value of some of the materials, we may say that it affords a grand opportunity for a combination of both value and design.

Gold.

Gold, of course, is the metal from which the greatest portion of jewellery is made, and, besides its intrinsic value, no metal is so pleasing in appearance, or is so well suited for the purpose. Even when of low standard, it is able to hold its own against other metals; and this being the case, a successful imitation of gold is what the maker of mock jewellery most desires.

While talking of gold of low standard, I may perhaps be allowed to say, as affecting the public very much in this matter of trinkets, that many persons imagine that in buying a gold ring for instance, because it is hall-marked, it must be of good, or, I will say, fine gold, indeed, in some cases, that it is 18-carat gold, which every one knows is the best adapted for manufacturing purposes. But the fact is, a hall-marked trinket may be as low, I believe, as 9-carat gold, that is to say, the greater portion of it is not gold at all, but alloy. Trinkets made of 18, 16, or 14 carats possess a proportionate intrinsic value of their own. They permit of delicate workmanship, while they are hard enough to resist wear; but below that, although the trinket itself may have an artistic value, yet it can hardly be said to be of gold, 12-carat being half gold and half alloy, and 9-carat gold having but little more than a third of the precious metal in its composition. I need not say that 3, 4, and 6-carat gold is practically of but little value. Till the reign of George III., the standard was fixed at 22 carats, then at 18 carats; subsequently exceptions were made, and now only wedding rings are required to be of 22-carat, or what is called guinea gold. Silver, on the contrary, has a fixed standard, and all hall-marked silver is of the same metallic value. I cannot but say that the suggestion which has been made by Mr. Streeter and others, that the public should insist that the jeweller of whom they may buy should insert upon his invoice the value of the gold he sells, is a good one. This would check certain malpractices that undoubtedly do exist, and I am not at all sure but that it would lead to the fixing of one standard, as is the case in France and other countries, and that then the public would get their value for their money, and we should, by means of our superior powers of production, be enabled to increase our exports of jewellery to the Continent, where at present it is looked upon with considerable disfavour, not on account of its design or manufacture, but because of the doubt which exists as to its precise value.

There is one reason why the fixed standard of gold is of less importance in this country than in others. England, unlike most continental countries, does not possess a distinctive type of jewellery. In France, Belgium, and other countries, there is a national peasant jewellery, which is handed down from generation to generation, and considerable sums of money are expended in the ornaments which are to become heirlooms, and the manufacture of them is an important industry. Now, as peasants, or persons who are unable to form correct estimates of the value of gold from its appearance and weight, would be greatly liable to be imposed upon, and their savings be exchanged for trash, unless some stringent rule were laid down, a mark of purity, which has only one meaning, is an important thing. Every one knows the mark, and to see it upon the article they may desire to purchase is a guarantee to them that they are justified in expending their money upon it. The amount of money thus locked up in France, Holland, Spain, and other countries is enormous. In England, on the contrary, among the great bulk of the people there is no family jewellery. The great houses of the country pride themselves upon their jewels, but a country farmer, who, it may be, cultivates the land his ancestors for hundreds of years back did, would laugh at the idea of family jewellery; his pride would lie in a different direction. This, doubtless, affects our English manufacture to a certain extent, for trinkets are bought to serve their purpose and their time; they are used to day and thrown away to-morrow. They grow old-fashioned, are discarded, and, if of gold or silver, are sold as old metal. A French peasant woman would as soon think of selling her earrings as old metal, because they did not accord with Paris fashions, as she would of selling herself for a slave. This want of reverence for personal ornaments may have made manufacturers much more careless, both in design and material, than they would otherwise have been.

Silver.

Silver is used, to a certain extent, in the manufacture of ornaments, but the alloys I shall presently refer to have beaten it out of the market. At one time, silver chains were very commonly worn, and many a schoolboy who received as a present a silver watch and chain, went back to school with a feeling of considerable pride in the possession of them. Now, it is extremely probable that, with regard to the chain, at all events, he would be very much better pleased with one of Mr. Pyke's Abyssinian Alberts. To see silver chains now is a rarity, except among rustics, and they are very seldom displayed for sale in the shop windows. I must call attention to the beautiful oxidised silver casket upon the table, lent by Mr. Streeter. It is of exquisite pattern and workmanship, and shows what can be done with that method of treating the metal. There is no doubt whatever that it affords an opportunity for treating silver in a unique and artistic manner, and trinkets are made of it, though I have none here to-night to show you. At present the public has not been sufficiently educated to appreciate them, but I believe that before long, as taste in these things improves, a very large industry will arise in connection with the manufacture of oxidised silver articles; the metal is sterling, and wears well; it is capable of elaborate workmanship, and the treatment of it by oxidation gives it a distinctive character above a mere silver ornament. The national brooches and pins, set with various stones and pebbles, and known as Scotch jewellery, is a local industry of some merit, and the style seems very suited to the somewhat barbaric forms of the Scotch national ornaments. The stones used are cairngorms, yellow amethysts, jasper, and agate.

Aluminium and its Alloys.

The discovery of the metal aluminium, and the success of the experiments of Deville, Gerhard, and others, by which its production in large quantities was proved possible, had a wonderful effect upon the manufacture of imitation jewellery, inasmuch as it gave the manufacturer a metal which was as of good a colour, as workable, but not so expensive, as gold. With regard to the metal aluminium itself, I may refer you to a paper read in 1859 by our Secretary, Mr. Le Neve Foster. It is a very malleable and ductile material, about four times lighter than silver, and nearly as light as glass; and, from the properties it possesses, it is capable of being applied to a variety of uses. It has been made into jewellery and ornaments of various kinds, but has never, I think, become popular. Some very beautiful articles have been manufactured from it, and in some respects it has an advantage over silver; it is not affected by the atmosphere, while it works easily under the graver. It is, however, rare to see articles made from it exhibited, though, ten or twelve years ago, buttons, shirt-studs, and brooches might have been bought cheaply in the Lowther-arcade and other places. It is, however, largely used for the mounting of telescopes, opera-glasses, surveying instruments, and spectacle-frames, its lightness being of value in such articles; and, though it is admirably suited for the wheels of clocks and watches, I do not find that it is extensively, if at all, used. Although its use as a pure metal for trinkets and ornaments has not been established, yet, as I said just now, it has had a very marked effect upon the manufacture of mock jewellery, from the fact that, with copper, it forms an alloy that in colour approaches gold more nearly than any other. The aluminium, when used in small quantities (the proportion being about 5 per cent. of aluminium and 95 of copper), gives a hardness to copper, rendering it capable of being polished to a high degree, but without destroying its malleability, such an alloy having also the further merit of not being sensibly tarnished by exposure to air. The value of such an alloy as this to the maker of imitation jewellery is at once seen. In order to show this, I have here some pieces of chains, one of which, Mr. Streeter tells me, is 18-carat gold; one, Mr. Pyke says, is of what he calls Abyssinian gold, it being really of such an alloy as that I have referred to; and one which is of a "composition," which, up to the discovery of aluminium, was the nearest approach in colour to gold that could be got. The difference in favour of the aluminium bronze, which is its correct title, is evident. The "composition" to which I refer is probably an alloy of copper and zinc, in the proportions of 66 parts of one with 34 of the other. Pinchbeck is another alloy of copper and zinc, of which watches and other trinkets were made, but it tarnished rapidly, and was much too dark in colour even for 18-carat gold, while the mosaic gold, as the alloy I have mentioned is also called, approaches, when polished, very nearly to the appearance of 9-carat gold, of which a large number of trinkets are made and sold.

Doublé d'or.

I have said that the materials of which trinkets can be made are innumerable. Among those that are in use at the present time, and have been used with success, I may mention *doublé d'or*, which is a manufacture of French invention, dating from the year 1830, and which is produced as follows:—A plate of copper has a layer of gold placed upon it, the thickness of the gold being as one to eleven of the copper. The two plates are made to adhere by solder, and are then passed through rollers till they have been reduced to the required thickness. Great care has to be exercised to keep the metals from parting. It is evident that an article made from such a plate must have a gold surface, more or less thick, and that it is less likely to suffer from abrasion or wear than gilding, where the deposit is oftentimes very infinitesimal, three pennyworth of gold having been known to cover a gross of livery buttons.

Tortoiseshell and its Imitations.

Tortoiseshell ornaments are well known, and, inlaid or in combination with the precious metals, it forms beautiful trinkets. Some ornaments have been made from what is called artificial tortoiseshell, another French invention. This material was first introduced by M. Pinson, of Paris. It is obtained by melting, at a moderate temperature, gelatine, with a small amount of metallic salts, and running the whole into moulds. The peculiar markings and grain of the tortoiseshell is obtained by staining the substance with hydro-sulphate of ammonia. The objects produced, such as bracelets, brooches, combs, and various other fancy articles, are then polished and made ready for sale. Some of them are inlaid with gilt metal or silver, and some very pleasing effects have been produced. An imitation tortoiseshell is also made from horn, which is softened by heat, pressed in a mould, and then re-hardened.

Shell, &c.

Most trinkets of what is called mother-of-pearl are cut from the shell of the oyster, much in the same way that pearl buttons are made. The shells are imported specially for the purpose, and the portions of them likely to be useful are removed by means of small saws revolving in a lathe. These portions are then split, and rendered equal in thickness by rasping. The various shapes are then cut out, and are finally polished by the use of rotten-stone.

In the Exhibition of 1862, Mr. Harry Emanuel exhibited some ornaments in ivory, which were quite new in style, and there is no doubt whatever that the material is capable of being treated in a most artistic manner. It is semi-transparent, and can be used either with its natural colour, or stained and painted, still retaining its natural surface.

The same gentleman also exhibited what he called pink pearl-shell jewellery. The shell was used in combination with other materials. The catalogue of the exhibition says, "that the pearl is cut from a rare shell found in the West Indies, and, from its delicacy of colour, far surpasses the best and purest coral, while its brilliancy equals that of many gems. From its hardness, it is susceptible of a very high degree of polish, and it seems eminently adapted for use in jewellery, for which purpose it has not before been applied." It is a rare material, and there is considerable difficulty in manipulating it; but there is no doubt of its beauty, and that it looks well in combination with other jewellery and with the precious metals.

Wood.

The ornaments in wood most known in this country are those made in bog-oak, of which large numbers are sold yearly at a very moderate price; not so moderate, however, as to preclude imitation. Side by side on the table is a brooch of bog-oak and a brooch and earrings of some hard wood, stained to resemble bog-oak, and looking at them it is difficult to tell which is which. There is a considerable difference in the price, however, the imitation being about five times less than the real. The imitation, however, gets brown in a very short time, while the oak always retains its colour.

The bracelets and brooches of wood that are made in Scotland, are first of all turned, and are then highly varnished or enamelled, and coloured according to the pattern of some popular tartan. Oddly enough, as it seems to me, there is a considerable export of these goods to France.

Jet and its Imitations.

Jet is a very beautiful material, found in the slaty rocks at Whitby, in Yorkshire. It is said to have been worked long before the time of the Danes. It is supposed to be, by Dr. Young, wood in a high state of bituminisation. It is a material that makes admirable mourning jewellery, and it has a lustre and brightness which gives it the preference over bog-oak. I understand that Birmingham has taken up the manufacture of jet ornaments, that the various pieces of jet are worked at Whitby by hands in the employ of Birmingham manufacturers, and that the pieces are then sent to Birmingham to be mounted. Ebonite and vulcanite, both a compound of caoutchouc and sulphur, are among the imitations of it; another being a compound formed of a wood powder blackened, moulded, and hardened by a certain process. A large number of persons in the east-end of London gain a livelihood by the manufacture of vulcanite ornaments. The material is very workable, and not expensive, and women and children can help.

The vitreous imitations of jet are not, to me, particularly successful, but, as a manufacture, the English is better than the French, for this reason. The glass in the French is fastened to the metal backing only by shellac; the consequence is, that a slight blow will cause it to break off, and the heat of a room has been known to separate it. The English glass work is soldered to the metal, the glass having first of all a facing of some kind, and, except under very rough usage, it will wear very well. It is sometimes desirable to effect a combination between glass and metal, as in the case of some kind of buttons for instance, and some common kinds of brooches. The pieces of glass, having been moulded or pinched the required shape, are placed on an iron tray upon which is a metal foil, upon which a flux has been previously applied. The tray is then placed in a furnace, and, at a certain temperature, the glass and the metal foil fuse together, and enter into such perfect combination that, when broken, the metal and the glass still adhere to each other.

Machinery and Hand Labour.

I have said that machinery has done much for the cheap and rapid production of jewellery. Of course it is almost impossible that hand-work can be entirely dispensed with, especially if anything like a difficult ornamentation is attempted. Even in the commonest article, say a brooch or a locket, the pin has to be fastened by solder, the hinge has to be affixed, and, in the case of a chain, the fasteners at both ends have to be put on. What machinery can do is this, it can save labour in stamping, and punching, and working mathematically correct, as it always does, it can turn out two parts, as the cases of lockets or the links of a chain, so perfectly true to each other, that no cutting, or filing, or fitting is required. To give you an illustration of this, these two little watch wheels, which Mr. Streeter has given me, are so true to each other, and their cogs are so mathematically correct, that they fit one into the other, and become as it were one piece of metal. These wheels can be cut by thousands, and what is true of the first pattern is true of all the rest, and what is true of the whole wheel, is true of every cog; they can be turned round, fitted haphazard, yet are still true. So much for what machinery can do towards saving labour of this kind. No handwork could possibly produce such a wheel as this in such a time and at such a cost. I believe I am right in saying that this wheel can be produced at a cost of threepence. In the case of trinkets, it can stamp out the parts of a locket so that it shall only require a pin to be inserted in a socket to make its manufacture complete, and this it can do for other things.

Here is a locket which has no hand-work whatever about it; it is stamped out of one piece of metal; it has no hinges; it does not, of course, open, and the back and front are kept together by clamps, which are simply turned over.

It may be interesting, perhaps, if I go regularly through the manufacture of a brooch by hand, as followed by a working jeweller. Mr. E. Stokes has kindly enabled me to show you some of the appearances a plate of metal undergoes before it can come out in its complete form. Here is a plate of metal, and here is a die; this die, as you all, I have no doubt, know, is cut in steel by a class of workmen who are called die-sinkers, but of whose work I need say nothing. The object of the workman is to get a perfect impression of this die upon the plate of metal. To obtain this, he manipulates the metal, and gradually works it down into the die bit by bit. Having worked at it for some little time, it is found necessary to anneal the plate, as it is called, for long continued hammering makes it brittle, and incapable of further extension. It is again heated, and allowed to cool slowly. This operation has to be repeated a number of times during the process of taking the impression, and its various stages are represented here. This having been accomplished, the next step is to add any other parts that may be necessary, by soldering, and then the whole is placed in what is called "pickle," that is, a hot alkaline solution, which removes the effects of the fire, and then, if of common metal, it is gilt, and the parts that are intended to be bright are burnished.

This taking an impression from a die is done by machinery in precisely the same way, only the press acts instead of the repeated taps of the hammer; the whole piece is not stamped out at once, as many will think, but a portion at a time, and the same annealings take place. I believe I am right in saying that experiments are being made with a view to attaining, by a slow and equal pressure, the power of completing the stamp at one operation. Equal pressure is what is wanted. You will readily understand that, in forcing the metal into the die, it is very likely be much thinner at the point of pressure than anywhere else. This is the great difficulty, which is not overcome even in handwork. I may say that in making jewellery there is always a loss of metal in working. In filing, chasing, cutting, &c., the metal flies off in a fine powder; this falls upon the floor, and is carefully preserved, the sweepings of a jeweller's shop often being of great value. The working loss in gold is calculated to be one pennyweight per ounce; therefore, in estimating the price of jewellery, this has to be allowed for. In machine-made work, the liability to loss is greater than in hand-made, because the particles fly off to a greater distance, and are not so easy to collect. This difficulty is got over by placing a glass shade over the machine, which catches the particles and keeps them together.

The cutter by which the star shapes for lockets are cut out revolves at the rate of about 3,000 revolutions per minute. The value of such machine cutting is this, you get all the angles mathematically true, which it is almost impossible to get by hand, and this exactness in geometrical patterns, where the least inequality offends the educated eye, is very great.

I hold in my hand a piece of chain, which is, to my mind, a perfect triumph of machine work. It is a piece of common snake-chain, which may be seen in any jeweller's shop, and, in common metal, may, I believe, be bought wholesale at about 4s. 6d. a-yard. It is a marvellous piece of ingenuity. Its regularity, its flexibility, and the closeness of its manufacture is wonderful, and I think it may fairly rank amongst the highest productions of machinery. I believe I am right in saying that it is the work of a Mr. Holland, and that he has been able to keep the method of manufacture a secret to himself, and that all the snake-chains of this precise pattern are made by him. Any way, no one has yet been able to discover, from an inspection of the chain, in what way it is made; and, pull it to pieces as you will, it defies scrutiny; and, as a distinguished manufacturer said to me the other day, "I have tried over and over again, but have failed, and I believe one might grow gray in trying." Mechanists may be able to give a shrewd guess as to the kind of machinery employed, but the combination they cannot guess. Let us hope that the secret, if it is possessed by Mr. Holland only, will not be lost when he is gone; for the pattern is not only one of the most popular, but certainly is one of the most pretty and useful. It has a few defects; for instance, it is easily snapped in two, and when once snapped it is unmendable, for it is the only pattern in which there is no solder.

If I cannot explain to you the manufacture of the snake-chain of Mr. Holland's invention, I can this, which is technically called a spiral chain. It is hand-made, and consists of two wires, with turned edges—a male and a female wire. These are bound round what is called a spit, the edges being turned towards each other. The elastic character which the finished work has, is caused, it will be readily seen, by there being a space between the edges of the wires. The wider the wire the greater the elasticity. The varying width which this bracelet, for instance, has, is given by the spit, which is wider in the centre than it is at the ends. It will, therefore, puzzle some to know how the skip is removed; this is done by burning. When enough of the wire has been rolled, it is cast, spit and all, into the fire; the wood burns but the metal remains intact. It is an ingenious chain. I am not acquainted with the name of the inventor, but he certainly has enabled some very effective ornaments to be produced. There is another method of getting rid of the spit used in France, and possibly in England. The spit is formed of metal D'Arcy I believe it is called, an alloy of bismuth and lead, which is fusible in boiling water. The chain is made as before, and the alloy is run out by applying heat.

A considerable saving of labour has been effected by the introduction into the trade of ready-made mountings for stones. These mountings are used not only for the cheaper but for the finer kinds of jewellery. The parts that go to make up this ear-ring, for instance, are cut out separately by machinery, and then soldered together. Another invention for the same purpose, by M. Ferré, consists of a strip of metal with a serrated edge; this is bent in the shape required, and the teeth are bent over the stones.

Conclusion.

Now, by way of conclusion, let me give utterance to an idea that has come into my head with regard to this matter of personal adornment. I am not going to say that makers and sellers of sham jewellery are lowering the morals of the country. I will not say they aid and abet the actual lie of those who would have us believe their brass is gold, and I will not go so far as my friend, Dr. Dresser, who, in a paper read before us last year, asked if the destruction of Pompeii and the woes that have lately fallen upon our neighbours across the Channel, were not due to their false quantities in decorative art. But I do mind me of a sentence of that quaint divine, Dr. Andrew Fuller, who said that, in the time of Elizabeth, a "lady would as soon have patiently digested a lie as have worn a false pearl." I am afraid this high regard for truth is not characteristic of the present generation. There is, on the contrary, a good deal of show and humbug about even ladies and gentlemen, and "all is not gold that glitters;" and it is possible that mock jewellery, false hair, pretended jewels, and other shams may blunt that keen sense of truth and right which distinguished our Saxon progenitors. At the same time, I am bound to admit that by the rapidity and cheapness of manufacture now-a-days, things of beauty are placed before those who would never otherwise enjoy them, and perhaps, after all, as Mr. Wright, in the report I have alluded to says, "There is no valid reason why the factory girl should not display her gilt buckle and brooch of the same design as the golden one worn by the lady of the villa." Art may thus serve the community by cheapening the cost of the beautiful, and afford gratification to the humblest members of society, by superior designs reproduced in the cheapest possible form, and attainable by all.

Before I sit down, I must refer you to the specimens of jewellery upon the table. This case, lent by Mr. Streeter, contains some gold ornaments manufactured by machinery, the design being a *fac-simile* of various leaves of trees, the most delicate fibres being reproduced with a surprising fidelity. This diadem and necklace of entwining ivy is most graceful in design, and seems to me to display a great amount of artistic skill in the work manship. These trinkets, that I have referred to during the evening, have been lent me by Mr. Silber, of Wood-street, who very kindly allowed me to choose from his warehouse the representative ornaments of the French, German, and English manufacture. I have taken the best and the commonest of each, and placed them side by side, so that you will be able to compare the workmanship and the designs of each of the great export countries, although they are here more as specimens of peculiar manufacture than that of artistic work.

This case of aluminium bronze ornaments, lent me by Mr. Pyke, who calls it Abyssinian gold, brings very clearly before you the perfection that may be arrived at in the manufacture of jewellery. Independently of the value of the material, the workmanship is of the highest order, and I do not think any praise is too high for the artistic skill displayed. If taken as a representation of this particular branch of English manufacture, I do not think it can be beaten by any other country. It is such work as this that shows how the taste of the public is being gradually educated to the appreciation of beautiful forms. Such magnificent gold ornaments as those of Mr. Streeter are beyond the reach of the poor man, who may, however, have in base metal a very artistic article of adornment. It is this only which redeems "mock" jewellery from the vulgarity which one has learnt to consider as almost inseparable from sham. My best thanks are due to all these gentlemen for their kindness, as also to Mr. Stokes for the dies I have referred to.

DISCUSSION.

Mr. George Wallis said there was one point connected with the jewellery trade at Birmingham, and he might be permitted to refer to it, which it was particularly desirable should be known, it was, that every manufacturer had his own speciality, as regarded the character of his goods, that the maker of gold work never made plated work, and that the particular quality of gold that he was in the habit of using was well-known to his customers, and therefore his reputation was at stake as to its quality, whether it was 12, 14, 16, or 18 carat. Again, no maker of real gold work, as it was called, ever made silver work, which was decidedly distinct, and in that case also the manufacturer's reputation was pledged to the quality of the goods he sold. They had all frequently heard it said that anything which came from Birmingham must be an imitation, but he would say, if it were made as an imitation, it was sold as an imitation; and, whatever might be done by the retailers afterwards, it went out of the hands of the manufacturers honestly for what it was. He had had the pleasure of living in Birmingham for seven years, as Head Master of the Birmingham School of Design, now called the School of Art. He had known Birmingham from his boyhood, and had kept up his connection with it ever since he left, in 1858, and during the time he was there or since, he had never read in any police report in the newspapers of any workman purloining the goods of his master, although they were in the habit of dealing with precious materials amounting to the value of a million and a quarter in the year. In 1855 he had the pleasure of reading a paper in that room, upon the "Recent Progress in Design," and he brought up from Birmingham a considerable display of the products of that town. Many of the objects were mounted upon cards, which were marked London so-and-so, and people thought they were made in London, but that was a mere myth; it answered the purpose of the manufacturers to cater for the whim of the retailer, and he mounted his goods accordingly. He should like to see this kind of thing done away with, as it would be more honourable and honest. In the Exhibition of 1851, Birmingham did not exhibit a single article of jewellery, but in 1862 they made a very excellent display, chiefly through representations made by him. Previously, the manufacturers said they did not care what the public thought about Birmingham jewellery; they sold it honestly for what it was, and did not care to betray the secrets of their customers. He was sorry to say that many persons, who ought to have known better, said they did not care to look at the Birmingham cases, because they did not consider there was anything worth looking at. There had been a deal of talk about French design, but he was satisfied that the French designers had led the English into some of the most outrageous absurdities, and it arose out of the incessant following of the mere whims and caprices of the French. The French got the idea that unless they made designs to meet the whims, caprices, and conceits of the English manufacturers they could not sell them; but this was a mistake, for when the time came that workmen and manufacturers got a little instruction, and a more severe style began to prevail in England, the French found it was needful to meet the demand, and then they gave them some excellent lessons on this point. He found at Birmingham, where he went to work in 1852, that the jewellery trade had followed the French so thoroughly, that they could not show anything in 1851 which was original. He made a dead set at this, by making himself personally acquainted with some of the jewellers, and inducing them to send their apprentices to the School of Art, and by joking and bantering them on the absurd character of some of their productions, they began to see that something more might be done by attending to some principles of design. Ultimately, their apprentices and young men came to the School of Art, and during the seven years he was there, 300 apprentices went through the classes of those schools. It was very commonly said it was no use saying that this had any effect upon the manufacture, because it was not fashionable to say that anything ever came of this kind of teaching. But, however, this went on, and, in 1862, they were enabled to show a very creditable exhibit. Since then it had gone further, and he was quite sure he should search now throughout the whole of the trade and not be able to find many of the things which prevailed largely in 1853, 1854, and 1855. And what was very remarkable was, some of the best and soundest designs were to be found in the imitation work. He might conclude by saying that, the last time he came up from Birmingham, he met a young man in the trade whom he recognised as an old student, and whom he found had left the gun trade, in which he had formerly been engaged as an engraver, and entered the jewellery trade, in which he said he was successful. He also stated, that on hearing from a lady that the Birmingham jewellery trade would be ruined, owing to the state of affairs in Paris preventing any French designs being supplied, he informed her that he had always made his own designs, and had never used any French ones; and he (Mr. Wallis) was much pleased to hear, also, that he was indebted to the instruction he got in the School of Design for being able to do so.

Mr. Wm. Botly said that, being descended from a manufacturing jeweller, he had some knowledge of the subject, and was happy to be able to add his testimony to the truth of many of the statements made in the paper. With regard to the wages earned by working jewellers, the sums mentioned were often exceeded, for he could state, on good authority, that in former days, at the establishment in Bond-street which was the original of that lately carrried on by Messrs. Storr and Mortimer, and more recently by Messrs. Hunt and Roskell, two young men (his father and another), who were expert at a particular branch, received a guinea and a-half per day, working from 9 to 4. He could also speak of the great improvement which had taken place since the repeal of the Corn Laws, both in the wages and general condition of the workmen in Birmingham, particularly those who, working at home, and employing their families, &c., under them, were called "chamber masters." He believed the best bog oak ornaments came from Ireland, and were very excellent. Ivory was objected to because it did not keep its colour, although very beautiful articles were made from it in this country. To show the immense amount of business that was done in some of the minor branches of the business, he might mention that he once heard from an arsenic manufacturer that he had taken an order for three tons of that article, to be used in the colouring of dolls' eyes, and small articles of that kind; and as but an infinitesimal quantity was used in each case, it was evident there must be an immense amount of such articles made. It was well known that metal was hardened by hammering, so that repeated annealing was necessary; and, therefore, if any process could be discovered by which the requisite shape could be impressed upon the metal at one operation, it would be of great advantage.

Sir Walter Stirling said he was much pleased at finding that Birmingham was in reality the temple of truth, for the general impression was quite the contrary. It was evident, however, from what Mr. Wallis said, that what was fictitious jewellery was honestly sold as such, and therefore there was no deception. He considered it a great public benefit that articles could be produced of the highest finish and beauty, without having intrinsically such a high value as to tempt housebreakers and thieves; and he hoped it would be more generally recognised that the beauty of trinkets should depend on the excellence and taste of their manufacture. The same principle applied in the highest circles of society, for he believed there was no such thing in use now, even at royal tables, as gold plate, except in rare instances. On one occasion, when dining with the Goldsmiths' Company, he inquired for the gold plate, but the only specimen shown him was a cup, which had been set before Queen Elizabeth. Even silver plate was now so closely imitated by electro-plate, that it was almost entirely superseded by it, and people might now sleep in safety, either in their town or country houses, without the fear of burglars breaking into their plate-closets and carrying off that which was not only precious as having been in the family perhaps for several generations, but also from its intrinsic value. It was very creditable to the artists to see such beautiful imitation jewellery, but, after all, there was nothing which could equal the beautiful appearance of pure gold. Indeed, having witnessed the Royal procession of the previous day, he was of opinion that even Temple-bar was vastly improved in appearance by the gilding bestowed upon it.

Mr. Brenton said there were two difficulties in the jewellery business at the present time; one was the great license given to the manufacturers in the quality of the gold, and the other was the obstructions thrown in the way of manufacturers by the Goldsmiths'-hall. With regard to imitation jewellery, he thought the finest was undoubtedly the Abyssinian gold. He had no objection whatever to the quality of the workmanship, but he thought it wrong to call it by such a name, because they knew that gold was found in Africa, and in small quantities in Abyssinia, and therefore the name was apt to mislead people. Reference had been made by Mr. Larkins to the fact that they did not export so large a quantity of jewellery as they ought, and he agreed that that was to be accounted for by the fact that gold was stamped at too low a quality, even nine carats, which gave foreigners a very bad opinion of English gold. He felt sure if they did not stamp anything under 12 carats the trade would be much improved.

The Chairman, as a Birmingham man, said he felt very much pleased at hearing that that place was a temple of truth. He thought it was quite clear that the trade had been helped in Birmingham by the artistic taste developed by the Schools of Design, and by the International Exhibitions which had been held. He had much pleasure in proposing that the best thanks of the meeting be given to Mr. Larkins for his valuable and interesting paper.

The vote of thanks was passed unanimously.

ANNOUNCEMENTS BY THE COUNCIL.

COUNCIL.

Admiral the Right Hon. Lord Clarence Paget has been elected to serve on the Council, in the place of Admiral Inglefield, who has resigned, having been appointed by H.M. Government to a Special Mission to the United States of America.

POST-OFFICE SAVINGS BANKS.

The Council have appointed a Committee, consisting of Messrs. G. C. T. Bartley, Andrew Cassels, and Major-General Eardley-Wilmot, F.R.S., to consider and report what changes in the regulations of the Post-office Savings Banks are needed, to render them more suited than they are at present to the habits and requirements of the wage class.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscriptions paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

France.—The following letter has been received from M. du Sommerard:—

"Commission Supérieure, Paris,
le 31 Janvier, 1872.

"CHER MONSIEUR,—Je reçois la communication que vous voulez bien m'adresser au sujet de l'Annexe française à l'Exposition Internationale de Londres en même temps que les extraits des Journaux que vous me faites parvenir et qui comprennent le compte rendu d'un Meeting tenu à Mansion-house ces jours derniers, meeting dans lequel plusieurs orateurs se sont élevés avec véhémence contre un prétendu droit de vente et d'enlèvement des produits exposés qui aurait été imposé par nous aux Commissaires de Sa Majesté.

"Je m'étonne de l'importance donnée par certains orateurs à des affirmations qui ne reposent sur aucun fondement; je m'étonne surtout que des faits complètement inexacts aient pû être affirmés publiquement dans une Assemblée aussi considérable sans avoir été rectifiés.

"Un des orateurs, auquel sa situation de correspondant d'une de nos principales Maisons de Paris semblait donner plus d'autorité, et qui, en tout cas, devait paraître exactement renseigné, a annoncé, comme une révélation, des faits dont je regrette d'avoir à le dire, il n'avait pas une parfaite connaissance.

"Il a été dit que les Exposants français avaient exercé une pression violente sur les Commissaires de Sa Majesté; on a parlé de bazar et de boutiques; tout cela est erroné.

"Jamais le Commissaires Généraux du Gouvernement français n'ont soulevé la question de vente dans l'annexe. Ils se sont bornés, et les procès-verbaux des séances sont là pour justifier mon dire, à demander aux Commissaires de Sa Majesté l'autorisation de construire, aux frais de leur Gouvernement, une annexe pour y développer les produits de leurs nationaux, en présence de l'insuffisance des galeries qui leur étaient affectées; et les Commissaires de la Reine ont accédé avec la plus parfaite bonne grâce à cette combinaison tout à l'avantage de l'œuvre internationale.

"Quant à la prétendue condition de vente et d'enlèvement des produits exposés dans ces galeries, condition qui aurait été imposée par nous à la Commission Royale, elle n'a jamais été formulée, je le répète; elle n'a jamais existé.

"Il est vrai qu'en raison des circonstances spéciales pour la France dans lesquelles s'ouvrait l'Exposition de 1871, en raison surtout de la sympathie qui se manifestait à Londres en faveur de nos nationaux, nous avons cru, secondés par la bienveillance des Commissaires de Sa Majesté, que certaines facilités pouvaient être accordées à quelques uns de nos exposants, tout en conservant à l'annexe française le caractère de dignité et de bonne tenue à laquelle le public, je n'hésite pas à l'affirmer, a rendu quoiqu'on puisse dire, pleine et complète justice; mais nous n'avons jamais entendu, mon honorable collègue, M. Ozenne et moi, nous prévaloir de ce précédent pour opérer une pression, comme on l'a prétendu, sur les Commissaires de S. M. et leur créer des difficultés telles que celles qu'on leur oppose aujourd'hui.

Aussi nous considérons comme un devoir de pouvoir répondre aux bons procédés dont nous avons été l'objet de leur part en leur déclarant, sans hésiter, que nous renonçons, pour l'Exposition qui va s'ouvrir, à tout privilége analogue, et que nous entendons nous conformer aux règles en usage dans les grandes Expositions Internationales, à la condition expresse toutefois que la même marche sera suivie par toutes les nations représentées à l'Exposition Internationale.

"En somme, toute cette affaire qu'on a voulu élever à la hauteur d'une lutte de principes, était, comme vous le voyez, résolue par avance en ce qui concerne la France du moins, et se réduisait à une simple question de police intérieure.

"Veuillez agrées, tant en mon nom qu'en celui de mon collègue, M. Ozenne, et faire agréer aux Commissaire de Sa Majesté, l'expression de nos sentiments les plus sincères.

Le Commissaire Général de France,
(Signé) E. du Sommerard.

To Major-General Scott, Secretary.

Arrangements have been made with the French Commission, by which M. König, of Paris, will exhibit a complete collection of scientific acoustic instruments. Messrs. Weiggand and Co., of La Hogue, propose to exhibit a kiosk, described as "the music temple in its full power of propagating the undulation of sound, and which appears to possess many peculiar properties. This firm also sends a "phonotographic," on the Lefèbre system, and an apparatus for showing the phenomena of interference. Mr. Rein, of the Strand, also proposes to exhibit instruments of this class.

CORRESPONDENCE.

INDIVIDUAL PROVIDENCE FOR OLD AGE, &c.

Sir,—Permit me the opportunity of offering a few practical opinions on the report of a recent meeting held at the Society's Rooms, on January 31st, 1872, and which appeared in the *Journal*, No. 1,002.

In the first place, I consider a better title or name would be "Individual Reliance."

In the second, all classes of the community throughout should combine and conform to live within their means or positive income, reserving not less than ten per cent. of the total amount of earning or income as savings in the bank and insurance office. By this arrangement, every man in his relative grade or position would be "cutting the coat in accordance with the cloth," and once in ten years would have the proud satisfaction of seeing a whole year's income or earnings stored.

I enclose a graduated scale of income and outlay, by which listed arrangement, if every man would conform to its rules, the results would necessarily and certainly follow.

Individual exertion and individual reliance, if fostered and encouraged as they should be, would soon produce increased comfort and national wealth; but, unfortunately, grasping monopoly and aggrandisement, with aspirations for aristocratical display, is the order of the day, and will bring curses instead of blessings, if continued. Millionaires are being created at the rate of about a hundred in a-year. It being an undisputed fact that upwards of one hundred million sterling is stored or saved yearly out of a gross income or earnings of four thousand millions yearly, by a population of thirty-two and-a-half millon of persons in Great Britain, and yet this great saving only averages one-fortieth instead of one-tenth, which could be accomplished by care and prudence.

Upwards of a million paupers disgrace our country. "The poor we always shall have with us," has been been broadly said, but it does not necessarily follow that paupers and idlers shall be bred and fed by those who try to help themselves.

Scale of Salaries or Incomes, with Expenditure and Savings, regulated by a System.

Income per annum.	Outlay Yearly.					
	Rent and taxes.	General living.	Life insurance.		Savings in bank.	
£	£	£	£	s.	£	s.
52	10	36	1	0	5	0
75	15	51	1	10	7	10
100	20	68	2	0	10	0
150	30	102	3	0	15	0
200	40	136	4	0	20	0
250	50	170	5	0	25	0
300	60	204	6	0	30	0

The rent and tax being restricted to one-fifth of income.
,, general outlay ,, ,, two-thirds of ditto.
,, life insurance ,, ,, one-fiftieth of ditto.
,, savings in bank ,, ,, one-tenth of ditto.

The system or principle is equally applicable to salaries, incomes, or earnings above £300 per year, and would produce immense advantages if only adopted.—I am, &c., Wm. Austin.

17, Bristol-terrace, Bermondsey-park, S.E.,
London, February 14, 1872.

HOME COLONISATION.

Sir,—In this huge manufacturing community, fluctuations in trade are from time to time inevitable, and local distress must frequently ensue from an excess of craftsmen over the work required to be done. There is no check upon apprenticeship; a youth may choose what trade he will. As these inequalities and these concomitant distresses recur again and again, it becomes an anxious question, "how such troubles may be alleviated?" A question which, when put, will, I know, meet with the frequent and ready reply, "by emigration;" nor have I the least doubt that this is the true *dernier ressort* of over-population. But is there not yet plenty of room at home, if there were only some means of re-distributing labour, when there is, by any mischance, an excess in any locality? I am not now advocating that favourite and unreasonable scheme which is every now and then cropping up afresh, that of employing labour on intractable waste lands, but I believe it has been officially stated that "there is in this country as much cultivatable land lying waste and profitless as would employ all the unemployed in England." People labour under the delusion that emigration beyond sea, a voyage half round the world, with all its attendant expenses for passage, outfit, &c, is alone the panacea for the ills of the old country, and the true course to wealth. There is much in this notion which is fallacious; there is no special efficacy in this expatriation, unless the population of this country be absolutely too great, but, on the contrary, a loss of human power, skill, and energy to Great Britain, for it is the most vigorous and enterprising who are constantly leaving England, and an increasing proportion in the residuum population of the unhealthy and enervated; in fact, distant colonisation threatens to do for the population of this country what continuous wars did for France.

Now, the intrinsic virtue of a colony lies in this, that it withdraws surplus labour from overcrowded centres at home, and enables it to be re-aggregated in more natural and balanced proportions in America or Australia. But this balancing by re-aggregation might, I believe, for some time yet, be effected as completely, and far more economically, at home. To do this, we should ascertain, by statistical inquiry, the proportion which different employments bear to population. A capitalist thus well informed, we firmly believe, might establish a home colony which would well repay a large outlay of capital; and if a registry of workmen were instituted, we should be able to know at once where excess and deficiency of hands existed, and should doubtless be able to effect something towards its re-distribution; in fact, workmen themselves would have it within their own power to ameliorate these inequalities.—I am, &c.,

W. Cave Thomas.

February 17th, 1872.

EPPING FOREST.

Sir,—My attention has been drawn to the report in your *Journal*, of a discussion at the Society's rooms lately, on the forests of England, wherein the position of Epping Forest was rather lengthily considered. There seems to have been some misconception as to the nature of the rights over that forest, and the general position of the question.

Prior to 1863, the Commissioners of Woods and Forests, acting in the name of the Crown, and without the knowledge of Parliament, disposed of the Crown rights over more than 4,000 acres of Epping Forest, for less than £5 per acre. The result of these sales was soon apparent. Enclosures of the land over which such rights had been sold were soon made, there being then no one to prevent enclosure except the commoners, most of whom were unable, even if disposed, to resist the illegal proceedings, by instituting a costly Chancery suit. One of the forest lords, relying on the supineness and inactivity of the Crown, actually enclosed about 300 acres without purchasing the Crown rights, and that enclosure still exists. On the matter being brought before the notice of the present Chancellor of the Exchequer, he distinctly declined to take any proceedings against the offender, or to spend any money for the purpose of preserving Epping Forest. I need not ask what effect this would have upon those desirous of enclosing.

One of the speakers stated at the meeting last week, that "he wished to correct a very common notion that the public, *qua* the public, had any right whatever over them" (*i.e.*, the open spaces in and around London). He might have said more than this, namely, that lords of manors have no right to enclose commons without the consent of the commoners, or without obtaining a Parliamentary power to do so. The "public" is not recognised in law, but it is nevertheless equally true that the inhabitants of the manor or parish in which a common is situated invariably possess a right over the waste. Respecting commons within the metropolitan police district, I may state that, by the Amended Metropolitan Commons Act, recently passed, which provides for the preparation of schemes for the management and preservation of such commons, it is expressly provided that a certain number of ratepayers of the district shall have power to initiate proceedings, the only clause relating to compensation being one which says that it shall be paid for such rights, if any, as are injuriously affected by the public enjoyment of such places.

In reply to a question, Mr. Clutton said that the value of the rights of a lord of a manor was not, as stated, one-sixteenth. He then went on to say that he had recently enclosed part of a private forest, and "had got four-fifths of the value, with the consent of the commoners." Surely Mr. Clutton must be aware that this is not an answer to the question. I suppose that if the commoners, out of their regard for Mr. Clutton, had ceded the whole of the enclosure to him, he would have contended that the lords have virtually a right to the whole. Agreements are not always, nor necessarily, an equitable admeasurement of the respective rights. The annual reports of the Enclosure Commissioners would clearly show Mr. Clutton that the awards of those gentlemen, when recommending enclosures, under the Enclosure Act of 1845, invariably give to the lords of manors from one-twelfth to one-sixteenth, thus establishing our contention that a lord of a manor has not the right to deal with the waste as he thinks proper, to suit his own personal ends.—I am, &c.,

E. W. Fithian, Secretary of the
Commons Preservation Society.

ECONOMIC BOTANY.

Sir,—I have read Mr. Collins's paper "On the Study of Economic Botany" with much interest. I beg leave to supplement the portion of the paper devoted to an account of the exertions of the Indian government in cultivating and acclimatising useful plants, by a short notice of the rise and progress of tea cultivation in India.

About 40 years ago, during the administration of Lord William Bentinck, the existence of the tea plant in a wild state in the province of Assam was discovered almost simultaneously by Major Charlton, Mr. Bruce, and Colonel Jenkins, all three well known as zealous agriculturists and economic botanists in Bengal. As in many or in most other unexpected discoveries, the announcements of these gentlemen were received with great suspicion, but "tea in Assam," from being a long time "pooh-poohed," became at last a recognised fact, not, however, until an imposing deputation, headed by Dr. Wallich, had proceeded to the spot to examine and report on the disputed question. After this, the Indian government adopted effectual measures to utilise this great discovery, by opening experimental gardens at Mussoree and in Kumâon, under the superintendence of Dr. Royle, and by deputing Mr. Fortune to China, to procure tea-seeds, Chinese tea makers' implements, and information on all points connected with the cultivation and manufacture of tea. At the same time, the cultivation of the plant in Assam was entered on through private enterprise. The Indian government for many years distributed tea-seeds from China, Assam, and its own plantations in Kumâon free of charge to all persons favourably situated and disposed to experiment on their new branch of commerce and agricultural industry, so that it spread into different parts of the Himalayas, such as Kangra, the Punjab-hills, Dehra Dhoon, Darjeeling, and Chittagong, where it is now becoming a flourishing trade, as well as in Assam itself and Cachar. In this latter district the tea-plant was also found growing wild on slightly elevated spots called "Teellahs," and attaining the dimensions of small trees. So soon as the government was satisfied of the favourable result of its own experiments, and found that tea cultivation had been entered into on so many parts of its dominion, the government plantations were offered for sale, and at the present time I believe that the tea trade of India is entirely in the hands of private persons, and joint-stock companies, and this was, no doubt, the right way to act; instead of carrying on a trade with the revenues of the state in rivalry with the general public.

Mr. Collins might well have added a little more to his notice of the efforts of the Indian government in introducing the cinchona into India. It is not too much to say that it is one of the most important and beneficent acts, in the interests of the people, that a government could possibly devise. In India, where, at certain seasons of the year, thousands of the poorer people are stricken with intermittent fevers, and where hitherto quinine, from its high price, has been beyond the reach of the poor, it is impossible to over-rate the mitigation of disease and misery that will result from a full and cheap supply of the cinchona alkalide over the length and breadth of the land, and this great consummation may be reasonably looked for now, from the progress of the experiments in the Neilgherries and at Darjeeling. As in the case of tea, so with the cinchona, the government will, no doubt, withdraw from the market so soon as the commercial world is ready to take the supply into its own hands.—I am, &c.,

A. Campbell.

Farnham Royal, Slough,
Feb. 19th, 1872.

THE NEW ZEALAND FLAX.

A report of the Flax Commission, appointed to investigate the preparation and the relative value of the *Phormium* fibre, or New Zealand flax, has been printed, in which the microscopic structure and chemical composition of this plant, together with its market prices and general use, as compared with Irish flax and Russian and Manilla hemp, are set forth. It appears that there are several flax-mills at work in the colony, varying in their efficiency and the quality of the article produced; but that room yet remains for further improvements to be effected. The first duty undertaken by the commissioners was to visit the chief districts, where *Phormium* fibre is prepared, and to enquire into the different processes of manufacture. The tables of the Registrar-General had shown that, during the year 1870, there were 161 mills in operation, with an aggregate of 342 stripping machines, employing 1,450 horse-power, 1,766 persons, the produce being 4,457 tons of fibre; but several proprietors had closed their mills at the time of this commission, in consequence of the fall in the value of the fibre. The inspection by the commissioners, of the mills then actually at work, proved that throughout the colony one almost universal method of manufacture is adopted, with the view of producing fibre for rope-making. The green leaves are stripped by revolving rollers with projecting beaters, travelling at a high rate of speed, which crush the epidermis against a fixed plate so set as to allow room for the fibre to remain intact. The fibre, thus freed from the leaf of the plant, is washed by various methods, put on the ground or on lines to dry and bleach, finished by an arm or barrel-scutch, and when baled is ready for the market. No material alterations in the manufacturing processes have been made, but a more skilled labour and enlarged experience have improved the general quality of the fibre, so that it is more eagerly competed for in the London market, as approaching nearer the appearance of Manilla hemp, and is in fact capable, in the opinion of competent judges, of being so prepared as to surpass it. The chief improvement, recently introduced, is the wet-scutching, by which the fibre is cleaned and softened, although it has not always been commercially successful, for, whilst local purchasers were ready to give £3 per ton extra for the flax, the loss of fibre by formation of an excessive amount of tow, and the additional expense of labour, increased the cost from £6 to £10, so that the new process was abandoned; but, notwithstanding this, the commissioners strongly recommend it for further trial. The mills are chiefly worked by steam power, and good streams of water are also essential for the effectual washing of the fibre, which, when carefully prepared and neatly baled, fetches as much as from £17 to £21 per ton, although the ordinary price is about £15. The cutting of the flax leaves is an important point. In some fields an established, vigorous plant, in suitable soil, will yield four good leaves for manufacture every year. The leaves are usually of twelve months' growth, and vary from three to five feet long. In some parts they are greatly injured by a small "looper" caterpillar, about an inch in length, which eats quite through the fibre, in patches from a half to two inches, and a quarter of an inch broad. This insect comes to its full size, and is most numerous, in the month of December. Of the leaves, when cut, 5½ tons yield one ton of fibre. They are mostly found after two years' growth to have passed their prime, and began to decay. The green strippings of the leaf form food for the horses. Extensive areas, covered with wild *Phormium* plants, leased from the natives, with abundance of water at hand, and labour at a moderate rate, render some of the mills highly profitable. They, of course, vary in their value, and improved plans of scutching, setting, rolling, and washing, with other important points in the process, are occupying the attention of the manufacturers generally. The commissioners state that more life and enterprise in respect to the fibre industry are to be found in Canterbury than in any other province. An interesting question has been raised as to the relative durability of the *Phormium* fibre rope. It is discovered that the New Zealand white rope, when kept dry, will last longer, and wear 60 per cent. better, than tarred rope of the same material, and 34 per cent. better than Manilla hemp rope, although this last is found to be actually improved when wetted with salt water, in consequence, it is believed, of the shrinkage—equal to 5½ per cent.—which takes place, whilst the effect of the salt water on the New Zealand rope reduces its lasting qualities 34 per cent. The *Phormium* rope of Canterbury, when oiled, is proved to possess a great power of resisting wet. Plain New Zealand rope, constantly in the water in a Californian pump, was found to last not more than seven or eight days; Manilla rope would run for twenty days; but a piece of the oiled New Zealand rope did not give way till it had been 95 days in continual wear. For heavy work and running gear, the fibre has been so successfully treated, being divested of the gum and otherwise strengthened, as to become, in the estimation of many, more valuable than Russian or Manilla hemp. From samples carefully collected by the commissioners, the breaking strains of a large portion have been determined, and it is shown that the strength of the several descriptions at present exported varies from 53 to 84, with an average of 69, as compared with Manilla, which is taken as the standard at 100. On the other hand, the samples of native-dressed fibre ranged from 70 to 122, with an average of 91. In the northern and central districts, the quality of the fibre thus tested has been best, but in the south there is a marked absence now of those inferior qualities which once created an unfavourable impression in the home markets. There has been a classification of fibres, according to the manner in which they are cleaned and freed from scull, and also in reference to their colour and texture. Such terms as "mixed in colour," "harsh," "wiry," "poor colour," "green and brown," "red ends," "croppy," "coarse," "rough," "much straw," and "heeled" are of frequent use, and indicate differences in value to the extent of several pounds sterling per ton. It is also mentioned that the sisal fibre, which is obtained in Yucatan from a species of aloe, is the only kind that will compete with the *Phormium* as a substitute for Manilla. The native-dressed *Phormium* appears to be the finest, but it has been found almost impossible to obtain any large supply of it. It may be interesting to add, that there are several kinds of this peculiar fibre, differing chiefly in their colour, especially of the edges and mid-rib, and that the growth of the plant in its earlier stages is exceeding slow. It is, moreover, found that the varieties are most surely perpetuated by sub-dividing the roots. The structure and mode of growth of these roots show that a true underground stem is formed with fibrous rootlets, which stem, after a growth of several years, with a succession of leaves, bears a flower stalk, and then decays; but it also, during the period of its growth, gives off lateral buds, from which new fans proceed, acquire their own roots, and finally become independent plants, clustering together, and forming unusually large bushes. In propagating the plant, these lateral fans, as soon as rootlets have been formed, may be removed and transplanted in the same way as tubers, and will be vigorous in proportion to the amount of nutritious matter which has been accumulated in them. It is not yet certain to what extent the repeated cutting of the leaves for manufacture affects the development of the flower stalk, the increase of the root, and the formation of the new fans. And, indeed, the normal growth of this plant is a matter still surrounded with doubt. It is difficult to say what its full value may be, since maturity is not attained until after several years, so that the system of taking the leaves after two or three years' growth is no real test of its capabilities, and on this account the commissioners do not recommend its cultivation on an extensive scale, more especially as there is more than a sufficient supply of the raw material to meet a much larger demand than at present exists. Manufacturers prefer the *Phormium* that grows on high or dry ground, as it is purer, and more easily stripped than that found in swamps. There appear to be as many as 55 varieties of this plant, as distinguished by the natives, but it is believed that 20 marked varieties are all that can be accurately defined. The commissioners feel confident that *Phormium* has now acquired a permanent hold on the market at a remunerative value, and that past failures have arisen, not so much from any fault inherent to the plant, as from want of experience. It is where there have been labour at a moderate rate, abundant raw material, and water for motive power and washing, that the fibre has been produced with the largest amount of profit. In every case, minute care and constant attention are requisite for the production of the finest descriptions and qualities of the fibre. The commissioners summarise the information they have collected by referring concisely to the chief points in the manufacture of a good quality of fibre. The selection of the leaves, which should have from 14 to 20 months' growth, and their careful preparation, is a matter of prime importance. Care must also be taken that the machinery be kept clean and in perfect adjustment. The washing of the fibre, after it has been reduced to finely-divided bundles, is essential, to secure excellence of quality, but long soaking is to be avoided, as tending to make the fibre soft and cottony. The rolling is advantageous when the washing has been completed, as it consolidates and defines the bundles, and the bleaching and drying which follow should be effected with rapidity. Scutching is the next step in the process, which, where the former parts have been efficiently carried out, should be performed rather with the view of burnishing the fibre than of reducing the quantity, by the production of a large proportion of tow. The use of oil is found to improve the appearance of the fibre, and also reduces its liability to undergo further maceration in water. It is best applied as the final stage of the scutching. The animal oil used by the natives is pronounced to be the best, and superior to the application of tar, which has an action on the fibre like that of acids. With respect to the baling, wire or hoop-iron is condemned. Scrim or other light cloth is in general favour for this purpose. The use of the plantain leaves for the Manilla bale suggests that the New Zealand fibre might be economically and safely baled in coverings made from its refuse leaves. The dimensions, also, of the Manilla bale are recommended. It measures 3 ft. 3 in. by 1 ft. 8 in., by 1 ft. 8 in., and weighs about 2¼ cwt. The commissioners urge that the name "phormium" should be adopted for this New Zealand fibre, as avoiding misconception, and being more in keeping with the names applied to the other roping fibres with which it has to compete in foreign markets.

The following tables are taken from the commissioners' report:—

From April, 1870, *to May*, 1871.

	Bales.	
In five distinct qualities brought to public sale in London....	36,008	
Sea-damaged	87	
Tow..........................	1,546	
	£	s.
Total value, reckoning six bales to one ton	140,506	0
Average price	23	8

	Relative Durability and Wear.					
	Circumference before experiment.	Circumference after experiment.	No. of days run.	No. of feet run at 4,575 per hour.	No. of miles run.	Durability per cent.
Dry.	in.					
Manilla	1·43	1·25	20	915,000	173·3	100
New Zealand (white)	1·56	1·25	28	1,281,000	242·6	134
,, (tarred)	1·56	1·34	15	686,250	129·9	74
Wet.						
Manilla	1·43	1·12	22	1,006,500	190·6	110
New Zealand (white)	1·56	1·18	20	915,000	173·3	100
,, (tarred)	1·56	1·34	19	869,250	164·6	95

It is hoped that a method of preparing the fibre before shipment, that will soften and divide it sufficiently fine to make it suitable for the manufacture of textile fabrics, will be ultimately crowned with success.

THE EMERALD MINES OF MUZO.

The past history and present condition of the emerald mines of Muzo, which are situated in the State of Boyaca, four easy days' journey from the capital, derive considerable interest from the fact that, with the exception of the East Indies, the emerald can only be found at Muzo. Mr. Bunch, secretary of legation at Bogota, has obtained most of the information contained in his notice of the subject from his French colleagues, who would naturally be in communication with the French company now in possession of the mines. According to a law recently passed by the Columbian Congress, the present strict monopoly, under which these mines are held by the government, will cease in 1874, at the expiration of existing agreements, when it will be free for any one to work them.

From certain indications, apparent to persons residing upon the spot and acquainted with the country, it is evident that the mines of Muzo were known long before the discovery of America and the conquest of Granada by the Spaniards. When an expedition came in the year 1553, under the orders of Don Juan de Lancheros, to reduce the tribe called "Los Muzos" to the Spanish rule, these Indians were found to possess a large quantity of emeralds. How they worked the mines it is not easy to understand, as they had no tools of iron. It is supposed that they had found the stones in the bed of the mountain torrent, for it sometimes happens that the winter rains produce great land slides, which lay bare large veins of emeralds, the stones in which are washed out by the waters. But these gems are of a very inferior quality; they resemble those which are still found in the Indian burial places, or in the lakes into which the Indians used to throw their riches during their contests with the Spaniards. However, this may have been, the mines of Muzo were worked, soon after the arrival of the Spaniards, on a large scale, both in the open-air and by means of subterranean galleries; but about the middle of the eighteenth century the labours were abandoned, no one knows why. The old people of the district relate that their fathers used to work at the mines until the mountains vomited flames, which lasted for many years, and made it impossible to go on. This tradition resembles a fable, especially as there are no signs of a volcanic eruption near Muzo. It is, therefore, impossible to say why the labours were interrupted. Not until after the war of independence, and the expulsion of the Spaniards, were they resumed, when the Republic took possession of the mines, and let them out to individuals and to companies.

About the year 1844, a Columbian, named Paris, carried a large quantity of emeralds to Europe and the United States, many of which he sold for considerable prices. In order to disarm hostility at home, he presented to the city of Bogota various valuable objects, such as a fine bronze statue of Bolivar, cast by Tenerani, of Rome, a clock for the cathedral, instruments for the observatory, &c. He died a rich man. In 1864, a French company obtained a grant of the mines for ten years, for an annual payment of 14,700 dollars (about £3,000), together with a monopoly of all emeralds in Columbia, the government binding itself to prohibit the working of any other mines which might exist in the territory of the union. This company is now in possession of Muzo, where the works are directed by a French engineer, named Lehmann. In the opinion of this gentleman, the mountains of Muzo are rich in emeralds, the quantity hitherto extracted being almost inappreciable. The principal mine now worked is pierced in every direction by galleries made by the Spaniards. Since 1825 it has been worked in the open-air; an immense number of gems have been found, many of them of great value. After this mine shall have been exhausted, which will not be for many years, not a thousandth part of the ground containing emeralds will have been touched. This consists of a chain of mountains which extends beyond human sight. At two days' journey from Muzo, there is another mine, called "Lasquez," which was just touched by the Spaniards, and is evidently very rich. All this ground, including Lasquez, bears traces of the presence of the Spaniards; and, as the geological formation is the same in the whole neighbourhood, it is clear that the day is very far distant when these mountains shall be exhausted; in fact, they may be said to be inexhaustible.

The mountains of Muzo, like those of the whole central Cordillera of the Andes, belong to the lower formation of chalk. If the structure be observed of one of the portions now worked, the emeralds will be found in two distinct layers, the first, or upper one, composed of a calcareous bitumen, which is black and friable; the second, lower down, also of calcareous bitumen, but hard and compact. These two layers are generally separated from each other by a distance of from seventeen to twenty-two yards. In the upper layer are found the veins which yield the "nests" of emeralds, that is to say, a number of these gems massed together. But after one of these nests the vein disappears, being crossed by others of a different kind, which run in a different direction to those containing the emeralds. These latter veins are called "cenicerous," from their ash-colour. They are generally horizontal, whilst the emerald veins are perpendicular; they all run from north-east to south-west. The veins of the lower layer are more regular, and are followed for fifty or sixty yards, and even more. "Nests" of emeralds are very seldom found in them, but they are more easy of extraction. When veins of fluor-spar, well crystallised, are met with, the emerald is not far off; the presence of rock crystal is also a good sign, as likewise that of a pretty pyramidal shape, of the colour of honey, called "parisite."

The mine of Muzo is worked both by galleries and in the open air; the latter method, although more expensive, is more profitable, in consequence of the great irregularity of the veins, which are thus more easily got at. All the emeralds now extracted are sent to Paris, where they are cut, an operation which causes them to lose more or less of their size and weight, according to the degree of crystallisation and of purity. Of late years, too, this gem had obtained a fictitious value in France, on account of the colour, green being that of the Empire. They were much in demand at the Imperial court. It is impossible to determine the number of carats annually taken from the mines of Muzo. The production is very variable, depending upon the number of veins which may be found, and their richness. Whole months may pass without a single emerald being found, whilst 100,000 carats may be procured in a few days. It is also impossible to fix the mean value of the carat of emerald, as, when the stone is large, of a very dark colour, and perfectly pure, which latter condition is extremely rare, it may be worked up to about £20 sterling a carat, whilst stones of a bright colour, full of flaws, and divided into small fragments, are not worth 5s. a carat. These are called "Morallos," and have scarcely any value. There are no means of ascertaining the mean annual quantity of emeralds which has been previously or is now procured. This is the company's secret, which it preserves, from fear of the competition which will arise when it applies to government for a renewal of its lease. It is, however, estimated that, notwithstanding the expense of working, its financial condition is prosperous, and every one believes it will endeavour, in 1874, to secure that renewal. But there is no chance of the monopoly being preserved, since the present system is prejudicial to the treasury, as there are many mines which might be worked with profit, but which cannot be touched as matters stand. Without doubt, any great increase in the number of emeralds brought into the market would tend to lower that price; but it seems highly probable that English capital might hereafter be successfully employed in this branch of industry.

NOTES ON COMMERCE AND TRADE

The tenor of certain dispatches of Sir H. Parkes, our representative at Yeddo, to Earl Granville, leads to the conclusion that certain restrictions which have hitherto been placed upon trade in Japan are rapidly disappearing. The accounts from one of the consular districts gives an insight into the system under which trade has been conducted by means of guilds, and the measures that are proposed to be adopted in the future. It appears that at Osaka, the wholesale merchants in every branch of commerce are associated into what is called "Toiya Nakama," or "Toiya no Kumi," terms which may be translated "guild." The members of these guilds have certain rules for the transaction of their business, by which rates of commission, storage, and other charges are fixed, the days of business meetings, the appointment of officers of the guild, &c., are regulated. A breach of these regulations is not punishable by law, but the other merchants of the guild are usually able to bring a refractory member to submission, and they sometimes go so far as to exclude him from all business relations with themselves. Cases, however, have often occurred where a merchant with good business connections has been able to set the rules of his guild at defiance, and conduct his trade independently. Each member of the guild acts in turn as "gioji." The gioji holds office for one month in the larger guilds, and for a year in the smaller, when he is replaced by another member. The duty of the gioji is to preside over the general business of the guild, and especially its relations with the government. He is assisted by the "sodai," a permanent officer appointed by the guild, and drawing his salary from the common fund. It is part of the sodai's duty to attend regularly at the government office, and to ascertain what sales or other business may be expected, and to make a report to the members of the guild. Regular days are appointed for the buyers and sellers in each department of trade to meet here for the transaction of their business. One day is appointed for rice sales, another for silk sales, and so on. Another officer, called the "chodzake," is employed by some of the more important guilds. His duties are similar to those of the secretary of a chamber of commerce. Each "toiya nakama" had formerly its own place of meeting, generally a room in one of the principal hotels; but the Mikado's government has compelled them, since the middle of the year 1869, to hold their business meetings in a building constructed for the purpose, within the precincts of the office of the Finance Department in Nakanoshima. This step, viewed in connection with the other commercial measures of the Mikado's government, Mr. Aston thinks is highly significant, and he illustrates, in a memorandum on the commercial system of Osaka, the mode of conducting business by the following example:—A Nagasaki merchant receives advices that some article of produce is fetching a high price in the Osaka market. He accordingly prepares to send a quantity by a junk which is leaving for that port. The almost universal custom, in voyages of this length, is for the merchant to accompany his goods himself, or to send a supercargo in charge of them; for otherwise, the length of the voyage, and the numerous stoppages by the way—every Japanese junk anchoring at night—afford frequent opportunities for pilfering. The want of good postal communication between different parts of Japan is an additional reason for this practice. For short distances, a supercargo is usually dispensed with. If the Nagasaki merchant finds it inconvenient to send a supercargo in charge of his goods, he may apply to a wealthy junk owner for a "funakawase." This is a kind of policy of insurance, which takes the form of a mortgage. The mortgager transfers the goods to the mortgagee for shipment to their port of destination, and receives in return a bill of exchange on some merchant at that port for the value of the goods, or as much as the mortgagee is willing to advance upon them. If the goods arrive safely and in good condition, the bill of exchange is not presented, but it is retained as a security in case of loss or damage by shipment or other causes. At Osaka, the owner of cargo has several courses open to him. He may dispose of it by private sale to the merchant with whom he is in the habit of dealing; he may dispose of it through him to another member of the guild, in which case a commission is charged; he may entrust its sale to a broker, of whom there are large numbers in Osaka, or he may attend the public meetings of the guild with his samples, and sell it there, either in the ordinary way or by auction. At a Japanese auction sale, each bidder writes his name and bid on a slip of paper, which he puts into a box. When the bidding is over, the box is opened, and the goods declared the property of the highest bidder. Damaged goods and government property are usually disposed of in this way. To become a member of a guild, it was necessary to purchase the goodwill of the business of a merchant already belonging to the guild, and for this it was often necessary to pay a large sum. This was termed buying the "kabu." This system was abolished by the Mikado's government soon after the revolution of 1868, and the only steps at present necessary in order to enter a guild are to give notice to the government, which raises no needless difficulties, and to pay a small subscription to the general funds of the guild. The consent of the other members must also be obtained, but in most cases this is only a matter of form. The retail trade of Osaka is managed in almost the same way as in European countries. The retail dealer cannot import the wares in which he deals, nor can he make direct purchases from a foreigner; he must always buy from the "toiyas." The recognised period for which the toiyas give credit to their customers is two months, but during the last two years, credit transactions of all kind have been greatly limited, owing to the state of the currency and of the country generally. Until lately the retail branches of trade were, in many cases, subject to the kabu system, but this restriction was finally abolished, at least nominally, by a notification of the Osaka government. The kabu system is now, by law, entirely abolished in every branch of commerce. These monopolies were acquiesced in rather than maintained by the Taikun's government. Indeed they were abolished by Idsu no Kami, one of the governors of Osaka under the old *regime;* but the inherent vitality of the system caused it to spring to life again as soon he retired from office. The kabu was originally a Chinese institution, but long custom had so familiarised it to the mind of the Japanese merchant that he was unable to conceive of any other, and it was only the strong government of the Mikado, and a minister of finance imbued with European ideas upon commerce, that was able to effect its downfall.

A comparison of British and metric weights and measures is of some value as affecting international trade. Messrs. Spon have just issued a small case of scales for such comparison which will be acceptable to students, translators, and others. A strip of cardboard about one inch wide and ten inches long, is devoted to each scale. These scales are twelve in number, and bring into visible comparison inches and milimetres, feet and metres, miles and kilometres, square inches and square centimetres, square feet and square metres, cubic inches and cubic centimetres, cubic yards and cubic metres; gallons and litres, grains and grammes, ounces and grammes, pounds and kilogrammes, British tons and metric tonnes. The advantage of such scales for general purposes is evident; in converting one measure into the other, either by figuring or mental calculation on the instant, errors creep in almost unavoidably, but with the two scales brought into tangible contact, nothing is required but careful reading off; and, as the figures are large, and the divisions bold, error would be almost inconceivable. To take the first-named scale. In the upper line there are 10 inches, each divided into tenths, and again subdivided, and beneath are 254 millimetres (25 centimetres and four-tenths); this reads off with perfect ease to the 20th of an inch, or the single millimetre. In addition to this, the readings for each inch and centimetre are added in secondary lines, the initial inch and centimetre being given to nine places of decimals. Thus we have 1 in. = 25·399541132 millimetres, and 1 centimetre = ·3937079 of an inch. The other inches and centimetres are worked out to six places of decimals. In addition to this, on the back of each scale, are a comparative table of the two measures, and another of the English fractions reduced to decimals. The scales are arranged by Mr. A. L. Newdigate, M.A., who has certainly done the architectural and mechanical draughtsman, as well as students generally, considerable service by the production of these simple comparative scales.

GENERAL NOTES.

Scurvy and Diet.—The return of correspondence, &c., relating to scurvy in merchant ships, lately published by order of the House of Commons, shows that British ships are still infected with scurvy or allied maladies, resulting commonly from a poor and improper diet, more especially the absence of a due proportion of vegetable food. Her Majesty's Consul at Callao remarks that limejuice, even when issued without restriction, has failed, of itself, either to avert or arrest scurvy, a statement corroborated by the report of the Health Officer at Ascension, on the occurrence of scurvy on board the *Regent* and *Moorsfort*, when the limejuice appeared to have been issued regularly. The evidence generally represents the difficulty attendant on the regular serving out and taking the limejuice by men never very fond of it, and tends to the conclusion expressed by a shipmaster, that "the scale of provisions on board ship should be altered, so as to do away with limejuice altogether." There is reason to believe that limejuice does not quite answer the purpose intended, and that the act is little more than a "rest and be thankful" stage in the way to further change of food. The superintendent of the General Hospital at Aden states that so long as the crews of merchantmen are debarred vegetable matter for a long period, cases of scurvy must be expected to occur. And the finding of a naval court at Callao, to inquire into the causes of the breaking out of scurvy on board the *Princess Beatrice*, unanimously affirmed that the outbreak was mainly caused by the continued issue of salt provisions, and that the quantities of anti-scorbutics were totally inadequate for a long voyage. A ship is mentioned where the disease continuing to make progress, free use was made of a stock of preserved meats, fruits, and vegetables which was on board, with the effect of arresting, and in some instances curing, the disease. That scurvy is a disease of debility arising from monotony of diet, as well as its deficiency in antiscorbutic quality, is demonstrated by the case of the *Riversdale*, in which ship it appears the disease was confined to six men who joined at Calcutta for the homeward voyage, within a few days of their arrival out in another vessel, and so at once came again upon the usual sea fare, whilst the original crew of the *Riversdale* had enjoyed a three months' interval of fresh meat and vegetables during her stay in harbour. The six men were all in good health when discharged from their first ship, and were subject to the same condition on board the *Riversdale* as the rest of the crew. Dr. Dunn, of Hull (*Reindeer*), and Dr. Roe, of the British Hospital, Callao, declare that scurvy in fact is simply starvation, and the more exertion which is demanded of a man, when he cannot get nourishment for his exhausted tissues, the sooner will he die. The laziness charged by shipmasters with being a cause of scurvy is simply the want of power, induced by the lack of nourishment; and they state that the vessels which have arrived there with their crews affected by scurvy have invariably been those ships the crews of which have had but little vegetable food throughout the voyage. The secretary of the Seaman's Hospital Society points to the great reduction of numbers (100 to 40 in the years 1865-9) resorting to the *Dreadnought*, as affording valuable testimony to the advantage of recent legislation on the subject. This local proportion will probably be superior to that at other ports frequented by an inferior class of vessels, or where the matter excites less attention, and may be taken to warrant further legislative action. Masters and owners will not in all cases of their own accord lay in a sufficiency or judicious variety of suitable food. Owners know very little of the men composing the crews of their ships, and think enough has been done if the requirements of the Act are complied with. To leave the dietary scales to be settled between the owner and the crew at the time of engagement, puts the sailor at a disadvantage, who, through want, from his own indiscretion may be, is driven to reship on any terms, and before he has had time to recruit his health on shore.

The Electric Wand is a complete electrical machine, in two detachable parts. It comprises a rubber Leyden jar and a glass rod electric. The machine is a modification of the portable electric machine, invented by the patentee's late brother, Cornelius John Varley, who received for it the honorary testimonial of the Society of Arts. The chief features which distinguish the new machines are, firstly, the Leyden jar is placed on one side of the glass rod electric, and is of a peculiar construction, which prevents the charge accumulated from bursting through the sides of the jar, a very frequent occurrence with jars of ordinary construction. The whole apparatus is made of a more compact form, and the Leyden arrangement is better insulated, whilst the cost of construction is so much reduced that the new machines are produced for one-sixth of the price of its predecessor. In a convenient form, they supply the means of gaining a very good insight into the laws of static electricity. It illustrates the heating power of electricity, by igniting gas, firing electric cannon, &c., and will therefore be found highly useful in the chemist's laboratory for endiometric measurements. It illustrates, in a simple manner, the repulsion and attraction of like named and opposite named electricity. In conjunction with the apparatus are devised several experiments, which illustrate easily-varied phenomena, among them the electrical orrery and the attraction of pith balls, and the consequent repulsion, giving them an active motion, showing, in a practical manner, Grove's discovery of the correlation of forces. The force used in storing up a charge in the condenser, or Leyden jar, is reproduced by giving motion to the orrery, or causing light substances to move about with celerity. For those engaged with experiments on relative conductivity of various dielectric substances, the instrument furnishes a ready means of obtaining a charge of high tension, suitable for qualitative tests with an electrometer.

Etchings Illustrative of late Events in Paris.—No style is better adapted than etching to exhibit violent effects and noble ruins, and the *aquafortistes* of Paris of the present day have a well deserved reputation. M. Alfred Cadart has recently published a series of albums of etchings, that well deserve and will obtain popularity. In the "Souvenirs du Siége de Paris," M. Maxime Lalanne gives the aspect of the besieged city from many points of view, the ramparts, and the most important fortifications, amongst which are views of Saint Cloud, Mont Valérien, the viaduct and bridge of the Point du Jour, the gate of Versailles, the panorama of the Seine, the avenue of Boulogne, the batteries of Montmartre, and the once beautiful little lake of Auteuil in its devastated condition, with a poste of National Guards on its margin. M. Martial treats the same subject in a different manner, illustrating episodes of the siege, such as the formation of a marching battalion of National Guards, the reading of one of the rare newspapers received from the provinces at one of the bastions, the home of the carrier pigeons, the statue of Strasburg covered with flowers, flags, and wreaths of immortelles, a trench at Bondy, &c. Another album, by the same able artist, contains admirable sketches during the domination of the Commune. M. Thiers' house, the cannon of Montmartre, the black flags, La Roquette and the hostages, the gate of Neuilly, the broken Column Vendôme, the Avenue of the Grande Armée, and Paris on fire. The same artist has a third series, which represent the burning of the Tuileries, the Hôtel de Ville, and other edifices, the pretty village of Auteuil, little better than a heap of ruins, barges full of petroleum burning furiously beneath the tunnel of the Canal Saint Martin, which passes beneath the Place de la Bastille and the Column of July. M. Pierdon contributes a fine souvenir of the burnt Palace of St. Cloud; M. Desbrosses gives Paris and the outposts; and M. Yon presents a series of his clever sketches in Paris after the war. This collection of etchings certainly form one of the most valuable illustrations of the disasters of the two past years.

Excavations at Ephesus.—Letters from Ephesus say that the excavations there, which are being conducted by Mr. Wood, the English architect, for the British Museum, are being conducted with great rapidity, there being more than two hundred men engaged in the work, and that all the *savants* and connoisseurs are watching the results with intense interest.

Education in France.—The present Minister of Public Instruction in France is taking active measures to extend and improve the teaching of the modern languages in the public schools. Three inspectors-general have been appointed to carry out the views of the Minister. M. Philarète Chasles, who takes the southern districts of France, is now busy inspecting the lycées of Languedoc, as regards English and German, and it is said that the examination of the teachers is very severe. This is needed, for the acquirements of the young professors in this line are of the most modest description; and, with respect to pronunciation, as bad generally as possible. As regards the pupils, the regulations are as follows:—Those of the fourth and higher classes are to study the grammar and literature of two living languages, in a practical, not a scholastic sense; candidates for the bachelor's degree are in all cases to present a thesis or translation in German; the scholars of the lower forms are, of course, to learn the elements of the languages. M. Chasles has aided the efforts of the Minister by the publication of a pamphlet on the subject of the "Study of German in the Secondary Public Schools," in which, amongst other curious assertions and opinions, we find the following, that one may learn English, Italian, or Spanish at any age, but not German. An important association has been formed for the promotion of female education, a large number of notabilities in art, science, and literature being amongst its members and subscribers, including MM. Laboulaye, Henri Martin, the historian, Levasseur, A. Lange, all members of the Institute of France. A number of ladies are also associated with the society.

The Market Price of Modern Pictures seems to be on the increase in Paris. At a combined sale the other day, thirty-four modern pictures sold for 163,215 francs, or, on an average, nearly £200 a-piece. Amongst the works sold were Delacroix's "Ophelia," 15,500 fr.; "The Interior of an Arab Stable," by the same, 17,000 fr.; "Arab Cavalier," by Fromentin, 5,000 fr.; Hamon's pretty "Boutique à Quatre Sous," 3,100 fr.; "Baptism," by Isabey, 2,920 fr.; "The Vedette in 1796," by Meissonier, 20,100 fr.; "Animals near a Pool," by Troyon, 25,500 fr.; and the last work of poor Henri Regnault, "A Sentinel at the door of a Bascha, in Tangier," 24,000 francs. At a sale of more than two hundred pictures, given by the artists for the benefit of a painter named Anastasi, who had lost his sight, the proceeds of which amounted to nearly £5,000, some remarkable prices were attained. "Thrashing Corn in Egypt," by Gérôme, a small work, sold for 6,100 fr.; "The Fountain of Cervara," by Hébert, 4,400 fr.; "The Bullfighter," by Madrazo, 6,100 fr.; "The Introductory Letter," a charming but small work, by Stevens, 5,800 fr.; "The Tableau," by Toulmouche, 6,100 fr.; a water-colour drawing of "A Stag in Repose," by Rosa Bonheur, 3,150 fr.; a drawing of "A Scene in Whitechapel," by Gustave Doré, 1,120 fr.; and a water-colour sketch by Meissonier, 5,100 francs.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

March 6th.—"On the *Goliath* Training Ship." By Capt. Bourchier, R.N. On this evening Admiral the Right Hon. Lord Clarence Paget will preside.

March 13th.—"On the British Trade with France during the last Ten Years, in its relation to the General Trade of the United Kingdom." By Leone Levi, Esq., Professor of the Principles of Commerce and Commercial Law in King's College, London.

March 20th.—"Notes from a Diamond Tour through South Africa." By Thomas Wm. Tobin, Esq.

March 27th.—*Passion Week.*

INDIA CONFERENCE.

March 8th (Postponed from February 23rd).—"On India as a Field for Private Enterprise"—Most suitable districts; situation and approach, described separately; soils, climate, sources of labour supply, &c.; staple crops to be grown with greatest advantage; indigenous products and minerals; tabulated statement of cost of cultivation of tea, cotton, &c., and probable profit of each; indigenous timber; live stock; form of government under which the settler will live in India. The Conference will be opened by Frederick Campbell, Esq., of Assam. On this evening Sir Donald McLeod, C.B., K.C.S.I., will preside.

CANTOR LECTURES.

The Fourth Lecture, on "Mechanism," by the Rev. Arthur Rigg, M.A., was delivered on Monday evening, February 26th. The remaining lectures will be given as follows:—

SYLLABUS.

Lecture V.—Monday, 4th March, 1872.

Motions produced by Links—Cranks—Connecting Rods—Detents—Intermittent, Reciprocating and Variable Motions—Examples.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon. ....**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. Arthur Rigg, "On Mechanism."
Society of Engineers, 7½. Mr. Vaughan Pendred, "Locomotives on the Louisville and Nashville Railways."
Royal Colonial Institution, 8. Discussion on Mr. Chehon's Paper on "Manitoba."
Victoria Institute, 8. Rev. J. H. Titcomb, "Prehistoric Monotheism."
London Institution, 4. Professor Odling, "Elementary Chemistry."
Entomological, 7.
British Architects, 8.
Medical, 8.
Anthropological, 8.
Royal Institution, 2. General Monthly Meeting.

Tues. ...Civil Engineers, 8. Mr. Emerson Bainbridge, "On the Kind-Chaudron System of Sinking Shafts through Aqueous Strata without the use of Pumping Machinery."
Pathological, 8.
Zoological, 9.
Royal Institution, 3. Dr. W. Rutherford, "On the Circulatory and Nervous Systems."

Wed.....**SOCIETY OF ARTS, 8.** Capt. Bourchier, R.N., "On the *Goliath* Training Ship."
Geological, 8.
Microscopical, 8.
Pharmaceutical, 8.
Obstetrical, 8.

Thurs...Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."
Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Mr. J. G. Baker, "Revision of the Genera and Species of *Scilleæ*." 2. Dr. Masters, "On the Andiœcium in *Cochliostrina*." And other botanical notices.
Chemical, 8.
Royal Society Club, 6.
Artists and Amateurs, 8.
London Institution, 7½.

Fri.......**SOCIETY OF ARTS, 8.** India Conference. Mr. F. Campbell, "On India as a Field for Private Enterprise."
Astronomical, 8.
Royal Institution, 9. Mr. R. Leibreich, "On the Effect of certain Faults of Vision on Painting, with especial reference to Turner and Mulready."
Quekett Club, 8.

Sat.......Royal Botanic, 3¾.
Royal Institution, 3. Mr. Moncure D. Conway, "On Demonology."

Journal of the Society of Arts.

No. 1,007. Vol. XX.

FRIDAY, MARCH 8, 1872.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT MEDAL.

Mr. Henry Cole, C.B., to whom the Albert Medal of the Society was awarded last year by the Council, "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum," attended by command of his Royal Highness the Prince of Wales, President of the Society, at Marlborough-house, on Wednesday last, and had the honour of receiving the Medal from his Royal Highness's hand.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscriptions paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society.

THE COMPLETION OF THE POSTAL TELEGRAPH SYSTEM.

The Council directed the following letter on this subject to be forwarded to Mr. Gladstone :—

February 23rd, 1872.

Sir,—With reference to the memorial from the Council of the Society of Arts, dated the 22nd day of January last, transmitted to you by Lord Henry G. Lennox, M.P., their Chairman, urging on the government the completion of the postal telegraph system, by the purchase of the ocean lines, I am directed to state that the facts and reasons set forth in that memorial have hitherto, with one solitary instance, received the general assent of the Chambers of Commerce and others before whose consideration it has been brought.

I am also directed to recall to your recollection that, after the first discussion which took place in this Society on the expediency of the compulsory purchase of the inland telegraphs, the course taken by the government was to direct Mr. Scudamore to prepare a report on the whole question, and that his report was laid before Parliament, and was printed, and that it served authoritatively to inform public opinion, as well as to become the basis for legislation on this important subject.

As proceedings for the introduction of new additional ocean lines are contemplated, which are considered, by those well-informed on the subject, to be unnecessary, and which, if no steps be at once taken, will eventually have to be purchased by the public, the Council of this Society most respectfully submit to you the expediency of the like course being now taken with respect to the ocean lines of telegraph as was taken in regard to the inland lines, in order that authentic information may be afforded both to the legislature and the public, namely, by causing a like report, as early as practicable, to be made and published.

I have the honour to be, Sir,
Your obedient servant,
(Signed) P. Le Neve Foster,
Secretary.

To the Right Hon. William Ewart Gladstone, M.P.,
First Lord of the Treasury.

To this letter the Council have received the following reply :—

10, Downing-street, Whitehall, February 29th, 1872.

Sir,—Mr. Gladstone desires me to acknowledge the receipt of your letter of the 23rd inst., and to inform you that he has referred it to the Postmaster-General.

I remain your obedient servant,
(Signed) W. B. Gurdon.

P. Le Neve Foster, Esq.

The following gentlemen, members of the Council, have been appointed a Special Committee for the promotion of the measure :—Lord Henry G. Lennox, M.P., Chairman of Council; Major-General F. Eardley-Wilmot, R.A., F.R.S.; Vice-Admiral Ommanney, C.B., F.R.S.; Seymour Teulon, Vice-Chairman of Council; Andrew Cassels; Edwin Chadwick, C.B.; Hyde Clarke; Samuel Redgrave, Vice-Chairman of Council. The Committee were empowered to add to its number, and extend its influence by inviting merchants, manufacturers, men of science, and others, connected with, or taking a special interest in, the Arts, Manufactures, and Commerce of the country, to join it.

Provincial action, by local organisation and the signatures of persons connected with commercial and manufacturing establishments, has been notified as in progress in Batley, Salford, Southampton, Hull, Northallerton, Peterborough Shoreham, Dublin, Belfast, Waterford, Drogheda, and other places.

THE LIBRARY.

The following books have been presented to the Library :—

Our National Resources; and How They are Wasted. By W. Hayle. Presented by the author.

Notes on Nuisances, Drains, and Dwellings. By W. H. Penning, F.G.S. Presented by the author.

Denominational Schools; their Claims and Teaching. Presented by the National Education League.

On the Birmingham Wire Guage. Papers read by Latimer Clarke, M.Inst.C.E., at Dundee and Exeter.

Two Vols. of Cassell's Technical Manuals:—Drawings for Machinists, and Drawings for Carpenters and Joiners. Presented by Ellis A. Davidson.

Report by the Committee on Intemperance for the Lower House of Convocation of the Province of Canterbury.

Three Vols., entitled the Animal Kingdom; Right Lines in Their Right Places; and Our Food. By Ellis A. Davidson. Presented by the author.

Geology and Zoology of Abyssinia. By W. T. Blandford. Presented by the Government of India.

Memoirs of the Geological Survey of India. Sec. VI. and VII.

Records of the Geological Survey of India. Vol. IV. Part 3 and 4 for 1871. Presented by the Geological Survey of India.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

THIRTEENTH ORDINARY MEETING.

Wednesday, March 6, 1872; Admiral the Right Hon. Lord Clarence Paget, K.C.B., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Ballesteros, José Merino, 95, Alexandra-road, St. John's-wood, N.W.
Boyes, Rev. John, Frome, Somerset.
Hopkins, W. R. Innes, Grey Towers, Middlesborough.
Kemp, Dudley, 74, Old Broad-street, E.C.
Norris, Charles, 124, Wood-street, E.C.
Pyke, Alfred, 32, Ely-place, E.C.
Richards, W. H., 5, Catherine-court, Tower-hill, E.C.
Ridley, Isaac, 27, Crutched-friars, E.C.
Wade, Charles, 79, Great Tower-street, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Alexander, Robert H., 30, Lombard-street, E.C.
Arnold, Henry, 18, Philpot-lane, E.C.
Atkins, Charles, 1, Water-lane, E.C.
Carnegie, A., 16, Bishopsgate-street, E.C.
Chadwick, John Oldfield, 65, Moorgate-street, E.C.
Cox, Rowland, 3, Great Winchester-street-buildings, E.C.
Forshaw, Thomas, the Bower, Bowden, Cheshire.
Geiselbrecht, J. C., 8, Leadenhall-street, E.C., and 7, Eton-road, Haverstock-hill, N.W.
Hughes, Joseph, the Arbour Farm, Hyde, near Manchester.
Joyce, Frederick, 57, Upper Thames-street, E.C., and Waltham Abbey.
McLaurin, Peter, Langholm, Dumfriesshire.
Routledge, George Ford, 20, Cannon-street, E.C.
Sacre, Edward, 26, Parliament-street, S.W.
Turner, John Wylde, 13, Somers-place, Hyde-park-square, W.
Wadsworth, John B., Mayor of Macclesfield, Highfield-house, Macclesfield.
Walthew, John, Mayor of Stockport.
Ward, Henry, Rodbaston, Penkridge.
Waterlow, W. B. (Mayor of Reigate), High-trees, Redhill.

The paper read was:—

ON TRAINING SHIPS.

By Captain Bourchier, R.N.

Training-ships for boys are no new things; but a training-ship such as the *Goliath* may be looked upon as an experiment, inasmuch as it has been established on an entirely different footing from the others. In going into the subject of training-ships, whereby boys may be fitted for the sea service, whether in the Royal Navy or mercantile marine, I may here say a few words in reference to the very excellent establishment already in working order, observing that the *Warspite* (which was, I believe, the first one established for poor boys, or rather the association for her maintenance) has been in existence since , and an excellent work has been accomplished in her. She has a large income, derived from donations, which have been invested and supplemented by annual subscriptions; the *Goliath* is not so supported. The Royal Navy training ships have also been in existence some five years, and have accomplished much; but in these there are certain limits to age, and the boys must, before joining, come up to a certain standard, which at the present time is a very high one, and, it seems to me, much higher than is absolutely necessary to manufacture good and able seamen out of; for in my experience, as well as that of other naval officers, it does not always follow that the biggest men make the best seamen; and it seems to me that the standard might be with much advantage considerably reduced, so long as only boys were received in the Royal Navy who are healthy and strong, and free from any physical defects. There are also certain regulations with regard to the boys in the navy training-ships, such as certificates of their birth, &c., impossible for some, and difficult enough for most of them to obtain. But, as my business here to-night is to explain, so far as I can, the aims, objects, methods, and results of the *Goliath*, I will at once endeavour to describe them, observing that if I make use of any nautical expressions in connection with my subject, or that my paper becomes tedious in its details, I must ask the kind indulgence of my audience.

So far as I can learn, Mr. Goschen, when President of the Poor-law Board, finding difficulty was experienced in obtaining a satisfactory outlet for boys brought up in district and separate schools, was struck with the great advantage that would result if a ship were provided in the Thames, for the training for the sea-service of pauper boys; and, after talking the matter over with Mr. E. H. Currie, Mr. Uvedale Corbett, and others, arrangements were entered into for acquiring the *Goliath* for this purpose. I should observe here that a provision was introduced into the Metropolitan Poor (1867) Amendment Act contemplating such an arrangement as this. It was deemed desirable that the training-ship should be attached to one of the existing school districts, and as two of the unions contained in the Forest-gate School district are water-side unions, it was suggested to the managers of that district that they should undertake the management of the ship, and they willingly, I believe, assented to the proposal.

This experiment, I may say, seems to be eminently successful so far as it has gone, for it cuts off from the boys their former associations effectually enough to induce a spirit of self-respect, self-reliance, and independence in them; and it is enough to compare the generally stupid, sullen, down-cast look of the boys in the various district schools, with the bright and intelligent look on their faces after they have been on board the *Goliath* a few weeks, to be convinced that they are not only acquiring habits which will be useful to them through life, but that the most certain means are being taken for effectually depauperising them. It was intended that the training-ship should be available for boys from all the unions and parishes in the metropolis, and accordingly, at the right time, arrangements were made for receiving them. Very lately, in consequence of repeated applications from unions outside the metropolitan area to take their boys, arrangements have been made, with the approval of the Local Government Board, for admitting boys from their unions also.

I have, when visiting the large district schools, been much struck with the great difference that appears in the countenances of the boys and girls; the countenances of the latter appear bright and intelligent, while those of the former strike one as I have described, but I am not the least puzzled now as to the cause. To proceed. I had the honour of being elected Captain Superintendent by the Board of Management of the Forest-gate School District, on the last day of March, 1870, and shortly afterwards received directions from them to go to Sheerness, to superintend the fitting out of the *Goliath* as a first-class training ship; and here I must take the opportunity of stating that I consider that a large measure of the success that has attended my efforts is, under God's blessing, mainly owing to the liberality and judgment of the managers, who have refrained from, in the slightest degree, trammelling me with red tape, but still kept a very careful watch over the expenses. I may say "great success," for, from the remarks made in the visiting books, extracts from which I shall have the pleasure of reading by-and-bye, the conclusion one must come to is, that the committees deputed by the different boards of guardians to visit and inspect the ship for the purpose of looking after boys think so, or they would not have placed their highly favourable opinions on record. By being untrammelled, it must not be understood that the managers did not look after the work in progress while fitting out, or the progress of the boys since. You will, I am sure, think we had supervision enough when I tell you that for the first three months after the *Goliath* came to Grays (which she did on the 10th of November, 1870), the Ship Committee visited us weekly, and since then up to the present time they visit her every fortnight, and inspect the crew and ship closely, besides having frequently inspected her during her fitting. I received the first batch of boys on the 19th of October, 1870, at Sheerness, and many will remember that day. The steamer which brought them and a large party of the managers got ran into by a sailing vessel close to the *Goliath*, and ran some considerable risk of being sunk. It blew a gale of wind; the cooking arrangements were far from complete, and the boys' dinners for that day had to be cooked at the Naval Barracks, and brought off by a small steam pinnace, thanks to the superintendent of the dockyard.

The aims of this institution are several, which may really all be brought under one head, viz., "Train up a child in the way he should go," &c. The more immediate object of this not yet sufficiently large establishment is to train boys up to the sea-service, either in the Royal Navy or mercantile marine; but if a boy shows more predilection for some other walk in life than that of a sailor, his training includes other matters, such as music, so that he can get a good living as a bandsman either in the army or navy. Again, we train boys as tailors, who would perhaps, from the high standard required by the rules of the Royal Navy, or from some physical disqualification, be prevented from entering that service; also carpenters, page-boys, blacksmiths, shoemakers, stokers, &c. All these boys take their turn in seamanship and school instruction, as I have ever found the labouring artisan considered a much handier man when, added to his knowledge of a trade, he has some practical seamanship at his finger ends, even if it is only how to make the end of a rope fast, hold on by his hands, or manage a boat, &c.

On the System of Training Boys on Board the "Goliath."

In order to explain this, I had better take a new boy, and describe what is done with him on his first stepping out of the boat into the ship. He comes up the gangway-ladder, and finds himself on the main deck, when, if it is during the working hours, he hears a low buzz of conversation mingled with the voices of the different officers at work with their classes. He stares about him, perfectly bewildered at first, never, probably, having seen a ship as this before. Perhaps he sees some old schoolmate, and a smile of recognition passes between them. After his name has been called from the paper or admit-note which the officer in charge of him brings, he is taken to the sick bay, to be examined by the doctor. Having passed, he has a flannel shirt put on, goes outside the door, where he finds an elderly officer ready for him, the master tailor, who puts him into his sailor's dress, which, from the degrading looking dress that our paupers are generally clad in, transforms him at once into a considerably better-looking little fellow. I say puts him in his sailor's dress advisedly, for it generally has to be literally done, as the boys, as a rule, have no idea of dressing themselves; and I have noticed that, in taking off their trousers, they never think of unbuttoning them, but slip them off their legs without.

After being dressed and allowed to find his way about a little, the boy is taken to the chief officer, who furnishes him with a card, which shews him his number on the ship's books, on watch bill, mess, station at fire-quarters, &c. I have known many boys when they first came on board to be very dull and discontented, but they get over that in a short time; they find everyone is kind to them, the food is so much better than they have been accustomed to, the clothing warmer, the boat-rowing, going aloft, climbing and crawling about in the rigging, which they are allowed to do in their own way during their play hours, the fun and games that they can join in, all more of a manly tendency than those they had at their schools, and, above all, the varied occupation, which more than anything serves to awaken and brighten the dull, stupid look that generally pervades these boys when they first come, makes them so fond of the life they lead on board that, although they are repeatedly asked by their guardians, who come down to visit the ship from time to time to see the boys whom they have placed here, whether they would like to go back, the answer is invariably "No, Sir." The necessity of being enabled to get their own living is constantly placed before them, and makes them anxious to leave the ship for situations, either at sea or on shore; but they never manifest the slightest disposition, even after punishment, to go back from whence they came. This says much for the manner in which the work and discipline are carried out by the officers on board. While on this subject, I may relate an incident which shows the confidence and trust the boys place in their officers. The master tailor, who is, by the way, an old seaman of very high character, was chatting to his boys in his shop, and scolding some who had been rather too reckless in climbing about outside the ship; while doing so, he said "Some of you boys will fall overboard and be drowned if you are not a little more careful." One of them observed to another, who was sitting near him, not intending it to be overheard, "No fear of any of us boys being drowned while any of the officers are about." It should be observed here that we have had several boys fall overboard at different times, but all saved by officers jumping over after them. One of the officers, I am proud to say, has been awarded the Royal Humane Silver Medal for a very gallant act of this description.

On Drill and Gymnastic Exercises, with the view of Developing the somewhat stunted Stature of the Boys.

During the summer, and whenever the weather is suitable, the boys are exercised aloft, and constantly in the boats; but as it frequently occurs that the weather is too severe in winter to send these little fellows up, I have had stout ropes fitted, to go fore and aft under the beams between decks, so that no opportunity may be lost of going through a series of gymnastic exercises, on the decks as well as on these ropes, and many of them have shown such aptitude, and become so strong in the arms, that they are enabled from practice to go twice along the ropes by their hands, without once putting their feet to the deck, the distance being 140 feet. It may be easily imagined how much this healthy exercise developes and strengthens the muscles of their arms and upper portions of their frames. This is much assisted by the extension motion drill, and I find it causes the boys, with other helps, to grow in a most surprising manner.

Many Trades may be Taught besides a Sailor's Profession.

It does not follow because a man or boy earns his livelihood on board a ship he must necessarily be a sailor. There are many men in a man-of-war who are not sailors; I may mention marines, stokers, blacksmiths, tailors, shoemakers, tinsmiths, writers, brushmakers, musicians, sailmakers, and ropemakers.

All these trades and some others may be taught on board a training ship; and in addition to a knowledge of any of these trades, it is a very useful thing for a boy to know how to manage a boat, to row, steer, to make all the knots, bends, and hitches, to strop a block, clap on a seizing, use a parbuckle, sling a cask, and furl a royal or topgallant sail, and the thousand-and-one things any lad may learn almost imperceptibly, in addition to any trade he selects or is found suitable for, without going to sea; and I suppose no labouring men are so handy in our colonies as those who have been trained as sailors, and have afterwards emigrated.

In the *Goliath*, our tailor boys make the boys' clothes, our shoemaker boys repair their boots, our boys make our own brushes; we have stoker and blacksmith's boys, &c. The boys repair our sails, make their own mattrasses, wash and mend their own clothes, clean the ship, and in short do everything that is possible to do on board.

I have some boys in training as office-boys, whose writing is first-rate, are well up in arithmetic, and of course belong to the 1st class in school, and some up in the 2nd class in seamanship.

Band and Singing Instruction—Tonic Solfa.

With regard to this subject, one that I am especially interested in, considering as I do that music and singing so much tend to humanising, &c., I may say that I have a hundred and twenty boys under musical instruction, divided into four bands, viz.:—1st, 2nd, 3rd classes, also drum and fife band. The 3rd class is a feeder to the 2nd, and the 2nd to the 1st; and all boys under musical instruction are taught to play from notes. The first-class band wear a handsome uniform, which I find a great stimulant to the other bands. They are taught by an accomplished band-master, who takes the greatest interest in them. All these boys have their turn at seamanship and school, as well as musical instruction. I wish I had the opportunity of letting you hear how well the first-class band can play, although so many of them have been placed out in the two services since November 5th, 1871.

I have 160 singers, 80 treble and 80 seconds, who are taught by Mr. Fenn, the head schoolmaster. That gentleman understands the art of teaching in an eminent degree. Some here have, I believe, heard the boys sing on board, and will be able to give their opinion as to their proficiency. These boys also have their turn at seamanship and school. The instruction in singing is generally given in the evening, so as not to interfere with the other instruction.

Character of the Boys.

When they first settled down in the ship, I found they were the most destructive young urchins that one could possibly have to deal with. Anything movable that it was possible to destroy they destroyed, and tried to do so with many things that were immovable; but I soon found out, by careful watching and studying their characters, that really it was not so much the love of mischief as misapplied energy; and by a careful direction of their thoughts, and by a proper management of their time, I soon found out that the force or energy formerly misapplied could be directed into useful channels. By the kindness and liberality of the managers, I was enabled to give prizes of pennies and halfpennies every week as certain rewards, which we term "good conduct money." These were given to the two boys who had kept themselves clean, and their clothes in the best order, during the week, and the boy who kept his musical instrument cleanest. By these means, and by punishing boys who were reported to me at 9 a.m. before all the rest of the boys, they soon found that they were happier when employed in play in their play-time than in mischief. I find there is little pilfering now in the ship; and although now nothing but a glass pane separates the issue storeroom from the boys, night and day, with loaves of bread, cheese, butter, sugar, &c., always in full sight, no attempt has ever been made to break into this storeroom. Another pleasant thing—I find little inclination to bully. They are, as a rule, kind to each other, the big boys invariably helping the little ones; and it is a pleasant sight indeed to see them on a Sunday morning, while waiting for the time for divisions and church, everything ready, walking round and round the decks, or up and down the forecastle, with their arms over each other's shoulders, while the busy hum of conversation goes on uninterruptedly, except now and then by the bugle sounding the notes for still or silence, when one of the officers gives some order, at the end of which the bugle sounds a single short note, signifying "go on." The effect of these notes is almost magical; in a second, at a certain sound of the bugle, every boy stands perfectly still, in an attentive posture, and remains so for some seconds, during which time an order is given by an officer in a loud, clear, and distinct voice, which is immediately followed by the short note I described just now, when the walking or other occupation of the boys go on as if they had never been interrupted. I find, as a rule, the boys are easily managed; kindness, not harshness, does best. Stopping a boy from going into a boat in the summer-time is a severe punishment. Offenders are dealt with every morning before the other boys, and the fact of standing out, and the serious tone always necessarily assumed in the investigation, is of itself no light matter; and I have known many of the boys who would rather have a thrashing quietly than be stood out from the hollow square in which the boys are formed every morning to hear the morning prayers read.

On the Subject of Rewards and Punishments.

I found much difficulty, when boys first came into the ship, in teaching them to keep themselves clean, but, through the liberality and kindness of the managers, I have been able to get over this difficulty by establishing a system of rewards, which consist of ratings somewhat similar to a man-of-war. I have now forty first-class petty officers, and thirty-nine second-class petty officers, who are paid every Saturday respectively 1d. and ½d. These petty officers are selected from the leading and best boys of the ship, and they have charge, under the officers, of certain parts of the ships, such as mates of decks, captains of tops, coxswains of boat; second-class petty officers are captains of messes, and other inferior ratings. These petty officers think it no light punishment to be disrated. We have five divisions, and an officer in charge of each. Another excellent reward, I find, is to give a large plum cake between the boys of one mess on each side of the lower deck that has had the cleanest mess through the week. I have a slate hung up on the lower deck, on which the officer in charge at meals puts down the times at which the divisions are reported cleared up by the captains; this creates some emulation, and serves to make the boys quick and smart, instead of dawdling. Our punishments are very trifling, one stripe is generally sufficient for most offences; cases of theft with stripes by birch, six having hitherto been the utmost that it has been necessary to inflict, which have been very rare indeed. It is perfectly understood among my officers, who are shrewd and very acute men, that preventive discipline, or, in other words, teaching a boy how to do right, is better than waiting until he has done wrong, and then report him for misconduct.

On the 7th of October, 1871, I had the pleasure of receiving on board a large number of visitors to see the distribution of prizes. This is a printed list, with the parishes to which the recipients of the prizes belonged. I studiously avoided, in selecting the boys for prizes, knowing to which parish they belonged, as I did not wish to raise any jealousy, or create any ill-feeling on that score. After the prize day, the names of the parishes were ascertained and this list printed, which I now beg to hand round for inspection.

Cooking and Dietary.

The cooking apparatus is very complete, and, although in a small space, amply answers all the requirements for 500 boys, besides officers. A great portion of our cooking is done by steam, and I find, from a system I have pursued, that little or no steam is wasted, waste steam being utilised for other purposes, such as warming the baths in very cold weather, &c. The dietary scale is a fairly liberal one, without waste, the boys getting meat every day. I have the pleasure of handing round copies of the dietary scale, which will give the fullest information on that point. Certain of the boys are selected every month, when the special duty boys are told off to assist in the cooking. I have one officer who superintends the boys doing the greater part, and two boys are always in training as ships' cooks. The test of being fit to go to sea as a cook in a merchant ship is, that the lad must have cooked the boys' dinners for one week, as well as the officers', without assistance from the head cook. The lowest range of boys' wages in going to sea is 10s. per month. I have sent some to sea at £1 to £1 5s. per month, and I sent one boy into a fine ship of 2,000 tons, some time ago, as a ship's cook, at 50s. per month. I may add here, that the dietary scale is the result of a twelvemonth's careful experimentalising. I could mention much of the alterations and changes made in the dietary during that time, but it would occupy too long.

Clothing.

I found a good deal of difficulty in making the boys keep their clothes in proper order, as they have been unfortunately accustomed, in the unions and district schools from whence they come, to be waited on a good deal. Their clothes have hitherto been repaired for them, and as this establishment is intended to be self-supporting. to a certain extent, it is necessary that the boys should be taught to mend them, put patches on where they are worn, &c. The plan I adopt when the boys join is, to give them one suit of clothes, besides an extra shirt and flannel, and they do not get the whole of their kit until they have been a month in the ship, or I find they are capable of taking care of their clothes. When a boy finds he gets no new clothes until he has learnt to mend those he has given to him, he becomes careful and tidy. On Saturday forenoon, every boy who has ragged clothes is obliged to go on the lower deck in his mess, and needles, thread, and patches are given him to mend with; the boys also darn their stockings. Every boy, when his kit is complete, has two serge frocks, two check shirts, two flannels, one pair of blue cloth trousers, one pair of serge trousers, one sailor's white frock, two pairs of white duck trousers, two white jumpers or frocks, two caps, and one pair of shoes, one comforter, one alpaca necktie, and two pairs of socks or stockings. It is necessary that the boys should have so large a kit as this, first, to give them a shift of clothing when they get wet, as they often do, and also, by giving them something to take care of, to educate them in the idea of having some personal property. This excites, to a great extent, their self-respect. I have had several boys who it seemed nothing would induce to keep their clothes mended. I caused the worst of these boys to be clothed in a biscuit-bag suit, a coarse sort of gunny bag, tied round the waist, forming a sort of petticoat and jacket all in one; this, and taking way his Sunday blue cloth trousers and serge frock, had the desired effect; it made a complete change in him.

On the Lighting, Warming, and Ventilation.

The *Goliath*, owing to the foresight and liberality of the managers, (which proved to be in the end real economy) during the time the ship was fitting at Sheerness, is probably more completely and better fitted for the service she is engaged in than any other training ship in the world. It is a great thing to say, but the system of hot-water pipes for warming the ship and drying the clothes is the cause of the greatest comfort to these boys, and promotes the efficiency of their training as well as contributing to their health and growth, in a manner almost impossible for one to describe.

It is well known, not only throughout the naval service, but I believe everywhere else, that dry ships and dry houses contribute materially to the health and cleanliness of individuals, and I find it operates in a most eminent manner. These boys have grown amazingly, some of them no less than four inches in height, and 2¾ inches in circumference of chest, since they have been in the ship, a period of time for some of them under a twelvemonth. The ventilation is very perfect, and although only one blanket is allowed to each boy in the winter, yet such is the warmth, that the thermometer, of which a careful register is kept three times every night in three different parts of the deck, on which over 300 boys sleep, it has never, even with the ports open, in the severest nights gone below 47°. Yet, in the summer as well as in the winter, the air during the night is as pure and wholesome as can well be conceived. The blankets are folded neatly over the boys' hammocks, and are thereby exposed to the air the whole of the day, which thoroughly ventilates them, instead of being lashed up and stowed in the nettings, as they are in a man-of-war.

The plan of ventilation for the orlop deck is very complete. Six large ports have been cut through the ship's side on this deck, but the wind is stopped from blowing directly in on the hammocks by glass sashes, hung on hinges placed on the inner side of the vessel, and is conducted by a wooden trunk on to the deck underneath the hammock, finding its way up the enormous hatchways the ship has been fitted with. In the summer, a wooden shaft, some four feet square, running from the forecastle down to this deck, and fitted with a movable iron ventilating cowl, forms a sort of windsail, about 40 feet long, and conveys a very large quantity of pure air on to this deck. The glass sashes are triced up during the day, and the air is thus conveyed at once to the beds and blankets.

Records of Progress, and Plan of Seamanship and School Classes.

The plan I adopt seems at first very elaborate, but on examination is found very simple.

The head schoolmaster and chief seaman instructor has each his book kept of school and seamanship classes. I find it answers very well to have the same number of classes in school as at seamanship, viz., five in number. Examinations take place about once a-month, when boys are promoted, according to their capacity and knowledge, from one class to the other. Quick and frequent promotions prevents them getting sluggish. Each officer keeps a divisional list of the boys under his charge, which boys are divided into two watches, starboard and port. This list shows the number the boy receives when he joins the ship, which is also stamped on his clothes; it shows which class he is in, in school, seamanship, and band, the trade that he works at on board, whether tailor, shoemaker, painter, or blacksmith; it also shows which boat and mess he belongs to. Thus, any officer sees at a glance, not only the qualifications of each boy, but also the special duties assigned to him.

A "Record of Progress Book" is kept in my office, with a page devoted to each boy, in which is noted his number on the ship's books, his name in full, height, weight, and circumference of chest, when he joined and when he left. Therein is also noted, from time to time, the marks he gets in the various seamanship instructions in school, also for swimming, signalling, and for special subjects, such as geography, history, &c., and elementary navigation. The marks never rise higher than 4, and their meaning is, 4, "V. G."; 3, "G."; 2, "F."; 1, "Indifferent." A record board is placed on the main deck, and is an exact copy of the record book, so that any boy can tell at a glance his value at the last examination he passed.

Without going into the details of the different instructions conveyed to the boys in each class in school and seamanship, which will be better shown in these papers, I may say that the boys are divided into two watches, starboard and port; one watch goes to school in the forenoon, and the other to seamanship instruction; and the watch that was at school in the forenoon goes to seamanship instruction in the afternoon.

On the Executive and Other Staff.

The staff attached to the *Goliath* consists of a captain, superintendent, chaplain, doctor, and other officers of the following ranks, viz.:—

Considering the class from which the majority of the officers come, that of petty officer in Her Majesty's Navy, I am proud to say that I have never yet had a case of intemperance; and to show the care with which they watch over the morals of the boys under their care, and considering the former associations of many of them, it is particularly gratifying to me to know I have never heard a profane or obscene word fall from one of these boys. This, I consider, is not the least advantage of the training they have here, for it should be remembered I have boys not only sent from the district school, but many of them, directly they go from the streets to the unions, are sent to me, and I find that when there are any turbulent boys at some of the schools, it is said, "Oh, send them to the *Goliath*." I confess I have no objection to this sort of boys, for there is generally something in them, and I rarely have any difficulty in dealing with them, finding always some good in every boy.

Returns from Officers, of Instructions given by Officers, and Work Done by Trades on Board.

The "returns" I have adopted, as showing the number of boys under instruction in each class, are very simple, yet comprehensive, inasmuch as I can not only get a total of the number of boys employed in every instruction during the week, but they also give me the exact number employed in each class forenoon and afternoon of each day; they also show me the number of carpenter boys, tailor boys, shoemaker boys, &c., employed on each day; and in addition to this, I receive a weekly report from the master-tailor, carpenter, and shoemaker, of the work done by each boy under them; and with reference to the master-tailor, the exact number of garments each of his boys makes. In order that these carpenter, tailor, shoemaker, and other boys, such as servants, &c., should not lose their seamanship and school-instruction, it is a rule that they shall be selected from the first and second classes in school, and shall have each alternative day, according to their watch, at seamanship and school. I find this prevents anything like monotony of instruction, and the boys consequently learn at a rate that really surprises me. These are some of the returns which have been made to me, selected at random from a number I have.

On the Financial Matters and Depauperisation of the Boys.

There is much to be said on this subject, but the time has hardly yet arrived when positive conclusions can be drawn. I may say, though, that I think I see my way clearly to the cost eventually not exceeding 6s. per week per boy. I have no doubt in my own mind that if the system as followed out on board the *Goliath* be enlarged, by having additional training-ships attached to her, and by throwing open this establishment to the parishes and unions of other places besides the metropolis, boys can be clothed, fed, educated, and trained (in such a manner as will entirely and effectually prevent them from ever being a burden again on the country as paupers) for something less than 5s. 6d. per week per boy, probably 5s. It is remarkable how much the habits of self-reliance, independence, and self-respect have been brought out by the education they receive in training-ships generally.

On the Necessity of having a Cottage Hospital or Sanitarium on Shore, belonging to the Ship.

It is very necessary, with so large a number of boys as we have, that we should be able at once to isolate any cases of fever or small-pox that may happen to break out; and as it is almost impossible thoroughly to do so in keeping the boys on board, the managers are about to make arrangements, by having a house, at a long lease, as a sort of cottage hospital. For that purpose, a couple of acres of ground attached to the house, which is very close to the ship, will serve as a play-ground, which is much required, to break the monotony of always living on board.

On the Necessity of having a Tender, for the purpose of Teaching the Boys Practical Seamanship, as regards Working a Vessel under Sail, thereby increasing the value of them to the Sea service.

The Board of Management have very wisely purchased a small brigantine, of about 84 tons, which, when fitted out, will answer two purposes, viz., (1) supplying the ship with fresh water (of which our consumption is very great) and carrying our stores from London; and (2) of teaching the more advanced boys that branch of practical seamanship which they cannot learn in a stationary vessel, that is, working a ship under sail. She will make short voyages to Sheerness for water every week, and consequently, when a boy has been in her for two or three months, with the training he has previously obtained in the big ship, he will be quite competent to go to sea as a useful ordinary seaman in the merchant service. I suppose there is no river in the world so well calculated to bring out a seaman's qualities as the river Thames, for in beating up and down that river it requires quickness of eye, activity of body, and clearness of brain, as I know from practical experience, having once belonged as a youngster to a small ship that carried stores from one dockyard to another, and when we always sailed.

On the necessity of having one or more Tenders, such as Frigates or other vessels, with a view of Increasing or Enlarging the System of Training, without materially increasing the Staff, thereby Economising the Expenses.

The best arguments I can bring forward in support of this plan are taken from a leading article in the *Times*, of the 11th October, 1871, which, if you will allow me, I shall quote:—

"The Board of Management for the Forest-gate

School District deserve public gratitude for a very suggestive experiment in the treatment of pauper children. It is too notorious that the contagion of pauperism is deeply seated in certain places and certain classes, and that it has a dangerous tendency to become hereditary. Especially disheartening has been the experience of metropolitan schools for the children of paupers. An exorbitant expenditure has resulted only in a few partial and temporary successes, disastrous failure being the general rule. The school-trained child of pauper parents might remain intelligent and industrious while at school, but, surrounded by associations of ignorance and idleness, he has been rarely found to escape the dangers of his situation when freed from control, and sent out to battle by himself in the world. Upon the constitution of the Forest-gate school district by the union of three East-end parishes, it was incumbent on the Board of Management to provide new schools. The outlay on school buildings would be of necessity large, and in all probability, for the reasons above-mentioned, would give no satisfactory return in a reduction of the ranks of pauperism. Fortunately, a plan suggested itself which seemed more hopeful than any former effort. If a training ship of considerable size could be obtained, placed under able management, and manned with the pauper children, the expense, it was argued, might be lessened. This, however, was a secondary consideration. What was far more important was the isolation from demoralising influences which would be secured by the employment of such a vessel for the purposes of an industrial school. It was obvious, too, that on board ship discipline could be enforced with far greater rigidity than in any school on shore; instruction in the ordinary educational elements could be combined more easily with practical training of every kind; wasted energy and capacity be diverted more successfully to useful purposes; and last, not least, a great national want be in part supplied. The Admiralty, we must do it the justice to say, perceived the economical and philanthropic merits of the plan proposed by the Board of Management, and handed over to it a fine wooden man-of-war, the *Goliath*, of eighty-four guns, rendered powerless by the progress of modern naval construction. The *Goliath* was fitted up at the cost of the ratepayers, a superintendent was chosen, and the vessel was stationed off Gravesend, nearly a twelvemonth ago. In our outer sheet may be read an account of the visit of the Government Inspectors, the Board of Management, and others interested in the scheme to the vessel on Saturday last, and a summary of the results obtained. It will be acknowledged, we think, that the adventure has so far been successful, and that it may possibly be made to assume much wider dimensions. . . . The course of instruction adopted does, in effect, make sailors of many among the boys. . . . Thus, besides the regular supply of trained sailor boys who may be expected to take to the Navy. . . . there will be a considerable residue brought up to steady habits of work on shore, to skilled labour and occupations which ought to secure them in after-life a decent subsistence, and a position far above the slough of helpless and hopeless poverty in which they were born.

"Thus in every way the substitution of training ships for pauper schools is a change for the better. The ratepayers find the burden lessened, while a number of unfortunate children, who would otherwise be socially lost, are draughted permanently out of the ranks of pauperism. The State gains a sorely-needed source of supply, which for a long time, unfortunately, can be in no danger of running short, for its naval service. We are complaining that the merchant service in these days is ceasing to be a nursery of seamen, and the difficulty of manning the navy has presented itself more than once lately in a perplexing fashion. Does not the experiment tried by the Forest-gate Board of Management point out a solution of the difficulty? We have a splendid wooden-built fleet, which, despite Admiral Rous's protests, will hardly be again called in use for the purpose of actual war. Why should not some score of our idle line-of-battle ships and frigates be spared to supply the places of unsuccessful pauper schools on shore? The ratepayers, being relieved from the cost of erecting school buildings, could well afford to organise an efficient administrative staff; or, if it was thought that the tact and thoughtfulness shown by the Forest-gate Board could not always be found, the control of these school ships might be placed under the direct charge of the Local Government Board, the ratepayers contributing to their support in proportion to the number of children from each district. In the case of the *Goliath* the parishes which have made the fortunate and meritorious venture have not a sufficient number of pauper children of their own to fill the ship, and it is a significant fact, indicating the remunerative nature of the scheme, that boys from other parishes are received on board, trained, maintained, and clothed for less than £17 a-year. The attempt to grapple with the problem of pauperism in this novel way has an interest not only for parochial ratepayers and for statesmen, who look to our "first line of defence" with anxiety, but for philanthropists, economists, and sanitary inquirers. We hear loud complaints about degeneracy of race in England, and the complaints are too painfully confirmed by the low physical types to be met with in our crowded cities. It becomes, then, no trifling matter to discover a way by which this fatal tendency may in part be stayed. We are told, and we can well believe, that the training supplied on board the *Goliath*—education not only in books, but in work—transforms with astonishing rapidity and completeness even the facial and bodily characteristics of the street Arabs who have the good fortune to be drafted to the school ship of Gravesend. Dull eyes brighten, narrow chests expand, stunted figures erect themselves, and the mental and moral nature partakes of the healthy change. In this metamorphosis we have a promise for the future. An addition of energy to the national race, the rescue of thousands from a life of squalor and dependence—these are gains worth purchasing at a higher price than a few out-of-date wooden men-of-war."

These supplementary training-ships, by being moored near each other in a part of the River Thames, at Grays, out of the navigation of the river, may be supervised by one superintendent. So far as their internal economy is concerned, one medical man; one chaplain, so far as spiritual instruction; and one head schoolmaster. One bath for swimming; one cottage hospital; one playground for landing; one garden for vegetables, &c.

The experiment initiated by Mr. Goschen has proved so far such a complete success, that it only now remains to enlarge it, by increasing the number of boys, which may be done by throwing open the entry, not only to the outlying metropolitan unions, but also to the Midland and other county parishes that have no sea-board, or that are situated at a distance from the rivers. They might send their boys to the *Goliath* under the same condition that the metropolitan parishes do, and there would be no difficulty in training 2,000 or 3,000 boys. Under the same system pursued on board the *Goliath*, and which has been found successful, other vessels similar to this ship, which are now lying useless at our naval seaports, might thus be utilised, and placed under the same board of management. These ships could be moored close to the *Goliath*, and all the boys sent first to her. After having been in her a certain time, they could be drafted to these other vessels, under a deputy-superintendent, &c. The *Goliath* could thus form, so to speak, the nursery to the other ships, whose crews would consist of more advanced and older boys, from which boys for sea, &c., could be selected.

Suppose four ships, sent by the Admiralty, similar to the *Goliath*, to be fitted up as training-ships, under the supervision and management of the Board, which has brought the *Goliath* to her present efficient state in the short space of eighteen months. They may be made to accommodate 500 boys each, and if the plan of taking boys from all or any of the counties were to be adopted, no doubt they would be soon filled up. The total number would, I am satisfied, be better fed, better educated, better clothed, and rendered more fit for the battle of life, and at a cheaper rate than they possibly could be in either their district schools or workhouses; while the certainty of depauperising these lads is in itself a grand thing. I have no doubt in my own mind that such a scheme, on the scale I describe, could be carried out by adopting the system pursued on board the *Goliath*, and the expenses, after deducting the first cost of fitting the ships out, would be less than five shillings per week per boy. The way in which the lads who had been under training in the *Goliath* grow is so remarkable, that, at the risk of my paper being thought tedious, I cannot help quoting an extract taken from a published report of Dr. Liddle, Medical Officer of the Whitechapel district:—

"In September last, I availed myself of the opportunity which was kindly afforded me to visit the training ship, *Goliath*, which is moored off Grays, Essex, where I saw the most striking benefits resulting from fresh air, good food, regular exercise, personal cleanliness, and cheerful industry, in the boys who are taken from the Forest-gate Industrial School, and who are in the course of training for Her Majesty's navy. These boys are the children of pauper parents, and were received into the industrial school at Forest-gate from some of the crowded and badly-ventilated courts of the Whitechapel district. The increase in the height, weight, and breadth of chest in the boys is most remarkable. If this improvement in the physical condition of the boys were the only benefit obtained by their living on board ship, and being subjected to the discipline necessary for fitting them for useful service, it would indeed be most valuable; but on observing the countenances of the boys, I found that they had lost the usual peculiar expression of features so common to that class from which the boys are taken, and instead of the downcast and sullen look, there was observable an expression of intelligence and cheerfulness, and I was informed that habits of self-respect are soon developed in each of them.

"Owing to the sanitary and other arrangements, the sick list is exceedingly small, averaging only one per cent., and out of 400 boys in a ship of 2,596 tons, where a good deal of hard work in all kinds of weather must be performed, only two or three cases of catarrh occurred during the last winter, which, as may be recollected, was a severe one.

"The following are the particulars respecting the physical condition of 18 of the boys when admitted, and their condition at the time of my visit:—

	When Admitted.				Present Time.†		
No.	Date.	Height.	Weight.	Chest.	Height.	Weight	Chest.
		ft. in.	lbs.	inches	ft. in.	lbs.	inches
1	Oct. 19th, 1870.....	4 6	73	27	4 9½	90	29½
2	" "	4 6½	83	27	4 10	94	29
3	" "	4 9	77	29½	4 11¼	89	30
4	" "	4 4	60	25	4 6	68	26
5	" "	4 5½	74	30¼	4 8¾	89	31
6	Dec. 7th, "	5 1	92	27½	5 3¼	97	29½
7	" 9th, "	4 9	78	28	4 10	86½	29
8	" 20th, "	4 10¼	97½	29	5 0½	104	30½
9	" " "	4 9	87	29¾	4 11¾	91	29¼
10	April 13th, 1871......	4 6¾	73	26	4 8	75	27¼
11	" " "	4 9½	87	27	4 11	89	28¼
12*	Jan. 25th, "	4 8	59	27	4 11½	107	31
13	" " "	4 7½	71	27	4 9½	86	28
14	Feb. 22nd, "	4 9½	88	27½	4 11	92	29
15	" " "	4 8½	83	27½	4 10¼	88	28¼
16	March 1st, "	4 4¼	75	26	4 6	78	27½
17	" 8th, "	4 7	77	28	4 8	84	29
18	April 17th, "	4 4½	75	27	4 6	82	28½

* Cook's Mate. † September, 1871.

"In referring to the rapid growth of the boys, the Captain mentions other instances than those above recorded. Thus, one boy grew two inches in seven months, and his chest increased in proportion, so much so that he was enabled to pass the standard required for boys entering the navy. Another boy increased in height no less than 2½ inches in eight months, and his chest also increased in proportion. Similar remarks will apply to many other of the boys."

This remarkable development I attribute to three causes. 1st. Improved food in quantity—more meat, plenty of fresh air, pure ventilation in their sleeping decks, and last, but not least, plenty of exercise and really hard work. When I tell you that the whole of the work of that large ship (2,596 tons) is done entirely by those young children, whose ages are between eight years and fifteen years, and that no man puts his hand to a single thing on board, except as a matter of instruction, you will be surprised, for keeping her clean is no small matter in itself, but that part of it is so well organised that all the cleaning is done before 8·30 a.m. in summer, and the remainder of the day is devoted to instruction of various kinds. The clothing is made on board, the boots are repaired on board, and in short, beyond going to sea, everything goes on much in the same manner as on board a man-of-war, always bearing in mind that we have children to do the work—not men. That the boys like the life is evident, for many guardians who have visited the ship have taken the boys on one side, and pressed them as to whether they would like to go back, but I have only known one or two instances of such a case, and those have been boys who have been on the sick list for a long time. The boats are entirely managed by the boys themselves, and it is considered degradation to take a boy away from managing a boat as a coxswain; in fact, one of my punishments, and no slight one either, is not to allow a boy to go in a boat in his play-time.

Results.

The general results are, a useful, healthy occupation, which includes an education that fits them in after-life to be perfectly independent, teaches them self-reliance, and gives them a feeling that they are able and willing to gain a good livelihood in a market which always requires strong arms and a fair knowledge of their business, nearly all the theoretical and a great portion of the practical parts of which are obtained during their training. I consider the following results would be gained by establishing training ships under the Local Government Board:—

(1). For the children in the different unions about the metropolis, who possess such an outlet as the *Goliath*, an immense advantage over those who not only drift back from union care to pauper society, or into crime, but also to those unhappy children who are kept in the unions in the society, more or less, of established adult paupers. I use the word "established" advisedly, having reason to believe that there are many paupers who look upon the workhouse as their home, and as an establishment instituted entirely for them. I say the children in the *Goliath* have immense advantages, for they are drafted off to an inspiriting occupation, away from the lowering influences of pauper associates.

(2). The maintainance of the establishment being dependent on the rates, no effort is required to keep up its efficiency by raising funds by voluntary contributions, as is the case in the industrial schools' ships, consequently the philanthropic amongst the ratepayers are not constantly called upon to put their hands in their pockets for voluntary contributions for the support of these poor boys, beyond what they contribute in the way of poor-rates.

It appears to me that many of the so-called City Arabs, instead of being sent to a reformatory, which at once cuts off from them the chance of being allowed to join the navy, might be sent to a union, and thence to a district school, afterwards to be drafted on board the *Goliath*, where, if the law would allow, they might be bound apprentices to the superintendent, with a clause in the indenture, by which, when opportunity offered, being of sufficient age and long enough in training, they should be transferred to a sea-going ship. There should be some means taken to prevent the discharge of these boys in the midst of their training; but this, of course, would interfere with the working of the Poor-law rules.

From my experience I might suggest a few things that would considerably improve the working of the system, and be of much benefit to the boys; but this is treading on rather dangerous ground, as there might be some objection on the part of those in authority, unless it be considered that a ship is very different from a district school, and should be governed by different rules from those which obtain in the district and workhouse schools on shore. I need, therefore, at present say no more on this head, beyond noting such as appointments and discharge of officers, admittance and discharge of boys.

Some of the rules which govern the internal economy of Greenwich Hospital School might be made applicable to the *Goliath* with great advantage.

The reasons why I would use the *Goliath* as a sort of nursery, or first admittance ship, are several.

1st. Boys of a much more tender age could be admitted, and go through a sort of preliminary training.

2nd. The big and little boys would not all be mixed up together, which would be very expedient.

3rd. The dietary scale might be different on board the nursery from that of other ships.

4th. The staff for the supplementary training ships might be also trained in the system pursued on board the *Goliath*, and could look forward to promotion.

I finish my paper with quoting an extract from the *Nautical Magazine*:—"A man or boy on board ship who is unacquainted with his duties is not only an impediment and a nuisance, but is a source of absolute danger. We appeal earnestly to masters and owners of British ships to do what they can to get good British seamen into their ships. There are plenty of boys who want employment. Begin with the boys, and we must have good men. It is worth while for masters to put their shoulders to the wheel and secure employment for these boys. If we once get a supply of intelligent, healthy boys, the discipline of the mercantile marine will be secured, and expense and desertion will decrease. The training-ships can supply boys who already know much of their work, and who, on account of their habits of cleanliness and ready obedience, as well as their knowledge, are of great value. If our readers who are connected with ships will, when they want a boy or an apprentice to the sea service, give the training-ships a call, they will probably find such a boy as they want. We cannot too emphatically call attention to these valuable institutions. A list is given of them further on. We only have to make one suggestion, and that is, that these boys are generally valuable in proportion to their age. If a trained boy of sixteen can be got, we would say, take him in preference to one much younger; but take a trained boy of any age in preference to an untrained one."

And now, Mr. Chairman, Ladies, and Gentlemen, allow me to thank you for the kindness and attention you have shown me, in permitting me the honour of reading this somewhat dull and tedious paper to you.

DISCUSSION.

Mr. Charles Horne was happy to be able to give his testimony to the excellent training given to the boys on board the *Goliath*, being one of the Guardians of the Croydon Union, which sent many boys to the ship. He considered that much better results were produced there, and at less expense, than at Anerley. He had a boy in his own service who had been to sea, and found him much more handy and useful than boys in general, and such had always been his experience. The most important point, however, was that such a system effected the depauperisation of the children, and this was worth any expense which it involved. He had visited the Industrial School at Anerley several times, and must agree with Captain Bourchier that, though the girls looked bright and cheerful, there was a dejected look about the boys, which was very different to the appearance of the boys on board the *Goliath*. It was very pleasing to see the affection which the boys who had been to sea had for their old home, when they returned from a voyage. He had especially noticed this on the *Chichester*, which had many "old" boys.

Captain Crawford said he had known Captain Bourchier since 1848, and had much pleasure in adding his testimony to the good results produced on board the *Goliath* by the admirable system of discipline and kindness there in force. He had had the pleasure of spending two Sundays on board, and was much delighted with the behaviour of the boys, both at service and in singing grace before and after meals. Discipline was carried to a perfection that could never be attained anywhere but on board ship, the sound of the bugle acting like an electric shock, and bringing them all to attention in a moment. The question of depauperising the children was of great importance; but, as an old naval officer, he also looked upon such a system as an admirable nursery both for the Royal Navy and the mercantile marine. He was sorry to hear that the navy had become unpopular, and that the Admiralty had been obliged to offer a free kit to the men to get them to join. He could not tell what was the reason of this feeling; but the merchant service was almost of equal importance, as by its means the products of all the world were brought to our shores, and civilisation was extended all over the globe. He hoped, therefore, that the system, which had proved so successful, would be extended without loss of time. It seemed to him very desirable that some of the old hulks, which were now kept up at great expense, should be placed round the coast, and used as training ships in the same way, so that these poor boys, who were growing up in ignorance and vice, might be taught to earn an honest livelihood for themselves. He had seen a report that the government intended to sell or break up the *Victory*, but it occurred to him that it would be much better to turn her into a second *Goliath*, and thus do honour to Nelson's memory. The system might with advantage be extended to all the unions throughout the country; and even if all the boys did not hereafter become sailors, they would be none the worse for the training they had had.

The Hon. W. W. Vernon, as a member of a union which had sent 47 boys on board the *Goliath*, was anxious to express his hearty concurrence in the sentiments expressed by previous speakers, as to the moral and physical improvement of the boys under the splendid discipline to which they were subjected. He hoped that before long the guardians of unions throughout the country would have opportunities of sending their boys to training ships, and suggested that a Roman Catholic ship might be started for the accommodation of the numerous Irish Roman Catholic boys in the various unions.

Mr. Botly said Captain Bourchier, in mentioning gymnastics, did not refer to swimming, and knowing that many sailors were unable to swim, he wished to know if this useful accomplishment was not taught; for in his opinion, every boy in the kingdom ought to learn.

Capt. Bourchier said it was quite by inadvertance that swimming was not mentioned. They had a splendid bath, 60 ft. long by 30 ft. wide. When it came down in May, only 29 boys in the ship could swim, but by the end of the bathing season this was increased to 187.

Mr. Uvedale Corbett said that having visited the *Goliath* several times, as Metropolitan Poor-law Inspector, he felt it due to Captain Bourchier to bear his testimony to the admirable manner in which it was managed, and to the marvellous effects produced upon the boys who had been trained there. He had been struck with it on every occasion, and especially with the affectionate confidence which all the boys seemed to have in Captain Bourchier and their officers, coupled of course with the greatest respect. This was one of the best features in the ship. He did not know that anything had been overstated by Captain Bourchier, but rather the reverse. He thought great thanks were due to Mr. Goschen, who inaugurated the experiment, to Mr. Scrutton and the members of the Forest-gate School District, who conducted it, and above all to Captain Bourchier, who had brought it to such a successful issue.

Mr. J. W. Franklin, as a member of the Holborn Union, which had sent about 50 boys to the *Goliath* training ship, had great pleasure in adding his testimony to the good effects produced upon the children they had sent there. When he visited the ship, the captain was absent, but he was ably represented by the officer in command ; and he trusted similar institutions would be increased throughout the kingdom. He thought the guardians of the various unions wanted educating in this matter, and suggested that a copy of this paper should be sent by the Society to the various unions, which, he believed, would tend to develope opinion upon the subject.

Mr. Hamilton thought justice had hardly been done to the Forest-gate District School, as the body who had taken the initiative, at their own risk, in this experiment, for so it was in the beginning. No doubt a great deal of the success was due to the admirable manner in which Captain Bourchier superintended it; but there was one subject he had not alluded to, which it might be as well mention, and that was the great influence for good which was brought to bear upon the boys by the presence of Captain Bourchier's family on board the ship. The softening influence of the female sex was displayed in every part of the organisation, especially as the female members of the family entered with great energy into all amusements and occupations of the boys. He thought this should not be forgotten, though he feared that it was not every *Goliath* which would be so fortunate.

Mr. Christopher Cooke said when at Portsmouth last summer he asked several old seamen whether it was possible to take the *Victory* round to Sheerness, when they were of opinion that it could be done in fine weather. If so, he thought it ought to be attempted, for it would be a disgrace to the country that Lord Nelson's ship should be broken up. It would be much better to bring her to Sheerness, and fit her up similar to the *Goliath*. He fully agreed as to the importance of swimming and gymnastics, and mentioned a case occurring in a school in Boston, where a boy, whose unruliness was a great source of trouble to his master, had been rendered quite tractable by having his superabundant energy expended in a little hard work.

Mr. Dibdin was much pleased with the excellent paper he had heard, and said the real question involved was the utilisation of a very useful product which at present was not used. This was one way in which, apparently, a great number of boys might be educated to fulfil useful functions in life, and pass from the ranks of pauperism to those of respectable citizens, and this was what all who had the interest of their country at heart ought to keep in view. The difficulty in raising so many thousands of children in this country from the miserable state in which they were, appeared to be the want of some practical means of doing so without discussing abstract questions, which always led to disputes. It was a lamentable fact that so many thousands of children, in the metropolis alone, were simply trained up as paupers and criminals, when they might do something better, and he hoped the Poor-law Board would take the matter up, and not leave it entirely to the guardians. He hoped that before long there would be similar training-ships all round the coast, in which the boys might be trained up in the same excellent manner they had had described.

Mr. Williams, as representing the *Chichester* training ship, thought that a little caution should be exercised in the multiplication of the ships. It seemed to be the general idea that these ships should be multiplied all round the coast, but already there had been, since the establishment of the *Chichester*, in 1867, some eight or nine other ships established, one at Dundee, and one on the Clyde, one on the Humber, one at Newcastle-on-Tyne, one at Bristol, and others elsewhere. It was no use to train up 4,000 or 5,000 boys unless employment could be found for them afterwards. For the first two or three years after the establishment of the ships there was a great stagnation in trade, all kinds of hands were thrown out of employment, and they could not get their boys out. It was only in the last two or three years that a spurt had taken place, and now their boys went off very rapidly. A time might come again when the shipping interest would not be so flourishing as at present, therefore the guardians and the Poor-law Board must take care not to have too many of these ships. He thought there were enough at present. Again, now that captains and shipowners were opening their eyes to the fact that something was to be got out of the boys trained in these ships, it was very difficult for a land-boy to get employment. The returns showed that during the last month they had sent eight boys into the Royal Navy, and during the same period they had also got some twenty-eight into the merchant service. These had been taken from the streets, trained in the ships, and were now able to earn their own livelihood honestly. From their shipping master's returns, he found that 16 boys had gone on their second and third voyages as able seamen, thus showing that when once the lads were trained they loved their profession, and stuck to it. During the year 1871, they placed 39 in the Royal Navy, and 192 in the merchant service, and during the same period ships were provided for 245 other boys, who reshipped on their second, third, fourth, fifth, sixth, and even seventh voyage.

Captain Crawford did not think they need be afraid of educating too many boys. He proposed that the Society of Arts should take the matter in hand, and send a deputation to urge the matter upon the proper authorities.

Mr. E. C. Tufnell said he was well acquainted with the *Goliath*, as it had been his duty to visit the ship, and he thought if they multiplied the vessels they must also multiply Captain Bourchiers. He thought it must be manifest to everyone that Capt. Bourchier had a power of managing children which very few had, and it was to that fact that the success of the ship was due. He said in the paper that he did not think the largest men always made the best sailors ; but two years ago the Admiralty put forth a regulation by which they would not allow any boy to enter their training ships unless 15 years of age, 4 ft. $10\frac{1}{2}$ in. in height. He thought in the lower classes of life boys at that age did not generally reach that height, although they speedily grew when they had better food and training than that to which they had been accustomed. This was confirmed by Mr. Williams' statement, that during the past year only 39 boys had entered the navy, although 192 went into the merchant service. He thought this was a mistake on the part of the Admiralty, and hoped they would see fit to alter it. It was true they got many boys from the country answering their requirements, but they were by no means so bright in intellect or so capable of instruction as town boys would be, much less such boys as were trained in the *Goliath*. There was another obstacle also briefly alluded to, that boys could not be placed on board the ship without the consent of their parents or guardians, and this being a Parliamentary regulation, it could not be altered by the Poor-law Board; but still, it seemed most absurd that such a regulation should stand in their way, as it often did. As to having a Roman Catholic ship, he saw no necessity for that, for the religious opinions of all sects had been specially provided for since the first foundation of the Poor-law. He gave his hearty concurrence to all that had been said in praise of the system adopted on board the *Goliath*, and, although a landsman himself, he was borne out in his view by various admirals and other gentlemen connected with the sea, whom he had taken to visit it.

Mr. Corbett said Captain Bourchier introduced a prize for the two most popular boys on board the ship, which he thought a most excellent plan. The winners were selected by the boys themselves, who were pretty nearly unanimous.

The Chairman, in presenting a vote of thanks to Captain Bourchier, remarked that an observation fell from Mr. Tufnell, to the effect that these ships might be increased very easily, but men like Captain Bourchier were needed to superintend them. He begged to say that he had known Captain Bourchier, who was a pupil of his own, and therefore he did not wish to lessen the respect in which he was held, but he believed there were many naval officers perfectly competent, and would do the duty with the same zeal as Captain Bourchier. There was one immense addition to Captain Bourchier's merits, and that was in his charming wife and family. They knew that where ladies would come and help in the education of youths, they could do more than gentlemen. He considered this question was one of great national importance, and as an officer of the navy he should naturally put its importance in the point of view of the defence of their country first; but he would not refer further to that. It was right he should state, in reference to Captain Crawford's remarks, that the Society of Arts should take some public action with regard to the increase of training ships, that the Society could do nothing more than invite public discussion upon such a matter. All who were interested in the matter might come forward and express their views, which were conveyed to the public in the pages of the *Journal*, but further than that the Society could not go. With regard to the religious question, that was the great difficulty with regard to all education; but in the navy they all lived together, Roman Catholics, Protestants, and Dissenters, in the greatest harmony. He had commanded ships and fleets, but he had never known a quarrel arise upon any religious question. Yet it was well-known that, taking seamen as a body, there were no men who feared their God more. In conclusion, he would only say to Captain Bourchier, "Go on and prosper," and hoped the name which his ship was getting from the public would led to a gradual increase in the number of similar ships, for the public were becoming thoroughly aware of the advantages of this education on board ship, where the boys were subject to a discipline which could never be obtained on land.

The vote of thanks having been passed, the meeting separated.

CHANNEL PASSAGE.

The Committee met on Tuesday, January 23rd, at 3 o'clock. Present—Messrs. Seymour Teulon (in the chair), F. A. Abel, F.R.S., E. Chadwick, C.B., Captain Donnelly, R.E., Major-General Eardley-Wilmot, Vice-Admiral Ommanney, C.B., F.R.S., and Captain Robert Scott, R.N.

Henry Cole, Esq., C.B., attended, and gave evidence as to the inconveniences and shortcomings of the existing arrangements:—

Captain Donnelly—I believe you have often crossed the Channel, to Calais, Boulogne, and Ostend, during the last 10 or 15 years?—Very frequently, in connection with the several exhibitions that have taken place in Paris, also on official duties, and also privately. I have had personal experience of almost every phase of crossing. I have enjoyed myself on the upper deck on a fine day. I have been thoroughly wetted through on a wet day on the deck. I have been sometimes even wetted through in the private cabins on a bad day. I have been obliged, at the commands of ladies who have been with me, to descend into the cabin below, from which I have retreated as quickly as possible, for that really was the worst part of the whole business. During the Paris Exhibition, I had a suit of mackintosh, in which I thought I could have defied the water. I had boots, trowsers, a cap, and a cape long enough to come over my legs, but I am bound to say it did not altogether answer, and I was obliged to give it up. Therefore, from the point of view of a persecuted traveller, I have had as many grievances, of all varieties, as most people.

Q.—Of the various routes, which have you observed most carefully; and, with respect to the departure and arrival of passengers and goods, which do you consider the best?—Experience has taught me to prefer the tidal service between Boulogne and Folkstone. In the Calais route, I did not remark any great difference in time during the greater part of the year. The Boulogne boats are larger, although, in the winter, when large boats are most needed, they sometimes put you in small ones. I have found the fewest disagreeables in the Boulogne boats, on account, I think, of their size and commodiousness; and I am bound to say that as long as you have a steamer, I do not think, on a fine day, when you can stay on deck, you can have anything better than a tidal steamer. It is very swift, it is very pleasant; in fact, I have not a word to say against it. It is only when there is doubtful weather that the passage becomes troublesome.

Q.—Have you not found that a good deal of time is lost by mixing goods, fish, bullion, and passengers altogether, and in getting them on board?—Yes; I have frequently remarked that. Last year, I stayed at Folkstone for some weeks, and I used to watch the tidal boats going out. I know that the company does the best it possibly can under the difficulties of the case. Of course, the company has to get its five per cent. if it can, and therefore it does everything which the passengers will bear towards getting the five per cent. Perhaps there is no remedy for it. I do not know whether you can make the directors give up aiming at 5 per cent., but, undoubtedly, there is a good deal of contradiction in the practice. People are made to believe that the journey can be performed in from nine to ten hours; but on one occasion, I observed that the boat was delayed in Folkestone harbour very nearly 40 minutes. It was a very heavy train; there was a great deal of luggage, which was transferred with a barbarous recklessness, which seemed to me quite unnecessary. Everything was tumbled together—hat-boxes, baths, ladies' dress-boxes; not a bit of system. On one occasion, I happened to be standing and conversing with as experienced a marine engineer as any in this country, and he said, "Is not this barbarous? You know they say that nothing can be done to remedy it; that it is in the nature of things that all these articles must be tumbled down together; they do it to save time. It has been suggested that they might sort the large from the small, and shift them by some more rapid and convenient process into the vessel; but they say they cannot. I believe it is the 5 per cent. that stands in the way." Then, besides all this difficulty with the luggage, there was an unusually large quantity of bullion. Probably it is cheaper to carry bullion by the passenger steamer than to send it by another. It may be safer, but I do not know why; I assume it is. There was a great deal of it, however, and there was a most enormous quantity of herrings, enough almost to fill the head of the vessel. All this was tumbled together as it would be in a pantomime. The luggage was partly put down in the hold; the silver bars were lying about the deck wherever there was room; the fish stinking and incommoding everything; the second-class passengers being turned anywhere. The 5 per cent. was the real cause of all this confusion, because as to its not being possible to let passengers have a comfortable steamer to themselves and their luggage, and sorting the latter a little, it is quite absurd. Nobody can say that it is impossible, if the 5 per cent. did not stand in the way. Therefore, my observation led me to think that if the South-Eastern would systematise its arrangements rather more than at present, it might be even to its commercial advantage. During my stay at Folkstone this kind of thing was always going on, more or less, and I used often to speak to people who took an interest in the subject. They would say it would not pay to alter, and no doubt it is a theory, more or less sound, that it would not pay. But it has not been tried, and the moral I draw is this—that before you ask the speculating public to go to great expense for all kinds of remedies, it would appear to be much more sensible, and less riskful, first to try and improve existing arrangements as far as possible.

Q.—Then with reference to your statement that, in fine weather, the Boulogne tidal boats are as good as possible, you would except this point of the rough treatment of the luggage, and the mixing of fish, bullion, and passengers?—Certainly. I simply mean that the boats are beautiful boats—very speedy; and so long as you can be on deck I do not think any bigger steamers will improve upon them. A tunnel, of course, is another affair. I only say they are capital steamers, excellently managed, and in fine weather it is a very agreeable journey, and as quick as ever you can expect it to be, in my opinion.

Q.—Then, even in fine weather, there is time lost, and a good deal of inconvenience caused by the mixture of goods and passengers?—Yes; the very day I am speaking of was a splendid day, and they had a beautiful passage, but they were delayed 40 minutes, and the passengers certainly could not walk about the deck in consequence of the baggage.

Q.—Do not you find, irrespective of the arrangements made with regard to the baggage and so on, that the comfort of the passengers is not sufficiently attended to in the absolute construction and form of the boats themselves?—I will take one of the best steamers, and in bad weather those who will not brave the cold, and those who have not secured private cabins, must go down into the very nasty cabin below, which, even if your stomach is pretty strong, is sure to make you ill. I feel perfectly certain that, if proper scientific advice was taken, and it was made somebody's business to render that cabin a tolerable or endurable place to be in—if it were properly ventilated—it would be an advantage, even from the company's 5 per cent. point of view. If Mr. Eborall and Sir Edward Watkin were obliged to go over every day until it was made sweet and wholesome, I have not the least doubt that, in less than a fortnight, there would be a perfect remedy for the present state of things in that cabin. I do not pretend to be a man of science, but I have heard the subject discussed by men of science, who say that, at a cost absolutely insignificant, but with a large dose of common sense and of administrative power, that cabin could be made nearly as sweet as the deck itself, even in the midst of the sickness that will be going on.

Q.—Do you suppose that the cost of ventilation would be large?—I imagine a mere flea-bite. You have the heat of the steamer, which has been found rather a good adjunct to ventilation. I do not pretend to say how it is to be done, but you have plenty of air, and you have plenty of heat which is thrown away, and if a scientific mode of ventilation were adopted, I believe the heat would be very trifling.

Q.—You have been speaking with regard to the general saloon; but do not you think that more private cabins are wanted also?—I think, without interfering with the management of the vessel, much more could be done. It is very much disputed whether a deck-cabin in the centre of the vessel is a good thing. Sailors do not like it; but, although I speak in the presence of sailors, I think their judgment is not worth much on the question of the public comfort. A sailor wants something that is handy, and he has not been used to think that he is the servant of the public on board ship. I do not pretend to say that a cabin in the centre of the deck is a right thing, but I do think, without impeding the handling of a vessel, a good deal more in the way of covered accommodation could be provided. I am told it was contemplated last autumn to send one of these vessels to Belfast, to be altered in such a way as to give more accommodation on deck, and I have heard that nautical men object to it. I do not say that nautical men ought not to have their way, notwithstanding what I have said. I do not think the vessels ought to be perilled in the handling of them, or put in jeopardy in any way; but still I do think that the nautical mind looks with a little degree of prejudice on anything which it is unaccustomed to.

Q.—You contemplate only very small private cabins?—I think something might be done, even by putting each passenger down in a sort of thing like a sedan-chair on a wet day, which is surely a good deal better than going down into that cabin, and a great deal better than getting wet through, which one is obliged to do now on a wet day. You let horse-boxes down very easily, and you can carry horses in a thing something like a sedan-chair; and I do not see why human-beings should not be carried in the same way, if they like to pay for it.

Q.—With respect to hiring the cabins that already exist, have you found any difficulty yourself in that respect?—Yes; there are a certain number of cabins—three, four, or five—but the public do not, I think, understand it. Those that are accustomed to crossing the Channel find out these things; but it is not managed in what I call a business-like way. Owing to my constantly crossing, I have had a great deal of civility shown me, and have nothing personally to complain of; but if an unprotected female, for instance, wants to know how she can get across best, she really does not find out from the advertisements and notices that there are so many private cabins which can be engaged at a certain price beforehand. This is particularly the case with the Ostend boats. The Ostend boats are larger than the Boulogne boats, and they are also beautiful boats for speed. I am speaking of the Belgian government boats, which are as good in their way as they can be for their size—indeed, they are very fine vessels—which ply between Dover and Ostend. But there is no system whatever, in hiring these cabins; it is a mere question of bribing the commissionaires. I may tell you what happened in my own case, and I hope it will get to the ears of some one in Belgium. Knowing that it was necessary to take some care about getting a cabin, I wrote to the agent from Germany ten weeks before my family was going over. I got no answer, and I then telegraphed him that my family would pay the cost of the cabin at Brussels. I got a letter in answer, saying that the cabin was properly secured. They went over, having his authority to ask for a cabin, but they found it occupied by three gentlemen, and it being a very wet day, somehow they had got possession of it. The steward had put them in, and they would not turn out. I was told by my family that they never experienced a worse passage. It does seem rather hard, if you write a fortnight before hand, and get a letter from the authorities saying you have got what you want, when the order is presented that neither captain nor steward should recognise it.

Q.—Once or twice you have referred to the 5 per cent. dividend, meaning, I suppose, that it is really a commercial question. Do you think that any improvement in the arrangements would be likely to produce very-largely increased profits?—I believe that if the best were done with the existing steamers it would encourage people to go abroad, rather than otherwise; and I have no doubt it would grow into a much better system of administration. Therefore, I think it would be well if the proprietors of the South-Eastern Company could be persuaded to take the risk of doing the very best possible with their existing boats as a commercial enterprise. It would, perhaps, take a year or two to develop the reforms properly, but I do not think the cost would be enormous; and I do think that if they managed it as well as they manage other parts of their business, it would be profitable to them. I am not a great believer in its being commercially profitable to spend a million or two, in the present state of desire for foreign intercourse, upon improving the system of transit. I should rather begin by making the best of the present boats, which are admitted to be extremely good, and I think, until that experiment has been tried, it is rather rash to go into anything else.

Mr. Edwin Chadwick—Do you think that if the Belgian government, who, as I understand you, have better boats than other lines, were to perfect them still further, that a great many people who now go to Brussels and Italy through France, would take the shorter way by way of Ostend, or the other ports in Belgium?—I have no doubt about it.

Q.—And therefore it would profit very largely?—I think so.

Q.—It would save the railway transit, and the time of travelling in going through the frontiers from France to Brussels?—I believe it would pay them to make the boats as comfortable as possible.

Captain Donnelly—As I understand, you think there is not a sufficient margin of profit to warrant a very large expenditure at once in this matter?—That is my opinion. I think, until the existing arrangements are perfected as much as possible, it is rather a wild speculation to be going into a great cost into other ways.

Mr. Teulon—Allow me to read a paragraph from the report to be presented to the proprietors of the South-Eastern Company on Thursday next:—"The directors are continuing to give careful consideration to this very important question, and have called for various reports on the subject. They are again strongly urging upon the Northern of France Company the necessity of immediately extending their railway at Boulogne to the Quai Bonaparte, so as to save the omnibus journey and cartage through the streets of Boulogne. The directors of the Northern of France undertook to carry out this extension in 1869, but they have hitherto refrained from adopting it, owing, in the first place, to the discussion of the Steam Ferry and New Harbour Scheme, and, in the second, to the unfortunate occurrence of the war of 1870-71." I may say that I have now nothing whatever to do with the South-Eastern Company, although I had for many years. With regard to several points in Mr. Cole's evidence I perfectly concur, having seen myself many of the evils which he has alluded to; but I should say that the company profess to be willing to do anything that they possibly can to improve the traffic. Indeed, they have gone so far as to have obtained a report from Mr. Harland, which, with the plans, has been sent to this Committee, in which he goes into the question of improving the harbours of Boulogne and Folkstone, and here is a large plan of a proposed large steamer to run between the two places. It is too large to turn in the present harbour, and therefore it is to be fitted with rudders at each end, so as to go in and out without turning. There is one point in Mr. Cole's evidence which I hope the Committee will excuse my referring to. For some years I was chairman of the Works Committee of the South-Eastern Railway Company, and the present large boats were built whilst I was a member of that committee, therefore I am well acquainted with the subject, though I have nothing to do with the matter now. Still, I know that there are fewer small parcels sent by the company in the way described by Mr. Cole than there used to be, for those going to Paris or into Belgium are generally put into a large crate, and locked up, and not opened until they cross the frontier, so that the number of small parcels are fewer. It is a very unfortunate thing for Folkstone that when the railway was constructed it should have been at right angles to the pier, as this occasions a great deal of extra labour, and consequent loss of time, especially when there are many passengers and much luggage.

Mr. Cole—I have no great aspirations for steamers more than 300 feet long. The point of my evidence is—accept what is now existing, and do the best you can with that. You may do as much more as you like in other directions, but do not leave us without any remedy for the next two years, whilst you are enlarging the harbours and building larger steamers. The only point I have not alluded to this. I think that the getting in and out of the steamers may be improved. It may be difficult to have covered sheds, and things of that kind, but I am speaking only of the existing steamers and of the existing Boulogne harbour, and I think that can be undoubtedly improved. It only wants a scratch of the pen, saying that the people shall not go by the omnibus from the pier to the Great Northern in Boulogne. That is a wretched local squabble; they think they can fleece the British of a few more francs on the journey, that is all. I should recommend that, with the existing steamers and existing harbours, the South-Eastern Company set themselves at work to improve what they have got. I have no objection to their going to Mr. Harland or anybody else to do something two years hence, but I may not be alive then, and I want something done by next year.

Mr. Teulon—They propose to do something at once. One of the boats has been sent round to Belfast to be altered.

Mr. Cole—And I dare say Captain Boxer will report that it is a failure, and there will be the same stinking cabins, no accommodation on deck, and the mixture of bullion, herrings, and packages, all going on just as usual.

Admiral Ommanney said that certain conditions were not open to amelioration. With respect to the cabin below, no doubt that could be very much improved by simply knocking down the dirty fittings, getting more space for air, and lighter frames for the people to sleep in, instead of the heavy incumbrances which now impeded the passage of air.

Mr. Cole said his advice to the South-Eastern would be, without incurring large expenditure, to set about ventilating the cabins scientifically as early as possible.

Captain Scott said he had sketched out a rough plan, showing how it could be done without altering the structure of the existing vessels, and at a comparatively small expense.

Admiral Ommanney said, if the public would be contented with a lower speed in the boats, they might have more comfort.

Captain Scott said the plans, in which he had embodied the committee's suggestions, would give them a great deal more comfort without altering the speed of the existing boats.

Admiral Ommanney said there was one very great grievance which had not been alluded to, that of overcrowding. On all these boats there was a notice posted up, under the authority of the Board of Trade, stating that the steamer was not to carry more than so many people, subject to such a penalty, but this was a perfectly dead letter; no one ever acted on it. When he went to Paris, in 1867, he took a return ticket to the Exhibition. When he got on board the boat he found there was an excursion of the working classes going over, and they were, in fact, being packed as if for a slave voyage—there was just standing room, and no more. He had to stand on deck the whole time, and coming back it was just the same; and, being bad weather, with the wind right ahead, the passage took about four hours. To tell the truth, there was not comfortable standing room, almost all the people were sick, and many of the men were drunk; the women got no assistance, there was no one to help them down below, and they were vomiting in all directions. There were these notices, saying that the boats were not to carry more than a certain number, but nobody paid any attention to it. If you went to the Board of Trade and complained, you were told you must prosecute, at your own risk and expense; that was all the satisfaction you got. When he went to Dundee it was just the same. They were two nights on the voyage, and canvass screens had to be rigged up on deck for the women to lie down under.

In reply to Mr. Chadwick,

Mr. Cole said he considered the South-Eastern tidal boats the best. The Belgian government boats were very good, and perhaps, as regards crossing the Channel, they were rather superior, being of a larger build, having a longer distance to go, and rougher weather to contend with; but the speed was about the same. He had no fault to find with the Boulogne boats for speed. The Belgian boats ran in connection with the railway system.

Mr. Chadwick—Do you not think that the Belgian government, which has shown itself alive to the importance of improving internal transit, irrespective of trading profit, might be induced to do more than the trading companies have yet done, so to improve the fittings and the construction of their boats as to reduce sea-sickness?—In answer to that question, which involves a good deal, my opinion is that this Committee, if it were so minded, would do good service by urging upon the Belgian government to improve the mode of transit between Dover and Ostend as much as possible, with a view of directly competing with the railways. If that were done, people certainly would not go by the way of Calais, but would prefer the direct route. And I believe that would be the most wholesome way of acting upon all the competitors for the traffic. A great number of persons now went by way of Calais, simply to shorten the annoyance of a sea-voyage, and if this annoyance were removed by an improved transit, they would no doubt go in greater number by way of Ostend.

Mr. Cole said he should be glad to see anything done that would have the effect of inducing the South-Eastern Company to do the best they could with their existing arrangements.

General Eardley-Wilmot said he understood that the company already desired to do the best they could to rearrange and improve their service, and that they were now turning their whole attention to that very point which Mr. Cole advocated. It was for that purpose Captain Scott had sketched out a rough plan for improving the ventilation of these boats.

Mr. Cole said he had no objection to any suggestions being made to the company, but he thought the responsibility should be left to them.

General Eardley-Wilmot said the company desired to co-operate with the Committee in any way possible.

Mr. Teulon said Mr. Eborall was present at the last meeting, and would have been present that afternoon had he not been unavoidably detained. He had had plans made on purpose to give the Committee every possible information, and expressed his desire to receive any advice which could be offered them.

Mr. Chadwick—On the occurrence of rough weather, one resource is to go below, and to lie down on a cabin-sofa. In my own case, I have been, on those occasions, made sensible of a chemical definition of man, as about two pailsful of water and a small proportion of solid matter to hold it. There is much testimony of persons that on cots suspended on stanchions or gymbals, which give to a great deal of the motion of the vessel, the disturbance of the internal fluids is diminished and prevented, and sea-sickness is diminished and prevented. Now, I think we should get trial made of suspended sofas or cots, which would occupy little additional space, for the privilege of using which susceptible travellers would be willing to make additional payment. But cots suspended on inflexible cords are improved upon by cots suspended on flexible cords of india-rubber. Are you aware that, during the American war, upwards of twenty thousand wounded men were transported in railway cars on cots, so suspended on flexible india-rubber as to prevent jars, and that not a single case of accident from jolting or shaking and displacement was known to have occurred?

Mr. Cole said he had heard of it.

Mr. Chadwick—At present there are about seventy sofas on one of these boats. No doubt if the suspended cots were introduced they would occupy more room, and a lesser number could be provided; but probably they would be much more useful. He desired to ask Mr. Cole if he did not think this would be worth a trial.

Mr. Cole said it might be an advantage, and it might be that the managers of the steamers would point out some reason why it was not so. He did not want to take the responsibility from the steam-boat company of saying what should be done. All he said was they could ventilate their cabins better, and accommodate the people better, and that they could find some means of getting in their cargo in in less time than forty minutes.

Captain Scott said he thought it was understood that it was no use telling people to improve their ventilation and accommodation unless you showed them how it was to be done, but that the company were quite willing to do it if some feasible plan were put before them. He had, therefore, sketched out a rough plan, which he did not say was to be followed exactly, but it conveyed a general idea of what was requisite. He did not propose to alter the front part of the ship at all, because, this being an experiment, there was no need to lay out much money at first; but if it succeeded in the after-part of the ship, it could be easily extended forward. He then proceeded to describe his plan, which consisted in adding to the cabin space, by taking off the planking of the deck in the centre part, leaving the beams untouched, and raising the planking about four feet, to the height of the bulwarks, so that the height of the cabin would be raised from six feet six to ten feet six. Ventilation would be secured by proper openings in the sides of this raised portion and by the hatchways at the top, so as to have a current of air continually passing through and carrying off all the bad smells, which were now so much objected to. He also proposed, as there was this additional height gained, to sling two rows of cots along the roof upon gymbals, which cots might be occupied by delicate persons likely to suffer from sea-sickness. He had no doubt the ventilation might be made more perfect by the adoption of a down-cast and an up-cast, and, as there was hot-air available, it would be very easily done.

General Wilmot asked where the cots were to be slung?

Captain Scott said immediately under and on each side of the raised portion of the deck. There would be a considerable height on each side of the proposed hatchways, and there the cots might be slung on gymbals above the heads of those in the cabin.

Admiral Ommanney asked how the people were to get into them?

Captain Scott said there might be steps leading up to a narrow footway running along by the side of them; there would be probably an extra charge made for these cots.

Admiral Ommanney said they would take up so much space that those who did not make use of them might object.

Captain Scott said there would still be a great deal more space left than at present.

Mr. Chadwick said it struck him as a most feasible and important experiment to try.

Admiral Ommanney asked what was to be done for those who liked to stop on deck?

Captain Scott said there would be a four-feet gangway all round the after-part of the ship, as well as all the space on the raised roof of the cabin.

Mr. Cole said he was afraid Captain Boxer would demur to the centre of the vessel being raised in this way, as he would say it impeded the handling of the ship.

Captain Scott said that would not be the case at all. He contended it was absurd to have a lot of men hauling at the sails when it could be all done very easily by means of a winch. Human beings were too valuable to be used as beasts of burden. He had shown this plan to some of the best naval constructors, and asked if there was any objection to it; and on that very day one of the most eminent of them told him it would make a very great improvement, and was precisely what was wanted.

Mr. Cole said he had had a great deal to do with ventilation at South Kensington, and he should say broadly that proper ventilation required letting in of plenty of air, and a letting out all the bad air. He did not see how the ingress of air was provided for by Capt. Scott's plan.

Captain Scott said he proposed to let in the air at the sides, and to let it out at the hatchways at the top of the raised portion. The foul air might be drawn out by means of a fan, but he had not gone into the details of that part of the subject.

Mr. Cole said that this question of ventilation was much more important in the first instance than that of cots or things of that kind.

Captain Scott said that the cots were quite a separate feature, which could be put up or not, as thought best.

Mr. Chadwick asked Captain Scott if he were aware that there having been a great loss of horses carried by the French navy during the Crimean War, the French government applied to the late M. Leon-Duvoir, the most successful engineer in the speciality of ventilation in Europe, to devise a plan for the ventilation of the ships for the transportation of horses, and that that plan was successful?

Captain Scott said he had heard of the plan, and of many others which had failed. There would be no difficulty about ventilating ships if proper persons were employed who understood the subject.

Mr. Chadwick was assured that the plan was successful as respects horses, and it might be well to consider of it for men.

General Wilmot said it appeared to him there would be a difficulty in Captain Scott's plan, from the raised portion of the deck catching the wind.

Captain Scott said it would not be above the level of the bulwark.

Mr. Cole thought there was some danger in proposing anything specific to the steam-boat company; he should prefer the South Eastern Company itself asking Captain Scott or his brother General Scott, or any other scientific man who understood ventilation, what was the best to do.

Mr. Chadwick urged the Committee to press upon the attention of the Belgian government the importance of introducing some such plan as this. He thought if the Belgian Government improved their boats, and competed with the English companies, it would tend to the improvement of our own trading Channel steamers.

Admiral Ommanney thought one of the most important points was some means of enforcing the regulations with regard to over-crowding.

Captain Donnelly asked if the steam-packet companies had given any intimation that they would receive any suggestions the Committee had to offer?

The Secretary said that both the South-Eastern and the London, Chatham, and Dover Railway Companies said they would be glad to have any suggestions laid before them.

Captain Scott said that a system of ventilation, in which steam would be the agent, might easily be added to his plan.

Mr. Cole said the last person he had discussed the question with was Colonel Ewart, who evidently understood the matter thoroughly, and he said that for a few pounds he could ventilate the cabin just as it was.

Captain Scott thought it would be impossible to thoroughly ventilate so confined a space as that of the present saloon.

Admiral Ommanney repeated that, in his opinion, the great evil was the over-crowding.

Mr. Cole said over-crowding was an offence against the law, and had nothing to do with the construction of the vessel, or affording scientific ventilation.

Mr. Chadwick submitted that ventilation, though an important object, was secondary to that of the prevention of the horrors of sea-sickness, to which "sea-legged" men, who did not suffer from it themselves, had not shown themselves so solicitous as they might be for others. No doubt overcrowding and bad ventilation below aggravated the evil, but when they saw, as at times they did see, the upper decks covered in rough weather with sea-sick passengers, under the highest ventilation, that of a gale of wind, how could they go on treating ventilation as the chief or sole remedy? It was for the avoidance of sea-sickness to the weakly that the tunnel was looked for by many—that should be the main object. That was the great evil of the Channel passage, to be obviated by length and breadth of ship, by suspended cots, and ventilation, and any means that science and art could devise. Passengers from America, and seamen even, declared that they suffered more from crossing the Channel than during the whole voyage across the Atlantic.

The following resolutions were then adopted:—

"That a communication be made to the South-Eastern and the London, Chatham, and Dover Railway Companies, stating that the Committee have had before them the question of the improvement of the accommodation on board the existing steamers, and the various matters connected with it, such as ventilation, over-crowding, a better management for putting the luggage on board, separation of the fish, bullion, and merchandise from the ordinary traffic, and requesting that the matter may be submitted to their boards, with a view to some steps being taken for improvement on these points.

"While not confining themselves to these points, as requiring improvement, they think it may be of use to submit, as a suggestion, a sketch, prepared by Captain Scott, R.N., with a view to obviate some of the present evils."

The Committee having been informed that a plan for the ventilation of ships for the transport of horses was prepared by Monsieur Leon Duvoir's and applied successfully on some vessels of war used in the Crimea, it was resolved:—

"That application be made through the Foreign Office for a copy of Monsieur Leon Duvoir's report and plan."

The Committee then adjourned.

The Committee met on Tuesday, the 30th January, at three o'clock. Present—Messrs. Seymour Teulon (in the chair), Major-General Eardley-Wilmot, F.R.S., Grosvenor Hodgkinson, M.P., Vice-Admiral Ommanney, C.B., F.R.S., and Capt. Robt. Scott, R.N.

Capt. Dicey attended, and gave a description of boats which he recommended as suitable for the Channel passage, and which, in his opinion, would be available without any alteration of the existing harbours on either side. He said:—

Having resided for some time at Dover, and also crossed the Channel several times in all weathers, I have always been greatly surprised to see the annoyance and inconvenience that passengers have been put to on board the vessels carrying on this service; and on the last occasion of my returning from India, the passengers who had made the voyage from India and Australia, declared that they had suffered more discomfort and inconvenience in this short passage than they had done the whole of the journey. I have also known instances when this exposure to wet and cold on these vessels had brought on severe illness, ending fatally. These circumstances have influenced me for some time past to consider whether the service could not be performed by vessels better adapted for the conveyance of passengers and goods between the two countries.

The harbours of Calais and Boulogne, from their shallow entrances and their confined space within the harbour, have hitherto precluded the adoption of a larger and more commodious class of vessel than the present from being employed on the service. The question, then, to be considered is, is it possible to design and construct vessels to draw as little water as the present vessels, to require as little room in the harbours, and that shall be as handy or navigable for entering those ports, and at the same time to roll and pitch less and afford better accommodation for passengers. As a nautical man, and one that has had considerable experience in vessels of all kinds, and in different parts of the world, I believe in my own mind that these advantages can be secured, but it must be by a departure from the old-established rule and design of the ordinary and generally adopted plans of the present steam-vessels.

In many parts of the Indian Ocean, the natives navigate those seas in vessels fitted with an outrigger; these outriggers are two long spars secured across the vessel in midships, and projecting many feet out on one side. At the end of these spars, there is a log of timber secured parallel to the vessel, which is sufficiently buoyant not to sink, and heavy enough to keep the vessel always upright, however much sail she may carry. This outrigger, in fact, is a long lever to keep the vessel upright, or nearly so. Passengers in the Indian steamers touching at Point de Galle will frequently see these vessels, of 100 or 120 tons, at anchor in the harbour when there is a heavy sea rolling in, riding a few yards off, as upright and steady as though they were in the dock, while the large steamers of the Peninsular and Oriental Company, of 2,000 and 3,000 tons each, are rolling gunwales in the water, nearly.

Why should not this principle be adopted for the Channel steam ferry; but, instead of the outrigger, to have two vessels connected together at a certain distance apart? I would, therefore, suggest that two vessels be constructed, say of 400 feet long, 20 feet beam, and 20 feet depth of hold; they should be very sharp at the two ends, and flat in the floor, with a rudder at each end, and secured by means of girders at a distance of 35 feet apart, and parallel to each other, with the propelling paddles working between the two vessels. Of course, it will be doubted by many as to whether these two vessels can be so secured together as not to strain and work in a sea-way, but in the present day of iron and steel he would be a bold man who would state positively that this could not be effected. By this arrangement the vessels could not, of course, be crank or top-heavy, and consequently, can be any moderate height out of the water; I have therefore named 20 feet depth of hold, and I estimate the draught of water to be six feet; this will give a clear side out of the water between the two vessels of fourteen feet, and admit of girders of this depth, of a slightly arched form, to be placed between the two vessels, the crown under the deck, and the foot of the arch at the water-line. At each section of the vessels, where the girders are placed, I would have a bulkhead, strengthened with angle-iron, to be bolted and secured to the girder on the outside, thereby carrying the strength of the girder through from the outside of one vessel to the outside of the other; by this arrangement the six feet of the bulk-head in the inner portion of the vessel will also form a part of the girder on the outside. The deck could be continued over the girders from one vessel to the other, giving ample space for saloons and cabin accommodation for passengers. This deck being nearly fourteen feet above the water-line, could never be reached by any sea experienced in this part of the Channel before named.

I would also strengthen the vessels by a strong transverse girder over the deck, from the bow of one to the stern of the other, the whole length of the vessels. There would be no difficulty in having this girder eight feet deep, that is, the lower part on the main-deck, and the upper part on or through the deck, over the saloon and cabin accommodation; by this means, I believe the screwing strain that the vessels would be subject to would be met and resisted. If necessary, a transverse girder could also be fitted between the two vessels under the deck, passing from the bow of one vessel, between the paddles, to the quarter of the other, and, at angle through the vessels to the opposite side, where it would be secured to the framing of the vessels. This girder being eight feet deep, and secured to the one above on the deck, will give a depth of sixteen feet, by which means the two vessels could be so united that they would be as one rigid mass, and resist any tendency they may have to strain and twist in a seaway. These girders need not be heavy, but light, and in proportion to the strain they may have to bear.

I would also point out that this system of vessel can be increased in depth of hold without endangering the stability, and thereby giving great facilities for securing the two vessels together by deep girders. And with regard to the draught of water, it is only a question of a little more beam or length to each vessel, to carry the extra weight of girders and deck, to keep the draught as light as may be required. It is also important to consider that, however light the draught may be reduced to, it will not effect the steadiness of these vessels in a sea-way, like that of the ordinary single vessel, for it cannot be questioned, I think, that however large, and however much beam you may give a single vessel, they will roll in a sea-way.

I would have all the accommodation, such as saloons, cabins, and every other requisite for passengers on deck, which, in a vessel of the dimensions that I have stated, could extend for 200 feet at least, that is, for one hundred feet before the paddle-boxes and one hundred feet abaft them, with a passage all round the accommodation on the main-deck. Over this accommodation there will be a spacious deck, as a promenade for the passengers, of the above-named extent.

The baggage and light goods that would be conveyed by these vessels would be stowed in the holds, and it could be so arranged that this should be shipped or landed by means of a lift passing down the hatchway, and at once transferring it to the shore or ship, as the case may be.

The boilers and engines could be placed in the holds of the vessels, below the deck, where there would be ample room for coals and all other stores of the vessels.

As these vessels will be high out of the water, and the paddle-wheels well protected, there will be no difficulty in giving them a great diameter, and, with powerful engines, there is no reason why they should not cross over from Dover to Calais in a little over the hour.

With a rudder at each end of the vessel, on the balance principle, by which that at the fore part of the vessel can be used occasionally, to assist the other rudder on entering or leaving a port, or in narrow waters, this vessel will be as handy and navigable as an ordinary vessel, and will also do away with the necessity of turning round in the port, but will go in and out without turning. There will be no difficulty in so arranging the wheel-ropes that the wheel on the bridge will work the two rudders at the same time.

The paddle and paddleboxes being between the two vessels, there will be a clear side on the outside of the vessel; nothing, in fact, to come in contact with piers and jetties, as the vessel passes in and out of the port, which is so desirable.

A vessel on this principle cannot possibly roll like an ordinary vessel, for the one vessel will act as a lever on the other, to keep her steady, as in the case of the vessel with the outrigger. There will, of course, be a slight rising and sinking felt on the deck, in very heavy weather, but nothing compared to the motion of a single vessel, however large, however great the beam may be.

It must be borne in mind that the sea at this part of the Channel, between Dover and Calais, or Folkstone and Boulogne, is not a long, rolling sea, like that of the Atlantic, but is a broken, chopping sea, most trying to ordinary vessels, but with the long double vessels will scarcely be felt; and unless the passengers crossing by this vessel are exceedingly sensitive to sea-sickness, I am convinced that they will make the passage without any inconvenience on this head.

I have heard of experiments having been tried on double or twin vessels, to ascertain whether they would roll less than the ordinary vessel in a sea-way, and it was found that they offered no advantage at sea; but the mistake made in these experiments has been that the two vessels were placed close alongside of each other, or nearly so. Had they been kept a considerable distance apart, they would have shown the action of the lever, as in the case of the outrigger. It must be clear, I think, to any nautical man that, the longer the lever between the two vessels, the steadier they must be in a sea-way.

This class of vessel can use the ports of Calais or Boulogne as conveniently as the present vessels, thereby doing away with the necessity of constructing new harbours or increasing the size of the present ones.

The cost of such a vessel, with powerful engines, to keep up a speed that would ensure the passage being made in a little over the hour, and with accommodation on deck to accommodate 500 passengers, in saloons and cabins on the modern and improved principle, would cost between £70,000 and £80,000.

Three vessels of this class could be put on the line in six months.

The *Times*, of March 5th, states that a deputation, consisting of Sir Edward Watkin, chairman of the South-Eastern Railway Company; Mr. Grosvenor Hodgkinson, M.P., chairman; and Mr. Warter, director, of the London, Chatham, and Dover Railway Company, and Messrs. C. W. Eborall and J. S. Forbes, visited M. Thiers on the 4th instant, at his official residence at Versailles, to represent to him the inconveniences to which persons travelling between England and France, and through France, were at present put by the passport system, the want of a through service by the route of the Mont Cenis Tunnel, and the deficient harbours of Calais and Boulogne. Sir Edward Watkin showed that the through traffic was being driven from the route of France to that of Germany. As regards passports, M. Thiers said this system was only a temporary measure of political precaution (*très temporaire*), and he was quite willing to consider whether the precaution could not be applied in another way. He would communicate with the Director-General of Railways, M. de Franqueville, as to through arrangements, *viâ* Mont Cénis, for the Italian and Eastern route, and he desired the deputation to confer also with that Minister as to practical details, and also in reference to some precise and practical scheme of harbour improvement. The government of France would not oppose any practical scheme, and would do all that was possible during its own necessities, as to capital, to facilitate the undertaking of any works by English enterprise. They were most anxious to see the means of intercourse between the two countries improved and extended.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

General Purposes Committee.—A meeting of the General Purposes Committee appointed by her Majesty's Commissioners for the Exhibition of 1851, to carry out the current series of Annual International Exhibitions, was held on Wednesday, at Clarence-house. There were present his Royal Highness the Duke of Edinburgh, the Marquis of Ripon, Sir Francis R. Sandford, Mr. Edgar Bowring, and Major-General Scott, secretary.

Jewellery.—A meeting of the jewellery trade took place at the Albert-hall, on Thursday, the 29th ult. Her Majesty's Commissioners have decided, as stated in the *Journal* of the 23rd February, that the committees of selection for the different classes of manufactures in the approaching Exhibition shall be composed partly of Commissioners and partly of persons engaged in the production of the objects comprised in each class. The meeting referred to was to discuss the mode in which the committee of selection in the class of jewellery shall be appointed. It came to the conclusion that the task of selecting the lay members of the committee ought to be left to the Commissioners, while the "practical" members should be nominated by the intending exhibitors, each exhibitor naming, on a form provided for the purpose, a number of gentlemen whom he would like to act, and the Commissioners choosing from those so nominated the number required to complete the committee, care being taken that both the manufacturing and the retailing branches of the trade should be represented upon it. This course will accordingly be adopted. It was stated that large collections of jewellery from France, Belgium, Germany, and Russia would be exhibited, and that India would also be exceptionally well represented. Special collections of the jewellery worn by the peasantry of different countries were also being formed. The Birmingham Chamber of Commerce will exhibit a selection of the jewellery manufactured in that town. The day appointed for sending in objects for submission to the Committee of Selection for Jewellery is the 4th of April. Previous communication with the Commissioners is very advisable to facilitate preparations, but the general rules do not absolutely require it. General Scott explained to the meeting that, in order to get together a loan collection of modern jewellery (the lenders of which would probably desire to use some of the ornaments on particular occasions during the London season), jewellers who were intrusted with such loans by private persons would be allowed to remove the jewels from the Exhibition, on condition of their being immediately returned after use on the occasion for which they were required.

France.—The President of the French Commission has ordered that a bronze medal be struck and presented to each of the French artists and others who contributed to the Exhibition of 1871; these medals are now ready for delivery, with the copies of the diploma of the British Commission. The obverse of the medal bears a figure of France, and the reverse an inscription recording the place and date of the Exhibition.

Reception of Exhibits.—The reception of goods for this year's Exhibition began on the 1st inst., and from what has already been received there is no doubt whatever that the manufactures of the year will be very adequately represented. Exhibitors are requested to be as punctual as possible in their delivery, and as correct as possible in filling up the necessary forms. The articles in the following divisions have been already received:—Machinery for jewellery, machinery for paper and cotton, scientific inventions, cotton, acoustic apparatus, paper, stationery, and printing. The following are the days upon which the exhibits in the other divisions will be received:—

Saturday, March 9th.—Reproductions (East Entrance).
Tuesday, March 12th.—Tapestries, Carpets, and Embroideries (East Entrance).
Thursday, March 14th.—Designs for Decorative Manufactures (East Entrance).
Friday, March 15th.—Furniture, &c. (West Entrance).
Monday, March 18th.—Stained Glass (West Entrance).
Monday, March 25th.—Musical Instruments (East Entrance).
Thursday, April 4th.—Jewellery (East Entrance).

All objects must be delivered to the officers appointed to receive them, unpacked, and ready for immediate inspection, and free from all charges for carriage, &c. To every object a label, duly filled in, must be securely attached. The number on this label must correspond with the number of the object on the delivery-order. It is recommended that labels be attached to objects by wire. Delivery-orders, duly filled in, must be sent in with the exhibits. These forms must contain a complete list of all objects submitted for exhibition, and the numbers in the first column must correspond with the numbers on the labels. The doors will be opened at 8 a.m. daily, and will remain open until four p.m., except for one hour, viz., from twelve to one o'clock. The various labels and forms may be obtained at the offices of the Commissioners. The east entrance is in Exhibition-road; west entrance in Prince Albert's-road; south entrance in Exhibition-road.

In the Fine Arts Division, artists are at liberty to send in their works without filling in forms of preliminary application, the days appointed being as follows:—

Thursday and Friday, March 7 and 8.—Paintings. (West Entrance.)
Monday, March 11.—Architectural Designs. (East Entrance.)
Wednesday, March 13.—Engraving, Lithography, and Photography. (West Entrance.)
Wednesday, March 27.—Sculpture. (West Goods Entrance).

A numbered list of the works submitted for approval must be sent in with them, stating the name and address of the artist, the title and the price (if for sale) of each work. To each work itself a label must be securely attached, bearing the same information and the corresponding number in the list.

Royal Albert Hall.—A series of eighteen subscription concerts, to be given in May, June, and July next, with the sanction of Her Majesty's Commissioners for the Exhibition of 1851 (President, H.R.H. the Prince of Wales, K.G.), and under the direction of the Executive Committee of the Royal Albert Hall (Chairman, H.R.H. the Duke of Edinburgh, K.G.). These concerts will embrace four classes of music, viz.:—Oratorios, given by the Sacred Harmonic Society, under the direction of Sir Michael Costa. Operatic and miscellaneous concerts, given by Mr. Mapleson, who will have the services of the whole of his opera company. Popular concerts, given by Mr. Arthur Chappell, the manager of the Monday Popular Concerts at St. James's-hall. Grand choral concerts, given by her Majesty's Commissioners, under the direction of M. Charles Gounod, with the aid of "The Royal Albert Hall Choral Society," consisting of above 1,000 voices. Her Majesty the Queen has signified her hope of being able to be present at the first concert of this series, on the 8th May. The subscription for seats for the entire series of eighteen concerts will be as follows:—Balcony (front seats), three guineas each; arena stalls, six guineas each; amphitheatre stalls, seven guineas each. The seats and stalls will be transferable. The prices of admission to the public for any seats not subscribed for, for each concert, will be at least as follows:—Single admission—balcony (front seats), 5s. each; arena stalls, 7s. 6d. each; amphitheatre stalls, 10s. 6d. each. The Executive Committee reserve the power of raising these prices after a date which will be announced. The concerts will take place in the afternoons and evenings, the dates will be duly announced. The subscribers to these concerts will have the privilege of obtaining season tickets for the Exhibition of 1872 at the uniform rate of one guinea each. Tickets for the series may be obtained at the Royal Albert Hall, and of the usual agents.

Penny Subscription Concerts.—Under the authority of the Executive Committee of the Royal Albert Hall, twelve concerts will be given at such price of admission as will enable all classes to enjoy music in the Royal Albert Hall. They will take place on Tuesday evenings, beginning on the 12th March, and ending on the 28th May, 1872. The concerts will consist of glees, songs, and instrumental music, with recitals on the great organ. Subscription tickets for the twelve concerts will be as follows:—Personal admission for the twelve concerts:—Picture-gallery, 1s.; orchestra, 2s.; balcony seats, 3s.; arena stalls, 6s.; amphitheatre stalls, 12s. Single admission to each concert:—Picture-gallery, 3d.; orchestra, 6d.; balcony seats, 9d.; arena stalls, 1s. 6d.; amphitheatre stalls, 3s. Tickets are now ready, and may be had at the Royal Albert Hall and the usual agents. This series will enable large employers of labour, and other persons interested in the welfare of the lower classes, to give them an opportunity of obtaining rational enjoyment at a small cost.

EXHIBITIONS.

Vienna Exhibition.—It is said that the Austrian government has learned from trustworthy sources, that the Internationale Society is determined to prevent the projected exhibition at Vienna, or at any rate to place all possible obstacles in its way, by preventing the completion of articles intended for exhibition, or, by simultaneous strikes, stopping the transport of goods. The Internationale regards the proposed exhibition as a purely aristocratic enterprise, intended to benefit great capitalists and manufacturers, whilst the artizans who make the articles to be exhibited will have to support additional burdens, because the dearness caused by the influx of strangers will weigh more heavily on the working classes than on any other. In order to carry out these objects, it is added that the division of the Internationale established at Geneva is engaged in forming a "strike fund," to support the workmen in their efforts against the exhibition. The secret members of the society at Vienna are said to be acting in concert with the division of Geneva, and subscriptions for a strike fund are said to be on foot in the workmen's quarters of the city. The government is urged to meet the threatened difficulties by employing all the soldiers who have been brought up to trades, giving them leave of absence from military duty until the opening of the exhibition; but one of the complaints of the Internationale is, that the free artizans have already been injured by the employment of some hundreds of soldiers on the works of the exhibition building. It is to be hoped that these rumours are unfounded, or at least greatly exaggerated, and that the prospects of the proposed exhibition will not be endangered by a movement based upon such utterly false premises.

CORRESPONDENCE.

TRINKETS AND THEIR MANUFACTURE.

Sir,—Permit me to supplement the very instructive paper on this subject, read before the Society last week by Mr. Larkins, with a few facts relating to machine-made chains. The first machine ever employed in this kingdom for the purpose of manufacturing small ornamental chains, was introduced by me, and patented in 1857. The patent bears date November 14th, A.D. 1857, No. 2,863. The machine was invented and chiefly constructed in America, but was completed for me by Mr. Holland, whom you mention in your paper, and was sold to Mr. Goode, a chain manufacturer of Birmingham. In 1869, I patented another machine for making chains of a different pattern, and the patent for this invention was also purchased by the same manufacturer. The first machine, which cost less than fifty pounds, performed the work of seventy operatives, and the chain was more perfect. The chain is constructed entirely by the machine complete for the finishers. Several of these machines have been employed by Mr. Goode, and an immense number of these "snake chains," of which the sample you exhibited to the members is a modification, have been sold, and a fortune realised from this new branch of manufacture, the origin of which I claim for America, and introduction of which into the kingdom is due solely to the patent laws.—I am, &c.,

George Haseltine.

8, Southampton-buildings,
London, March 6th, 1872.

PRISON LABOUR.

Sir,—The name of the governor of Milbank Penitentiary, who, in 1842, accompanied me over the prison, was the late Rev. Daniel Nihill, (not Myall, as reported in the *Journal* of the 23rd February last), whose opinion of prison labour I have heard confirmed since by the governors of American prisons, at Sing-Sing, Albany, &c. It was stated by Mr. Dickens that prisoners in solitary confinement have requested to be employed in congenial work of some kind.

The Dorsetshire prisoners seem to have commenced their prison work in the year 1791, and to have continued it beneficially for ten years at least.

In the summer of 1863, a young woman, in the southwest of Hampshire, was assaulted feloniously and murdered, while walking to church on a Sunday morning, by a ticket-of-leave-convict, who was executed for the crime, under circumstances which proved the mischief of the system decidedly.—I am, &c.,

Chr. Cooke.

London, 1st March, 1872.

HOME COLONISATION.

Sir,—The thoughtful letter of Mr. Cave Thomas in your last, on "Home Colonisation," has struck a chord in my memory which has been practically silent for many years, and perhaps you will allow me to say a few words on a subject to which I paid much attention when a very young man. Unhappily, the subject then got so mixed up with polemics, party politics, the land question, and other endless matters of dispute, that life seemed too short for the settlement of even the preliminaries, and, like many others, I left off writing and speaking upon a subject so apparently hopeless.

A period of thirty-two years has produced a great change in public sentiment on this as upon other matters, and it is possible the question of "home colonisation" may now be discussed, without its advocates being looked upon either as demented visionaries or as revolutionary fanatics.

Nothing can, to my mind, be more common sense than the question—"Why should the skill and experience of the country be sent out of the country, in order that it may exist and flourish?" Is it proved that the country is too small for its population, because it happens that the towns have grown too large as centres of employment? Let us take an individual illustration. Suppose that Sir Titus Salt, on finding his business as a manufacturer of "alpacas" had become hampered by the limitation of his facilities at Bradford, had done as the nation does, and gone on "as well as he could"—for that is the cant phrase—in the immediate vicinity of the town in which his enterprise had practically developed a new industry, on the ground that he must remain where the skilled labour which he required was to be found, does any one suppose that he would have been so successful, either personally or nationally, as he has been by his "home colonisation" enterprise at Saltaire?

I well remember his statements to myself, as to the nature of his undertaking, during his attendance on one of the juries of the Great Exhibition of 1851, and the simple earnestness with which he replied to the question of "How much will it cost?" when he stated that he had made up his mind to expend £200,000, but he supposed it would be nearer a quarter of a million; yet he was sure it would pay, apart from the comfort it would bring to all concerned.

After such an example as Saltaire, it would be a mere waste of time to quote kindred instances, in which far-seeing and enlightened capitalists have redeemed considerable populations from the depressing circumstances and evil surroundings of large towns, by employing skilled labour at home, which otherwise would have found its work in distant colonies or rival countries. Yet this is practically "home colonisation" by individual effort, which shows that this important improvement in the distribution of population does not, as was at one time fallaciously maintained, depend upon co-operation. It simply depends upon sound organisation and enlightened administration. One thing, however, is pretty certain, that the capitalists who were far-sighted enough to direct their energies and money in this direction in the first instance were co-operators in spirit, and comprehended the whole question.

We have of late years had an improved feeling in relation to co-operation—in relation to distribution—beginning notably amongst the upper classes in their West-end club-houses, then manifesting itself in a still more systematic and economical form amongst the toiling workers of Rochdale, for the supply of their domestic necessaries, and now rapidly running into co-operative mills and factories in the same districts. Re-acting by example upon the middle classes of the metropolis and other large cities, in the original Rochdale form of co-operative stores, this idea of combination for a given and well-defined purpose, as in the case of the West-end clubs, is getting fast hold of the public mind, and the steps from co-operation for distribution to co-operation for production, and that, too, by means of home colonisation, is not a very startling one. In, fact the operation of the limited liability principle in partnership, which, like many other good things, has been quite as much abused as used, is, in one sense, a solution of the problem, as regards the provision of capital, system of direction, and administration.

It has been the dream of some very good—yes, and very wise men too—that the solution of the pauper question, not to speak of the diminution of crime, is involved in this question of home colonisation. At any rate, Mr. W. Cave Thomas has well said, that "the intrinsic value of a colony lies in this, that it withdraws surplus labour from overcrowded centres;" and but for emigration for the purposes of colonisation, both pauperism and crime would have been worse than they are at present. But why it is necessary that the surplus labour of this country, whether skilled or unskilled, educated or not, should be sent to a distant portion of the globe, when there is room enough at home if properly utilised, remains to be shown. Of course, we shall have the old assertions about "spread of civilisation," "extension of British power," "mission of the Anglo-Saxon race," and a string of equally veracious platitudes, for which one has lived long enough to have the most profound contempt, especially when a day's journey through almost any part of England, Scotland, or Ireland contradicts the huge fallacy of "over-population," unless we are also to accept the doctrine that no people ought to depend upon any other country for anything which that people may require, and that such nation or people shall always be absolutely in a condition to supply its own wants, which is about as absurd as insisting that every man shall be his own tailor, and, to quote the old nursery rhyme, "butcher, and baker, and candlestick-maker.—

I am, &c., George Wallis.

March 2nd, 1872.

MEETINGS.

British Medical Association.—At a meeting of the metropolitan counties branch of the British Medical Association, held on Tuesday night at the house of the Society of Arts, John-street, Adelphi, Dr. Russell Reynolds in the chair, papers were read on "The Provident System of Medical Relief from a National Point of View," and "The Provident System of Medical Relief from a Medical Point of View." The former was read by Mr. D. Dalrymple, M.P., and the latter by Dr. J. Ford Anderson, M.D. Mr. Dalrymple, after a few preliminary remarks, said the public had been so long in the habit of receiving medical advice gratis, that it now became a question as to whether those who were thus in the habit of receiving this aid were entitled to it gratuitously. He had himself known persons, who were in a position to pay the proper medical fee, attend the out-patients' room and receive advice gratis. A remedy was, in his opinion, essential to check this imposition, and the only way to do this was by hospital reform in the present mode of out-door assistance and the more general adoption of the provident system. He regarded the establishment of provident clubs and provident dispensaries as a means by which this imposition could be checked. By small subscriptions, these associations would be able to take a position that would give to the patient prompt assistance, which was so effective in arresting many a serious epidemic. He believed that if the provident system were better known it would lead up to a vastly improved state of things. He thought there was another system of poor-law relief that required great reform, and that was the issuing of tickets that led to the road of beef, beer, and port wine. Dr. Ford Anderson said there were 1,170,000 patients receiving relief from hospitals in London, and, as a large proportion of this number were in a position to pay for that relief, the profession were deprived of the fees they would otherwise have. He argued that by a small subscription provident dispensaries could be maintained, and patients would have the advantage of receiving the advice of medical men appointed and paid for their skill. Dr. Rogers thought the principle of provident dispensaries and independent sick-clubs the best way of providing medical relief for the poor, but all attempts to carry out this system had, up to the present time, failed. He was satisfied that if a proper system of medical relief were established under the Poor-law they would be able to weed out those who were in the habit of receiving gratuitous relief when they were not entitled to it; and he hoped that Mr. Dalrymple would not go with those in the House of Commons who secede from State-supported medical relief in favour of the simple provident principle. The Hon. and Rev. Samuel Best, Mr. C. J. Lord, Mr. Alsager Hay Hill, and other gentlemen took part in the discussion, supporting in the main the desirability of provident medical relief.

NOTES ON ART.

Recent events in Paris have of course thrown a very large number of works of art into the market. This is not to be wondered at, but it is a matter of remark that at the sales that have recently taken place, what may be considered extraordinary prices have been realised. Americans have been the largest purchasers, and the following are accounts of the results of two sales that have lately taken place:—

The sale in Paris of the collection Michel de Frétaigne, which numbered sixty fine works, and realised a total sum of more than £20,000, affords remarkable instances of high prices, and some few instances of very capricious figures. "A Pasturage," by Rosa Bonheur, sold for 12,000 fr.; while a well-known work by Bonnington, whose pictures usually fetch immense prices in Paris, "The Seine at Rouen," sold for only 1,500 fr.; two works by Brascassat, "Cattle in a Meadow" and "Sheep," fetched respectively 6,100 and 5,100 fr. The works of Decamps, even his least important, fetched high prices; at this sale, "A Kennel," by that artist, a well known work, sold for 23,600 fr.; "The Interior of a Court-yard in Italy," another charming picture, for 22,000 fr.; "The Court-yard of the Saint Nicholas-hotel," for 16,800 fr.; "Dogs Hunting for Truffles," for 15,100 fr.; "A Fox taken in a Trap," for 6,050 fr.; "Children at Breakfast," for 5,500 fr.; and a small picture of "Calvary," for 6,150 fr. Three of Delacroix's admirable Eastern pictures, "Arabs on a Journey," "A Cavalier attacked by a Lion," and "An Arab Vedette," fetched 30,500, 17,000, and 14,100 fr. "The Head of a Young Monk," by Delaroche, painted at Rome in 1837, sold for 1,980 fr. Eight pictures by Diaz, figures, pieces, and views of Fontainebleau, fetched severally from 5,000 to 10,000 fr. Meissonier's works, as usual, created a furore, "The Two Van der Veldes" sold for 38,000 fr., "The Young Man Reading," for 20,700 fr.; "The Young Man at his Studies," 26,200, and the pencil sketch for the last work, 1,050 fr. "A Group of Trees near a Stream," by the late J. Rousseau, fetched the large sum of 29,300 fr. Lastly, there were several fine works by Troyon, "Crossing the Ferry," which sold for 32,800 fr.; "Animals Grazing near a Wood," 29,500 fr.; "The Ford" 25,200 fr.; and "A View of Marseilles," by Ziem, fetched 5,000 fr.

The collection Paturle, which consists of twenty-eight pictures, and two unimportant pieces of sculpture, fetched the large sum of 455,370 francs. Two works by Brascassat, "Animals Grazing," fetched each 19,200 francs; "Les Natchez," from Atala, a minor work by Eugène Delacroix, 19,000 francs; "Cupid, the Physician," by Destouches, the comparatively large sum of 9,300 francs; "After the Storm," by Isabey, 12,000 francs; "Tobias and Sarah," by Henri Lehmann, 9,100 francs; "Flemish Boors," said to be the first work of Meissonier, 4,600 francs: Winterhalter's "Decameron," 14,009 francs; two famous pictures by Ary Scheffer fetched high prices, "Margaret leaving the Church," 35,000, and "Margaret in the Church," 40,000 francs; two reductions by the same artist, of "Faust in his Study" and "Margaret at her Spinning Wheel," sold for 5,450 and 5,050 francs; "Reading the Bible," by Henri Scheffer, fetched 8,700 francs, and "Joan of Arc going to Execution," by the same artist, from the Orleans collection, 4,700 francs. One of Troyon's finest works created great competition and fresh admiration, for it has certainly gained by time, although it was much praised when it was originally exhibited in 1855; it represents a mixed group of animals flying before a storm; it fetched 63,000 francs. Decamps, considering all things, must be said to have borne off the bell; there were two small works from his pencil, "Turkish Children playing with a Tortoise," sold for 20,700 francs, and "Donkeys Reposing," certainly one of his masterpieces, an Eastern landscape, glowing in rainbow tints and bathed in light, fetched the large sum of 51,000 francs. The largest amount of all, however, was that given for "The Fishermen of the Adriatic," by Léopold Robert, which was knocked down at 83,000 francs. There were, it must be mentioned, peculiar circumstances connected with this work. It was the last picture painted by the artist, and it was purchased for the museum of Neufchâtel, the chief town of the Swiss canton in which he was born. The work obtained considerable notoriety also from another circumstance. M. Paturle purchased the picture soon after the death of the artist, and, as it had not been exhibited in public, he obtained the use of a room in one of the mairies of Paris, and it was there shown for the benefit of the poor, the payments for admission amounting to 20,000 francs. The prices obtained at this sale are, perhaps, proportionably higher than have been known at the Hôtel Drouot, yet they are likely to be surpassed at the sale of the Péreire gallery, which is to finish the week.

A very curious map has just been placed in the Galerie d'Apollon, in the Louvre. It represents France in the time of Louis XIV., and is entirely composed of various coloured marbles, like Florentine mosaic. It is the work of an artist named Coplet, who was attached to the courts, and bears date 1864. It may be mentioned here that the whole of the rare collection of cups, crystals, jewellery, and other objects of art have been replaced in this gallery, which is enriched with some very fine examples of furniture from St. Cloud and other royal palaces.

The fifth exhibition of cabinet pictures, by British and foreign artists, opens on Monday next, the 11th inst., at the New British Institution, 39, Old Bond-street.

The Minister of Public Instruction in France has come to the resolution that in future, instead of the artistic work at the Sèvres manufactory being executed, as heretofore, by a few painters and modellers attached to the establishment, it shall be thrown open, and orders given for what is required to various artists, as in other cases. *Art* says the object of this resolution is doubtless to rescue the porcelain works from that conventional style to which it has for many years been confined. Troyon, the famous landscape and cattle painter, who was brought up in the establishment, protested long since against the copies of copies which were produced there, and only reached excellence after he had emancipated himself.

The same journal says that the painted glass of Paris was in great danger during the siege and the Commune. Fortunately, some of the most remarkable windows were removed from their frames, and those which were left in their places suffered but little; but the danger has served for a warning. The municipal authorities have come to a determination to meet any further dangers as far as possible; they have commissioned a well-known artist to look up with the greatest care all the original cartoons known of existing and lost windows, and to arrange them according to dates and styles, and to these are to be added carefully-made copies from remarkable windows of which the original cartoons cannot be found; the whole, when classified, are to be preserved in portfolios or made up into books. The precaution is a praiseworthy one, and the execution of the project cannot fail to bring some notable works to light.

A Frenchman, M. Lasche, has recently patented a method of preparing oil-paintings for decorative purposes, so that they may be kept in stock in the warehouse, and, when required, easily carried and fixed to the work to be adorned. The invention consists in painting upon tin-foil with properly prepared colours any desired subject or design, either by hand or suitable machinery. Plain stones, imitations of woods and marbles, figures of birds, shells, flowers, landscapes, plain and ornamental gilding, and imitation of carved work, can all be executed on either sheets or strips by skilled hands at the workshop, and supplied by the yard or piece, like paper-hangings, for the decoration of buildings, ships, carriages, carpenter's, or cabinet work, furniture, &c. Tin-foil of the greatest thickness is used, either composed of tin, or of a mixture of suitable metals; this is evenly spread on a hard and smooth surface, which is slightly moistened, to assist in the process of spreading the foil. The foil is then painted, either by hand or machinery, with the subject or design required, and is afterwards varnished. When thoroughly dry, it is removed from the hard surface, and is ready for affixing to the work to be decorated, or it may be rolled up like paper, and stored till required. The work to be coated, or the object to be decorated, is coated with a sticky varnish, or with hydraulic cement, and a piece of the oil-painting of the required size being cut, it is carefully pressed against the prepared surface, precautions being taken to prevent air-bubbles remaining underneath, when it is said to become firmly adherent; and being perfectly waterproof, protects the surfaces covered better than ordinary oil-paint, while it is preferable to paper for wall hangings from its impermeability to moisture. From the flexibility of the foil, as well as the paint or gilding, the prepared material can be affixed to mouldings, carvings, or other irregular surfaces. The invention cannot fail to be of great utility if the permanency of the colours and the adhesion of the foil can be relied upon.

The annual report of Mr. Boxall, the director of the National Gallery, states that the great purchase of the year 1871 was that of 77 pictures and 18 drawings, bought of Sir R. Peel for £75,000. The only other purcease of the year was one of a picture by David Teniers, of his own chateau, bought for £1,000. Two bequests were received in the year—a portrait of Francesco Ferrucci, by Lorenzo Costa, bequeathed by Sir A. C. Sterling, and John Gibson's marble bust of the painter, W. Bewick, bequeathed by Mrs. Bewick. Sir R. Wallace presented to the National Gallery in 1871, Gerard Terburg's "Peace of Munster." The trustees have accepted the loan, for a limited period, from the Duke de Ripalda, of the altar-piece by Raphael, formerly in the convent of the nuns of Saint d'Antonio di Padova, at Perugia. The picture was placed in the Gallery on a movable stand in October. The daily average of attendance at Trafalgar-square in 1871 was 4,880. The number of visitors in the year was 911,658, and at South Kensington 939,329. The report records the death, in November, 1871, of John Peter Wildsmith, who had faithfully discharged the duties of curator from the foundation of the Gallery, in 1824.

A literary and artistic society, for the advancement of the arts, and the protection of the interests of artists and literary men of Great Britain, will be immediately incorporated by Royal Charter. In connection with it is an "Artistic Insurance Trust," or guarantee fund, with a proposed capital of £250,000, which will be invested in trustees. The premiums paid are, of course, for the insurance of works of art from loss or damage during the period of exhibition.

GENERAL NOTES.

Picard's Coffee.—After the meeting on February, the members were invited to taste some coffee prepared by Mr. E. Picard, of 140, Strand. This coffee, and the method of roasting and making it, was mentioned in the *Journal* of January 5th. Those members who tasted the coffee expressed favourable opinions as to its strength, purity, and flavour.

Prize for Improved Galvanic Pile.—In 1866, the French government, through the Minister of Public Instruction, offered a prize, equal in value to the sum of £2,000, for the most useful application of the galvanic pile. The documents were to be sent in during the month of April, 1871; a few applications only were received, and the jury appointed to examine them decided that none were deserving of the prize. By a recent decree the competition is again opened, the last day of reception of applications being the 29th of November, 1876.

Lighting Houses, &c., by Mineral Oil.—Mr. A. M. Silber, of 56, Wood-street, Cheapside, who read a very interesting paper before the Society in December, 1870, on his new method of lighting houses, streets, factories, railway stations and carriages by mineral and vegetable oils, secured by a number of patents, has been elected an associate of the Institution of Civil Engineers. Mr. Silber has had his inventions well-tried and perfected before bringing them more prominently under public notice. Some of the principal railway companies have tried his signal and other lamps, and so satisfactory has been the results, that his orders for them will possibly be large. The signal lamps will be of acknowledged benefit to our naval and maritime fleet. This has been recognised by the Board of Trade, for it is a matter of the greatest importance to signal long distances by night, and the lamps referred to can be seen at a distance of seven miles. These lamps have also this great advantage, that every description of vegetable and mineral oil (as burnt in ordinary lamps) can be burnt alternately in one and the same lantern, and when vegetable oil, as rape or colza oil, is burned, no cutting of wick is required, each light showing an illuminating power equal to 12 to 20 sperm candles, which can be increased to a light equal to 50 sperm candles when specially ordered. The lamps have been tried on the following railways:—London, Chatham, and Dover, Metropolitan, Metropolitan District, South-Eastern, Great Western, and the London and North-Western.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

March 13th.—"On the British Trade with France during the last Ten Years, in its relation to the General Trade of the United Kingdom." By Leone Levi, Esq., Professor of the Principles of Commerce and Commercial Law in King's College, London.

March 20th.—"Notes from a Diamond Tour through South Africa." By Thomas Wm. Tobin, Esq.

March 27th.—*Passion Week.*

INDIA CONFERENCE.

This Evening, Friday, March 8th.—"On India as a Field for Private Enterprise"—Most suitable districts; situation and approach, described separately; soils, climate, sources of labour supply, &c.; staple crops to be grown with greatest advantage; indigenous products and minerals; tabulated statement of cost of cultivation of tea, cotton, &c., and probable profit of each; indigenous timber; live stock; form of government under which the settler will live in India. The Conference will be opened by Frederick Campbell, Esq., of Assam. Sir Donald McLeod, C.B., K.C.S.I., will preside.

CANTOR LECTURES.

The Fifth Lecture, on "Mechanism," by the Rev. Arthur Rigg, M.A., was delivered on Monday evening, March 4th. The concluding lecture will be given as follows:—

SYLLABUS.

Lecture VI.—Monday, 11th March, 1872.

Regulating and Adjusting Mechanism—Straight Line Motions—Epicyclic Trains—Differential Mechanism.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lecture. Rev. Arthur Rigg, "On Mechanism."
Royal Geographical, 8½. 1. Major E. C. Ross, "Visit to Kej and Journey from Gwadur to Kurrachee." 2. Major Beresford Lovett, "Survey of the Perso-Kelat Frontier."
Medical, 8.
London Institution, 4. Prof. John Ella, "Elementary Music."
Institute of Surveyors, 8. Discussion on Mr. Smith's Paper, entitled "Land."

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. Mr. John Herbert Latham, C.E., "The Sooukêsala Canal of the Madras Irrigation and Canal Company."
East India Association, 8. (At the House of the Society of Arts.) Mr. I. T. Prichard, "The Representation of India in Parliament."
Royal Institution, 3. Dr. Rutherford, "Circulatory and Nervous Systems."
Photographic, 8.

Wed.....**SOCIETY OF ARTS, 8.** Professor Leone Levi, "On the British Trade with France during the last Ten Years, in its relation to the General Trade of the United Kingdom."
Graphic, 8.
Royal Literary Fund, 3. Annual Meeting.
Royal Society of Literature, 4¼.
Royal College of Physicians, 5. Croonian Lecture. Dr. Bristowe, "On Disease and its Remedial Treatment."

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."
London Institution, 7½.

Fri.......Royal United Service Institution, 3. Captain H. M. Hozier, "The Employment of Cavalry, as Illustrated by the late War."
Philological, 8¼.
Royal Institution, 9. Mr. J. Evans, "The Alphabet and its Origin."

Sat.......Royal Institution, 3. Mr. Moncure D. Conway, "On Demonology."
Royal College of Physicians, 5. Lumleian Lecture. Dr. Quain, "On Diseases of the Muscular Walls of the Heart."

Journal of the Society of Arts.

No. 1,008. Vol. XX.

FRIDAY, MARCH 15, 1872.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 13, 1872; Major-General F. Eardley-Wilmot, R.A., F.R.S., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Brandon, Jonathan, 12, Fenchurch-street, E.C.
Clarke, J. Moir, Moir and Sons, Aberdeen.
Harrison, Charles William, Whitmore-lodge, Beckenham.
Jupe, J. M., Mere.
Millar, D. C., Milerevan Works, Lambeth, S.E.
Piggott, David S., 39, Gresham-street, E.C.
Previté, Joseph Weedon, 32, Addison-gardens North, W., and 3, Newman's-court, Cornhill, E.C.
Price, W. C., 14, Bow-lane, E.C.
Stevens, Warwick, Darlington Works, 37, Southwark-bridge-road, S.E.

The following candidates were balloted for and duly elected members of the Society:—

Leigh, John Studdy, 8, Old Jewry, E.C.
Magnus, Daniel, St. Bene't-chambers, Fenchurch-street, E.C.
Rivington, Charles Robert, 1, Fenchurch-buildings, E.C.
Robertson, James (Mayor of Weymouth), Lansdowne, Wyke Regis.
Robson, Robert, 54a, Tottenham-court-road, W.
Rohde, J., Holly-hill, Wanstead.
Saunders, Herbert C., 3, Bolton-gardens, South Kensington, W.
Saunders, R., 1, Ironmonger-lane, E.C.
Wilkins, Thomas, Adelaide-chambers, 52, Gracechurch-street, E.C.

The paper read was:—

ON THE BRITISH TRADE WITH FRANCE DURING THE LAST TEN YEARS, IN ITS RELATION TO THE GENERAL TRADE OF THE UNITED KINGDOM.

By Leone Levi, Esq., F.L.S., F.S.S.

(Professor of the Principles of Commerce and Commercial Law in King's College, London; Doctor of Political Economy.)

Richard Cobden, and the noble band of the Anti-Corn-law League, belonged to the Manchester school of politics. Right in principle, vigorous in action, eminently practical in their mode of regarding any question, they were not the men to spend their strength for nought. With the abolition of the Corn-laws the League was dissolved, for it was for one object that the organisation was started, and that had been accomplished, but the Manchester school remained; Cobden and Bright still uttered their vigorous defences of free-trade, and their influence continued paramount with the government and the people. When, therefore, it became known that Richard Cobden had been negotiating, though in an informal manner, with Michel Chevalier the terms of a treaty of commerce between France and the United Kingdom, even the greatest opponents of such treaties could entertain no doubt that, at their hands, the interests of free-trade could never suffer, and the soundest principles of commercial economics would not be prejudiced.

It was not certainly as the sequel of any contract with, or in view of any reciprocity on the part of foreign countries, that Huskisson and Sir Robert Peel initiated those reforms in the British tariff which contributed so much to the expansion of trade. If any overture was made to any one country, in the hope of securing a better treatment of British produce and manufacture, the result always proved most unsatisfactory, for one and all turned a deaf ear to any such representation. As for France, she sinned in the most conspicuous manner against a sound commercial policy. The reign of Louis Philippe was distinguished by utter subserviency to the interests of a few miners and manufacturers. The concessions made by Britain in favour of French corn, shipping, manufactures, and wines, were only met by differential duties, high imposts, and positive prohibitions; and it was only when Napoleon III. consolidated his throne, and became, so to say, master of the situation, that any chance was given for a more vigorous and independent policy. But Napoleon was not France; and in France, as everywhere else, it is long before the nation is educated into a new policy. It took ten years of constant agitation, with meetings and demonstrations without end, to teach the people of the United Kingdom the first elements of free-trade. Need we be surprised if France, with no such peripatetic philosophers at work as the Anti-Corn-law League, has been somewhat slower than Britain in apprehending the import of a sound commercial policy.

But was a Treaty of Commerce the best manner for accomplishing this important project? The Treaty of Commerce was certainly not the work of the people of France or of England, but of a few economists and diplomatists in each country. True, it is the prerogative of the Crown to make treaties with foreign states, on the principle, I suppose, that secrecy and immediate despatch are generally requisite in such matters; but England only undertook to recommend to Parliament to enable the government to abolish the duties involved in the treaty.* What voice could France have in the negotiations, when she was altogether forbidden by her constitution from interfering in any manner with the executive? When the treaty was communicated by Mr. Gladstone to the British Parliament, not a few censured it in the most decided manner. Why, it was asked, should we depart from the policy of acting independently in matters of tariffs? Why make financial questions the subject of treaties? Why contract any obligation not to prohibit the exportation of coals for ten years? Allowing that the paper duties and other duties on manufactures should and would be removed, was it expedient to do it when the revenue could not bear the loss? The French market, it was said, is of great value to us, and it is well to make some concessions in order to open it. But France had already commenced some commercial reforms in 1856, and she was progressing in the right direction, with the concurrence of the whole nation.

Reasonable, however, as such strictures were, there was one unanswerable argument in favour of the Treaty. Its provisions were liberal. There was no bargain of commercial advantage. Limited as it might be in its bearings, it was progressing in the direction of free-trade. England engaged to abolish the duties on a large number of articles of the production and manufactures of France; to reduce the duties on French wines and spirits, and not to prohibit the exportation of coal; and France engaged to remove all prohibitions, and to reduce the duties on a number of articles of British production and manufacture to a maximum rate of 30 per cent. *ad valorem* instantly, and to reduce them further to 25 per cent. by the 1st October, 1864, the same to be converted into specific duties by a supplementary convention. Surely, conditions like these were not very radical on either side. England only undertook to do at once what she would certainly have done in a very little time; and France only advanced so far as to reduce her tariff to 30 or 25 per cent., the condition in which England was some fifty years ago. But if the concessions made by the treaty on both sides fell far short of the importance generally attached to it, its moral influence was considerable. The public adherence of France to the great principle which she had so long combatted; the readiness shown by England to subject her productions to the most unrestricted competition; the impression generally felt that the Emperor and the French government were in favour of a still more decided policy, which in time they would be certain to develop; the honours awarded to Cobden in France; and the high position held by Michel Chevalier in the French Senate, were all favourable to the extension of free-trade principles all over the world. And it did seem as if Cobden had, by the conclusion of the treaty, put the coping-stone to the great edifice he had so long been labouring to rear. Nor was the treaty sterile in result in other countries. Treaties of commerce were soon after concluded by France and England with Belgium, the Zollverein, Austria, Switzerland, and Italy, and, through their direct and indirect operations, the customs barriers which divided the different states of Europe were, one and all, rendered more elastic, and commerce and navigation felt all the effects of a fresh impulse.

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* Mr. Rylands, M.P., has given notice in the House of Commons to move, "That in the opinion of this House, all future treaties between this country and foreign powers ought to be laid upon the table of both Houses of Parliament before being ratified, in order that an opportunity may be afforded to both Houses of expressing their opinion upon the provisions of such treaties."

Alas, however, for any great expectations from such treaties. At the very time when the States of Europe were endeavouring to draw closer together by mutual commerce and intercourse, the United States of America entered into a fearful strife, which effectually destroyed a large and important trade. Cotton, one of the principal articles in British and French industry, hitherto mainly imported from America, was no longer to be had except at famine prices. The rich markets of America were also closed to France, to England, and to the world. In 1861, the trade of England with the United States amounted to £60,000,000, in 1863 it was reduced to £38,000,000. In 1861, the trade of France with the United States amounted to £19,000,000, in 1863 it was reduced to less than £8,000,000. Happy was it that at the moment when the American trade became so reduced and unprofitable, the European trade had, through the Treaty of Commerce, become much more active. But the opening of such new branches of trade only neutralised the loss of the American trade, and for the whole of the period between 1860 and 1870 the civil war in America continued to exercise a most disastrous influence on the European trade. From a table in my "History of British Commerce," it will be seen that in that decennium, whilst the exports of British produce and manufacture to Europe increased at the rate of 65 per cent., those to America, including North and South, increased at the rate of 37 per cent. only.

There can be little doubt that the reforms introduced by the Treaty of Commerce have led to a large increase in the commerce of France, and to a great extension of trade between France and this country. Look at the following facts. The special commerce of France, that is the import for home-consumption and the exports of French merchandise, increased as follows:—

Years.	Imports.	Exports.	Total.
	francs.	francs.	francs.
1827	414,000,000	507,000,000	921,000,000
1830	489,000,000	453,000,000	942.000,000
1847	976,000,000	891,000.000	1.867,000.000
1851	781,000,000	1.239.000,000	2.020,000,000
1860	1,897,000,000	2,277,000,000	4.174,000.000
1868	3,304,000,000	2,925,000,000	6,229,000,000

From the revolution of 1830 to that of 1848, a period of 17 years, the trade of France increased 97 per cent. From the creation of the Second Empire, in 1851, to 1869, a period of 18 years, it increased 188 per cent. In the same manner, the navigation of French ports increased very considerably, as may be seen from the following table:—

Years.	Entered.	Cleared.	Total.
	tons.	tons.	tons.
1830	1,019,000	629,000	1,648,000
1844	2,173,000	2,121,000	4,294,000
1847	2,799,000	1,497,000	4,296,000
1851	2,201,000	1,886,000	4,087,000
1860	4,165,000	4,291,000	8,456,000
1868	6,800,000	6,853,000	13,653,000

Surely, then, France has no reason to complain of the Treaty. On the contrary, it evidently brought more activity and more profits into the country than ever was contemplated. If we now examine the commercial relations between England and France, we find an increase equally marked. Between 1827 and 1868 they were as follows, according to French accounts:—

Years.	Imports from England to France.	Exports from France to England.	Total.
	francs.	francs.	francs.
1827	13,700,000	59,900,000	72,600,000
1830	16,100,000	64,000,000	80,100,000
1847	72,400,000	116,800,000	189,200,000
1851	69,100,000	293,300,000	362,400,000
1860	239,700,000	598,900,000	838,600,000
1868	573,300,000	872,200,000	1,445,500,000

If, moreover, we compare closely the nature of the trade between England and France, we find that, whilst a large portion of our exports thither consisted of coals, copper, iron, machinery, oil, English wool, woollen yarn, cotton yarn, linen yarn, silk thrown, raw silk, raw cottons, colonial wool, hemp, all of which are either raw materials or instruments of industry, France sends to us woollen manufactures, silk manufactures, refined sugar, gloves, lace, and other articles of French industry. In truth, the French manufacturers have had a double advantage from the commercial treaty—they have received the raw material of industry at a reduced cost, and they have obtained stipulations from other countries in favour of their manufactured goods, which they have taken care not to return. But the French manufacturers regard all importations of foreign manufacture as injurious to their interests; they assert a right to the monopoly of the French market. The object of the government, in their opinion, should be, not to provide for the good of the greatest number, but to look to the welfare of French producers and manufacturers. They ignore all the good which trading affords to the nation, and complain of the slightest infringement of their own privileges. Such a partial legislation they could not obtain under a strong government like that of Napoleon, but they did attain it under a weak government like that of Louis Philippe, and will probably attain again under the vacillating and retrograde government of M. Thiers.

Long before France committed the egregious folly, or, I might more appropriately say, the crime of going to war with Prussia, from pure jealousy of the aggrandizement of her neighbours, French protectionists had been harassing the government respecting the Treaty of Commerce, and again and again keen debates took place in the French parliament on the subject. Just before the war began, a formal parliamentary inquiry was proceeding on the Regime Economique, in view of the renewal or abolition of the Treaty. Doubtless, under the Empire, even this inquiry would have ended with strengthening the free-trade party in France. But when M. Thiers came into power, and at his right hand, as Minister of Finance, was M. Puyer-Quertier, the old opponent of a free commercial policy, their very first thought was to upset the Treaty. Accordingly, the intentions of the French government were speedily made known, that, taking advantage of the 21st article of the Treaty, which stipulated that "the high contracting powers reserve to themselves the right to introduce, by common consent, into this Treaty, any modification which is not opposed to its spirit and principles, and the utility of which shall have been shown by experience," the government was decided to propose modifications affecting different numbers of cotton yarn, yarns of cotton, linen, and hemp, tissue of cotton, linen, and hemp, and damasked linen. In his Message to the Assembly in December last, M. Thiers entered fully into the question. He stated that though the Treaty with England, Belgium, and Prussia had, in one way and another, expired, there were others still in force with Austria, Switzerland, and Italy, which had three or four years to run. He objected to these treaties for various reasons. They were concluded without the nation having been consulted; absolute freedom was introduced without any preparation by them; French manufacturers were left unprotected all at once; France accepted insufficient tariffs, drawn up by foreign commissioners to the exclusion of French commissioners, and they caused to the most important national productions, such as iron, tissues of all kinds, agricultural products, and especially the mercantile marine, an immense injury. M. Thiers would not constitute himself the author of an industrial agitation by substituting a prohibitory system for one of wholly free-trade, but he would propose that, while leaving to foreign trade all the freedom compatible with the public welfare, they should ensure to French manufacturers—to those who, during three-quarters of a century, made the fortune of France—the protection of adequate tariffs, in order that they might not perish under the unlimited competition of foreigners, a protection sufficient to prevent them from falling into a state of indolent security, yet not lessening their energy sufficient to reduce them to the position of protection.

Before the question was formally submitted to the National Assembly, fifty-five Chambers of Commerce reported against terminating the Anglo-French Treaty. But what cares M. Thiers for the opinions of the Chambers of Commerce? Bent upon a retrograde policy, he and his coadjutor in the cabinet brought forward measure after measure altogether opposed to free-trade. The taxes on raw materials which they suggested would have effectually destroyed the whole trade of the country. Fancy 80 fr. on 100 kilos. on wool; 100 fr. on wax; 9 fr. 20 c. to 12 fr. on raw silk, and the like. Well was it that the proposal was rejected by the National Assembly by so large majority as 377 to 329. But, after all, the government returned to the same policy, and it would be difficult to find, in the whole plan of French finance introduced since the war, the slightest indication of regard to the economic progress of the country. The question of withdrawing from the Treaties of Commerce was formally submitted first to a committee, and then to a commission of the Assembly, and on the 5th February, by a show of hands, a resolution was passed to the following effect:—

"The Assembly, considering that without returning to the economic system which existed anterior to 1866, it is necessary in the present situation of the country to revise the customs tariff, decrees as follows:—

'Art. 1. That the government be authorised to give notice of withdrawal in convenient time from the treaties with England and Belgium.

"Art. 2. That the present tariff shall remain in vigour until new tariffs are voted."

Meanwhile negotiations were opened with the British government on the subject; and both on the ground of sympathy towards France in her straitened condition, and also with a view to prevent the total abandonment of the treaty, the British government was asked to agree to some modification, or, in other words, to the reinstatement of protection in France, at least in a modified form. The relations between the two countries being most friendly, the British government felt bound, ere giving an answer, to seek to elicit the opinion of the British Chambers of Commerce on the subject, but the result was, as might have been expected, altogether contrary to the proposed concessions. One and all of the chambers of commerce declared themselves hostile to becoming parties to the return of protection in France in any form whatever. The Manchester Chamber of Commerce resolved in the following terms:—

"That this Chamber laments that the French people are required to bear very heavy taxation for the payment of interest on their national debt, and deeply regret that, with the beneficent results of a free-trade policy in this country before their eyes, the French government should think it necessary or desirable to fetter the interchange of commerce with other nations.

"That this Chamber desires to express its emphatic condemnation of a policy having for its object the imposition of taxes for purely protectionist ends—a policy which is inimical to the true interests of any country.

"That this Chamber rejoices in the fact that the anti-prohibitive and anti-protectionist policy initiated by the Anglo-French treaty of 1860 has resulted in a large increase of the importation of French products into this country, and that England is the largest customer in the world for the products of France; the imports from that country being, in real value, in 1858 £13,271,000, and in 1867 £33,740,660.

"This Chamber, therefore, most earnestly recommend her Majesty's government not to be a party to any transaction which will have the effect of undoing, in the slightest degree, the good work begun by that eminent statesman, the late Richard Cobden."

In the same spirit the Associated Chambers of Commerce, at their meeting at Plymouth last September, resolved:—

"That a memorial be prepared, and presented to her Majesty's government, that it will not relinquish the stipulated notice of 12 months required to be given before the cessation of the terms of that treaty; and, further, expressing a confident hope that if any new treaty be entered into, it will not be of a retrograde character."

The Bradford Chamber of Commerce, less judicious than the other chambers, reported that, provided it were a final settlement till 1877, when the last of the commercial treaties concluded by France with other countries would expire, the opinion of the majority of the trade was in favour of acceding to an additional duty of 5 per cent., making 15 per cent., as a matter of policy, and a proof of good feeling towards France. But what purpose would such a policy serve? The French government is essentially protectionist, and, if allowed, it will restore, one by one, all the most objectionable features of that policy. To treat on any economic question with such a government is perfectly useless; to make any concession is only to encourage it to a more decided career of retrogression. The new tariff on the raw materials, the new navigation law, and almost every portion of the policy embraced in the Budget indicate a policy with which England can have no sympathy whatever; and it becomes this country, for her own sake, to remain entirely passive, and to offer a bold front against any departure from a free-trade policy. To England, indeed, it is not a matter of indifference whether the important market of France is to be open or closed. Though British commerce is wonderfully elastic, it is not independent of the fortune of any of its various branches. In the commerce of the United Kingdom France has held a prominent place. In 1870 the trade with France amounted to £60,000,000, being in the proportion of 10·87 per cent. of the whole trade of the country. The exports of British produce and manufactures, which from 1841 to 1850 averaged £2,500,000, rose in 1861-70 to an average of £10,000,000. The exports of foreign and colonial merchandise rose from £7,500,000 in 1850, to £10,000,000 in 1870; and our imports from France, which in 1855 amounted to £9,000,000, rose in 1870 to £37,600,000. We must remember, also, that our trade with other European countries has immensely increased in consequence of the improvement of the tariffs, and that if any reaction should take place over all the States which have entered within the bonds of the treaties of commerce, the injury to British trade would be extensive. Yet we venture to think that any retrograde policy adopted by France will not be followed by Belgium, Italy, Germany, and Switzerland; and that the injury produced by such a policy will redound much more against France than against England. British industry will not suffer much by our receiving less French silk manufactures, and few will be inconvenienced by returning to the consumption of port and sherry wine instead of claret. But French industry will immensely suffer by receiving less of British raw materials and other instruments of industry.

It does really seem as if France has learnt nothing during the last thirty years, and as if her foremost men were altogether powerless to prevent the progress of a most suicidal policy. Not content with increasing the cost of the materials of industry by heavy taxes; not content with denying to the entire population those productions and necessaries which they could obtain from foreign countries, the French government has re-enacted the Navigation Laws, and imposed a surtax on goods imported by foreign vessels. True, the French mercantile shipping has not been increasing of late years. In 1860, the tonnage of shipping belonging to France was 983,000 tons; in 1868, it was 1,058,000 tons. In 1860, of the tonnage entered into French ports 40 per cent. were French and 60 per cent. foreign. In 1868, 34 per cent. were French and 66 foreign. But what is the reason for this? It is that the French are not very good at sea. A few years ago Britain was anxious lest the French Navy should excel hers, and, doubtless, France has magnificent steam frigates of the newest structure. But when they were required on the Baltic, they proved useless in the hands of French sailors and French admirals. And so it may be with their merchant ships. Surely the French cannot expect that the navigation law can produce good sailors, any more than the Corn-law can improve agriculture, or high protection strengthen and improve national industry. If British shipping has increased enormously of late, it is in consequence of the better structure of ships, the extension of steam navigation, the quickness of despatch in loading and unloading, and the removal of all fetters on navigation.

To British ships trading in French ports, the surtax now proposed must be a great loss; but surely the Treaty of Commerce of January 26, 1826, has never been abrogated, and that provided for the reciprocal abrogation of all discriminating duties levied upon the vessels of either of the two nations in the ports of the other, whether under the head of duties of tonnage, harbour, lighthouse, pilotage and others of the same description, or in the shape of increased duties upon goods on account of their being imported or exported in other than national vessels. And did not that Treaty (and at least by implication, as respects shipping, that of 1860 also) place Britain on the footing of the most favoured nation, so as to enable her to benefit by any privilege enjoyed by other States from any treaty still in force? Clause XI. of that treaty, by which "each of the two high contracting powers engaged to confer on the other any favour, privilege, or reduction in the present treaty which the said power may concede to any third power, and not to enforce one against the other any prohibition of importation or exportation which shall not at the same time be applicable to all other nations," must be held to have engaged France, morally at least, to place Britain, both in commerce and navigation, on the footing of the most favoured nation.

A reform and economy in her expenditure, especially as regards the army and navy, the adoption of a frank and friendly policy towards foreign states, the abandonment, once and for ever, of a desire to interfere in the internal affairs of other countries, and the adoption of a sound economic policy as respects her agriculture, mining, and manufacture, might yet enable France to recover what she has lost, to restore her public credit, and attract towards her the sympathies of other nations. But she is now pursuing a policy diametrically opposed to these principles—her expenditure is excessive, her army eats up her resources, she is meddling with Italy, and nourishes a revengeful feeling towards Prussia; her economic policy is altogether erroneous, and her leaders represent the principles and views of the worst days of the mercantile system. In truth, the present condition of France is most discouraging, and it seems almost vain to hope that the voice of the chambers of commerce, or French economists, or of an enlightened press may yet awaken France from her slumbers. For her own sake, to save France from her worst friends, let England be firm in her policy. We have nothing to do with the commercial policy of France, but, in so far as in us lies, let us by our example and our precept show that we have reliance on the policy of free-trade, and that, whatever others may do, we will adhere to the principle of buying in the cheapest and selling in the dearest market, of opening our ports to the ships of all nations, and of subjecting our industries to the freest and most open competition.

Trade with France.

IMPORTS (REAL VALUE.)

	1860. £		1870. £
Animals	—	..	128,000
Brass and Bronze	45,000	..	34,000
Butter	442,000	..	1,673,000
Clocks and watches	471,000	..	310,000
China-ware	—	..	59,000
Cotton, raw	62,000	..	1,464,000
" manufactured	384,000	..	493,000
Eggs	400,000	..	865,000
Flax, undressed	86,000	..	96,000
Flowers, artificial	113,000	..	245,000
Fruit, raw	66,000	..	188,000
Garancine	55,000	..	167,000
Glass plate	16,000	..	81,000
Leather Manufactures:—			
Gloves	566,000	..	961,000
Boots and shoes	72,000	..	87,000
Boot fronts	67,000	..	12,000
Madder and madder roots	92,000	..	98,000
Musical instruments	—	..	112,000
Oil-seed cake	166,000	..	298,000
Oil and spirits of turpentine	—	..	41,000
Rape	—	..	231,000
Platting of straw	183,000	..	21,000

	1860. £	1870. £
Potatoes	74,000	99,000
Resin	1,000	37,000
Seed, clover	169,000	197,000
Silk, raw	496,000	2,029,000
„ waste	165,000	196,000
„ thrown	172,000	449.000
Silk manufactures of Europe	2,277,000	10,904,000
Spirits, brandy	1,058,000	2,138,000
Sugar, refined and unrefined	787,000	2,362,000
Wine	1,036,000	1,458,000
Wool	90.000	384.000
Woollen manufactures	1,049,000	2,279,000
All other articles	3,213,000	6,421,000
Total	£13,875,000	£36,607,000

EXPORTS.

British and Irish Produce.

	1860. £	1870. £
Alkali, soda	9,000	54,000
Apparel, haberdashery	44.000	198,000
Beer and ale	14,000	26,000
Caoutchouc manufacture	18,000	102,000
Cement	33,000	43,000
Coals	564,000	920,000
Corn, wheat	6,000	133,000
„ wheat flour	—	127.000
Cotton, yarn	50.000	191,000
„ piece goods	207,000	756,000
„ hosiery	41,000	138.000
Drugs, chemical produce	16,000	90,000
Earthenware	7,000	22.000
Hardware, cutlery	118,000	153.000
Horses	95,000	147,000
Linen yarn	71,000	201.000
„ piece goods	61,000	205.000
Machinery	171,000	288,000
Metals, copper	548 000	257,000
„ iron	370,000	505,000
„ lead	24,000	68,000
„ tin	115.000	123,000
„ tin-plates	36,000	27,000
„ zinc	31,000	31,000
Naphtha	19,000	46.000
Oil seed	342,000	125,000
Painters' colours	34,000	41,000
Silk yarn	132,000	34,000
„ thrown	222,000	226.000
„ manufacture	60,000	105.000
Spirits, British	50,000	1,000
Telegraphic wire	75,000	208.000
Wool, sheep	573.000	208.000
Woollen yarn	234,000	367,000
„ manufacture	26,000	875,000
„ worsted stuffs	234,000	1,168,000
„ flannels	9,000	65,000
„ other sorts	14,000	174,000
All other articles	581,000	3,195,000
Total	£5,250,000	£11,643,000

Foreign and Colonial Merchandise.

	1861. £	1870. £
Bacon and hams	1,000	51,000
Bark	44,000	14,000
Camphor	5,000	14,000
Caoutchouc	57,000	87,000
Cochineal	21,000	10,000
Cocoa	35,000	17,000
Coffee	124,000	435,000
Copper	146,000	442,000
Corn, wheat	580,000	268,000
Corn, wheat flour	204,000	207,000
Cotton	370.000	504,000
Flax	42,000	42 000
Guano	44,000	2,000
Gum	21,000	11,000
Hair manufacture	178,000	4.000
Hemp	33,000	21,000
Hemp jute	54,000	262.000
Hides	38,000	33,000
Indigo	171,000	59,000
Oil, cocoa	42,000	12,000
„ palm	5,000	26,000
Quicksilver	20.000	19,000
Rice	166,000	229,000
Seeds	238.000	296,000
Silk,	13,000	52,000
„ raw	3,192,000	2,538,000
„ thrown	100,000	6,000
Skins	23,000	14,000
Sugar	3,000	—
Tallow	190,000	2,000
Teeth, elephants'	62,000	52.000
Tin	34,000	58,000
Wine	64,000	26.000
Wool	1,502,000	3,123,000
Other articles	710,000	1,405,000
Total	£8,532,000	£10,340,000

Total Trade.

Year.	Imports.	Exports. British, foreign, & colonial merchandise.	Total.	Total trade of the United Kingdom.	Per-centage of French to total trade of United Kingdom.
	£	£	£	£	
1860...	17,774.037	12,701,372	30,475,409	375,652,224	8·13
1861...	17,826,646	17,427,271	25,253,717	377,117,522	6·69
1862...	21,675,516	21,765,669	43,441.185	391,885,110	11·07
1863...	24,025,777	23,294,566	47,320,283	445,821,[illegible]20	10·60
1864...	25,640,733	23,825,403	49.466.136	487,571,786	10·15
1865...	31.625.231	25,355,072	56,980,303	489.903,861	11·63
1866...	37,016,754	26,597,429	63,614,183	534,195.956	11·90
1867...	33,734,803	23,022,420	56,757,223	500,985,666	11·31
1868...	33,896,327	23,514,183	57,410,510	512,472.062	11·00
1869...	33,527,380	23,277,222	56,804,602	532,535,292	10·66
1870...	37,607,514	21,982,999	59,590,513	547,338,070	10·87

DISCUSSION.

Mr. Botly thought they were very much indebted to Professor Leone Levi for the paper which had been read, for he thought a paper fraught with greater results had never been read in that room before. He remembered, after the Corn-law was first enacted, it was stated by some political economists that it was impossible for Great Britain to pay the enormous interest of the national debt without the Corn-laws, though it was also stated by some politicians, in 1829 and 1830, that the increase in the manufactures of the country, consequent on their abolition, would go far to pay the interest of the national debt. When Captain Bouverie, brother of the Earl Radnor, advocated in Salisbury the abolition of the Corn-laws, he was diametrically opposed by various parties; but the Earl of Radnor told him (Mr. Botly) that he considered legislators were acting in their most legitimate capacity when legislating for that class of persons who could not legislate for themselves; and that, if the Corn-laws were abolished, he had no fear that the interest of the landed proprietors would suffer. What Lord Radnor prophesied in 1831, 1832, and 1833 had come quite true, for both corn and landed property had increased in value, as he had proved in his own experience as a small landed proprietor. He felt quite confident that France was pursuing a suicidal policy in thinking of returning to protection. Her only chance of recovering her position was to leave trade as free as possible; but if she did so, she might again be prosperous, glorious, and happy.

Mr. R. Ogilvie said he must add his thanks to Professor Levi for the admirable lecture he had given, for free-trade was one of the most important subjects, not only to England, but to the whole of Europe. This question of the French Treaty should be treated in a calm and dispassionate manner. The French argued that we should make some concessions, but he must agree with Professor Levi, that it would not be wise in us to do so. It was true, no doubt, that France was now in great financial distress, and had to raise large sums of money by some kind of taxation, but our own experience showed that if this had to be done, it was much better to do it by adopting a liberal system of light duties rather than by imposing heavy ones. It was a maxim of Mr. Cobden's, that you might as well drown a man in seven feet of water as in seventy; and it was the same thing in finance. If you put on a duty of such an amount as to prevent the trader from realising a profit, trade was really stopped, and you raised no revenue at all. If, therefore, they lent any aid to France in the way of putting heavy duties on raw materials, it would be very much like giving a man a razor to cut his throat, in order to get out of his difficulties. Of course, if France chose to follow an unwise policy, and abrogate the treaty, she must do so, and, on giving due notice, she was quite at liberty to take this course; but she would find, so far from increasing her finances, she would considerably reduce them, and at the same time derange and destroy her trade. With regard to the navigation laws, which she had only recently rescinded, it was very lamentable to find that she proposed reimposing them, and unfortunately he was afraid this would be the case, for the Treaty of 1826 referred only to harbour and local dues, over which the government had no control. There was a mutual treaty between France and England that the ships of each country should only pay the same local and harbour dues as would be charged upon native vessels, but that did not at all affect the navigation laws where the imperial government imposed the taxes. If France should rescind the treaty, it was certainly not the policy of England to retaliate, by attempting to put on any larger duties, but she should follow the course which she would have done from 1860 downwards, had not the treaty been negociated at that time. In fact, as far as England was concerned, the treaty was not necessary, because Mr. Gladstone had already announced his intention at the first opportunity to introduce a large measure of financial reform. Advantage was taken of that to enable the Emperor of France, by confirming the treaty, to introduce free-trade at once into France by an edict in the papers rather than by discussing the question in the legislative councils. England, therefore, must pursue a free-trade policy, and no doubt in time France also would find that that was the wisest course. There was a large party in France convinced of the benefit of free-trade, but, at the present moment, there was such an rchy, that they were ready to submit almost to anything to keep a government in the country. In the agricultural districts, however, there was a great feeling as to free-trade, and in favour of the Anglo-French Treaty of 1860, and he hoped this would, in time, bear good fruit. He was old enough to remember when an Englishman could hardly go into France without meeting with insult and abuse; but this had all been entirely changed, and the Treaty had therefore had an excellent effect, not only commercially, but also morally.

Mr. T. Briggs said there was no man in the kingdom who took greater interest in the question of free-trade than himself; indeed he put the motto "Universal free-trade, the first condition of universal peace," on all his note-paper and envelopes. He could not agree with the lecturer that the Cobden school was still in existence in Manchester; or if the school-house itself, in other words, the Free-Trade Hall, existed, it was empty, as far as the question of free-trade was concerned. He was sorry that men like Professor Levi did not bring more prominently forward the fact that England was really not a free-trade country. M. Thiers had recently stated that England raised forty-two millions by customs duties, &c., and made that a handle for his attempt to re-impose protection policy in France. In the face of these figures, how could there be a real free-trade. He was surprised to see that the people in France did not see that the man at the head of affairs was virtually throwing the country over a precipice into utter ruin, and he should not be astonished at another rising *en masse*, to effect a change of government. He did not agree with the Treaties of Commerce, thinking they were quite unnecessary, and if made for a certain number of years, they were bound to be continued, although the provision might prove unwise and prejudicial; and thus vested interests were created which were difficult afterwards to eradicate. France, no doubt, was in distress, but he was afraid she had not yet seen the worst of it, at any rate, if her present intentions were carried out. He remembered, in 1868, picking up a piece of paper in the garden of the Tuilleries, containing an outline of a petition to the Emperor to adopt the principle of free-trade, and he was quite satisfied that if he had done so at that time, the war with Prussia and all the subsequent evils would have been avoided. He concluded by saying that he intended to set on foot an agitation for the abolition of duties on malt, tea, coffee, sugar, and everything else.

Mr. Hancock did not quite understand how we raised £42,000,000 in defiance of the principles of free-trade, as nearly every protective duty had been abolished. But money must be raised in some way for the national purposes, and although all would be exceedingly happy, no doubt, to have tea, coffee, and other things perfectly free and untaxed, the consequence would be an increase of taxation in some other form. The question raised by the Professor was most important, particularly as the facts and figures he had quoted showed that since 1860 the position of both France and England had immensely improved. No doubt much of this was due to other causes, such as the increase of internal railway communication and of intercommunication between the two nations, but still, when the figures mounted up as they did, the conclusion could not be avoided that the adoption of a comparatively free-trade policy had been an immense benefit to both France and England, and had been the means of adding immense wealth to each, which they would not otherwise have enjoyed. There could be no doubt that in all economical questions France was at least half a century behind England, and that the majority held strong protectionist opinions; in fact, they had been accustomed so long to artificial support that they could not understand that a country which adopted free-trade principles was like a man who had the free and vigorous use of his limbs, compared with one who hobbled along on crutches, and that to re-introduce protection was simply resorting to such clumsy and useless expedients for aiding locomotion. He, therefore, fully agreed that, whatever France might do, England should not abandon her free-trade policy. As regards France, the introduction of protective duties might for a short time apparently benefit a few manufactures, inasmuch as they would get an enhanced price for their stock on hand, and would not have to fear foreign competition; but the advantage would be but temporary, for all foreign demand would cease for goods which could be obtained elsewhere. France would lose a great portion of her trade, and the whole country would suffer seriously in consequence.

Mr. Saward was surprised that no suggestion had been made as to the sources from which France should raise the enormous ransom which she had to pay to Prussia, for this ought to be done before she was unconditionally condemned for her proposal to impose fresh customs duties. It was very well to say such a course would be prejudicial to French interests, but he thought the inhabitants of a country always looked to their own interests first, and their neighbours were a secondary consideration. The great question which lay at the root of this discussion was that of direct *v.* indirect taxation. He was a strong advocate of the latter, and thought it much preferable to an income-tax, which had been kept on in England much longer than it ought to have been, though, had it not been for this, many customs duties could not have been taken off. If England had to pay such an enormous amount as was now required from France, he doubted very much whether any English government would attempt to raise it by direct taxation. The income-tax, though fair enough in theory, could never be fairly carried out, and it ought to be abolished.

Mr. Espinasse said he believed the French government had granted certain advantages to England in return for our lowering the import duties on French wines. He wished to know, however, whether the import duties on Spanish wines had not also been reduced in consequence, though Spain had declined to give us any counterbalancing advantages.

Professor Leone Levi, in replying, said there was no doubt that the finances of France were in a very extraordinary and shattered condition, and that she required to raise a revenue from all available sources, but it was for the Minister of Finance to consider what taxes would have the least injurious influence. Unfortunately, M. Thiers had adopted the most unwise and prejudicial system he could find. If he were to reduce the army expenditure, which was on an extravagant scale, and impose an income-tax, as had been urged in the Assembly, especially by M. Wolowski, he would place the finances of France in a better position than he ever would by these paltry protective duties. With regard to England, he quite agreed that she had fallen short of the expectation generally entertained with respect to free-trade. The abolition of the corn-laws did not constitute free-trade, for about £20,000,000 of our revenue was still raised from custom duties, which were really so many barriers to trade. His own impression on this matter was most decided, that the government should abolish the duties on sugar, coffee, and cocoa, and the other few articles now liable to custom duties, and leave in force only, to be collected by the Commissioners of Inland Revenue, those on wines and spirits, for which there were moral as well as economical reasons to be taken into account. He trusted that Mr. Lowe, with the present surplus, would go somewhat in that direction. As regards the duties on Spanish and French wines, the duties were reduced in 1860, from 5s. 9d. to 1s. a gallon on wines under 26 degrees of strength, and 2s. 6d. per gallon on wines which were of a greater strength. Spanish and Portuguese wines, therefore, came in at less duty than they could previously; but, at the same time, they had to pay 1s. 6d. a gallon more than French light wines. The Spanish government proposed to reduce the duties on British manufactures, provided the British government would equalise the wine duties, and charge 1s. a gallon generally, irrespective of strength. The British government, however, was not prepared to go so far as that, feeling that, to admit wines having as much as 40 per cent. of spirit at 1s. duty might interfere materially with the revenue on spirits, which now yielded (including British spirits) fifteen millions. This led to the suspen[illegible] of negotiations for a treaty of commerce with Spain. It should be remembered that the reduction of duties on wine has been adopted because it was generally believed that an increased consumption of wine would produce a lessened consumption of spirits. No doubt Spain had benefited by it, and she had not yet given England any corresponding advantages, though she had been repeatedly asked to do so. But she declined, except upon conditions which the British government did not see its way to accept. He believed that Sir Louis Mallet was anxious for the treaty, and that the government were divided upon the question, but that the present Chancellor of the Exchequer was opposed to entering into any more treaties, and that, therefore, the negotiations were broken off for the present.

The Chairman, in proposing a vote of thanks to Professor Leone Levi, said it must be remembered that the condition of France was very different to that of England, and also that to accomplish anything, even here, two main things were required. First, an educated public, and then what sailors called a jolly good row; and when these were secured something might be expected. In France, unfortunately, at the present time, there was a great want of the first, and an impossibility of the second. But until there was something of the sort public opinion could not act upon the government. In England, happily, the government represented, and must act in accordance with, public opinion; and therefore, when enlightened by such papers as they had heard that evening, and by the words of commercial men in the great manufacturing centres who studied the subject. Progress was certain, though there could be no doubt that it was slower than some energetic gentlemen desired, still they must be going in the right direction. If, therefore, the Professor had advocated the true policy, he was quite sure it would be adopted.

INDIA COMMITTEE.

A Conference was held on Friday, March 8th, Sir Donald McLeod, C.B., K.C.S.I., late Lieut.-Governor of the Punjaub, in the Chair.

The paper read was :—

ON INDIA AS A FIELD FOR PRIVATE ENTERPRISE.

By Frederick Campbell, Esq.

The countries best adapted for the emigration of retired civil and military officers and gentlemen of limited means appears to be a subject which is giving rise to considerable discussion and public interest. Australasia, New Zealand, Port Natal, India, and other places are advocated and recommended in turn. Having myself travelled over and resided in most of the places above-named for many years, it is my intention to place before the Society of Arts the facts and information which my long and varied experience has enabled me to become possessed of.

The manner in which my experience has been gained may be stated in a few words. In Europe, I gave some years to the study of every branch of agriculture, as practised in the United Kingdom and the Continent by the greatest proficients of the day. I then proceeded to Australia, and continued agricultural pursuits amongst the farmers and live-stock breeders in various parts of the colonies, where I had ample opportunities of studying the soils and capabilities of those countries, their suitability as a field for European enterprise, and for the investment of capital. After some time occupied in this manner, I was induced to visit Hindustan. On my arrival, the staff for the extensive system of railways, which the government of India had determined to carry out, was deficient in officers, and as, amongst my other studies in Europe, I had gone through a course of civil engineering and surveying, I accepted an appointment on one of the government railways. In after years I found this step of great use to me. I was enabled to acquire a knowledge of the language, and the capacities and habits of the labourers of different districts, which was invaluable. After being some years engaged at this kind of work, the tea mania broke out in Calcutta and the north-east provinces in 1863, and companies and private speculators were induced to open out vast tracts of waste land for purposes of tea-planting in various parts of the country. This sudden creation of an entirely new enterprise produced a demand for skilful tea-garden managers, which it was impossible to supply, and this, with other causes, led to some disaster and want of success. In 1864, I was first called on, in consequence of my previous experience in such matters, to visit and report on certain tea estates, and, having a decided preference for any occupation connected with the cultivation of land, I have been occupied in this manner up to the present time. My professional visits have led me throughout Assam, Cachar, Sylhet, Darjeeling, on the north-eastern frontier, Kangra Valley, in the Punjaub, and Kumâon, in the north-west provinces, these places comprising the whole of the tea districts of India. The individual gardens visited comprised some hundreds.

From the foregoing it will be seen that my opportunities of judging, from a practical point of view, the suitability of the different countries before-mentioned for European settlers have been very considerable and varied. Of all the places I have visited, whether Europe, Asia, or Australasia, I have no hesitation in stating most emphatically that, for the man of limited capital, no country with which I am acquainted offers such advantages as India, and it is with the view of placing all these advantages before the English people that this paper is written, at the same time briefly giving, by way of contrast, what my experience has taught me as to the colonies I have visited.

What may be said of Australia and Tasmania, I believe is more or less applicable to the whole of the English colonies. The class of people most suitable for colonists are either labourers or those of sufficient capital to be able to afford to pay labourers—that is, people of large capital who seek a better investment than can be obtained in Europe; but for men who have been brought up to a profession, and possess only a small capital, nothing but hardship and probable ruin is in store. The reason of this is, that the land of the colonies is, as a rule, not at all rich, and soon becomes impoverished. It is generally encumbered with heavy timber, which, in consequence of the high rate of wages, can only be cleared at enormous expense, and the crops which are grown are not very remunerative. A man who has followed a profession cannot execute agricultural work, and the consequence is, that his land, before he can bring sufficient into cultivation for his support, or obtain any return, has absorbed all his little capital, and all his time and money are wasted.

The only class of small capitalists who have succeeded are men who have occupied small farms at home, and who have been brought up as farm labourers, and to whom hard work and hard living have been familar from childhood. These men, with the assistance of a wife and family, can, by years of perseverance and privation, secure a competence, but this is not applicable to the man who has never done a day's labour in his life.

Again, lads or young men, who have plenty of time before them and few wants, may succeed, by obtaining employment on sheep farms, and, after some years of attention, become possessed of a small share in the concern, and thus gradually become wealthy.

There are other considerations which render the colonies undesirable. The seasons are very uncertain, severe, and prolonged droughts are common; disease in cattle and bush fires may, in a single season, destroy the work of years, and the whole of a small capital. Such disasters occurring to a labouring man are of less consequence, as he still has his power to labour left, and can commence again, but to the gentleman who has a wife and family dependent on him, such a visitation is utter ruin.

It is to this class of emigrant, who requires a quick return and large profits, that this paper is especially addressed, and it is in India that these advantages may be most especially expected. So far as my experience goes, Assam and surrounding districts present the most attractive field in that country.

The most important subject to be considered, in the choice of a country or locality, for the new settler, is undoubtedly that of accessibility, as on that depends more than anything else the value of produce grown and the cost of material imported. Considerations of quality of soil, labour, and cost of land, are as nothing compared to the cost of getting goods to market. I believe that in the advantages in this matter Assam stands unrivalled; it is intersected in its whole length by the magnificent river Brahmapootra, and there are numerous tributaries running into it at right angles, extending to the foot of the mountains on either side of the valley, which are navigable.

The whole valley of Assam extends from longitude 90° to longitude 98° east. The river Brahmapootra, as stated, passes through the centre, and during the rains is of vast magnitude; it is composed of a main channel and numerous branches, useful for navigation during the floods. The main channel is navigable during the whole year for large steamers, as far as the military station of Delrooghur, traversing in its course 900 miles to its outlet in the Bay of Bengal. The course of the river along the valley of Assam, is nearly due east and west, at longitude 90°, latitude 26°; it turns at right angles, and runs due south, and joins the Bay of Bengal at latitude 21½°. The navigation is easy and safe throughout the year.

The valley of Assam is bounded on the south by the ranges of hills extending from Bengal, and known respectively as the Garrow, the Cossiah, the Juntia, north Cachar, the Mekeer, and and the Nagga hills. A considerable portion of these hills is surmounted by fine, undulating plateaux, 6,000 to 7,000 feet high, watered by numerous streams. They are about eighty miles wide, and divide Assam from Sylhet and South Cachar. On the north boundary of the valley are situated the Himalaya mountains, rising to a height of 28,000 feet, and from many parts magnificent views of the snowy ranges are obtained. At the western end is Bhootan, extending to a country which is, I believe, under the Thibet government, and inhabited by the Abos and other tribes. The boundaries of British territory lying between these ranges vary from forty to eighty miles wide; so far as they have been but imperfectly defined, it appears that the boundary extends to a certain number of ranges on either side, but which those ranges are is not very clearly decided, nor is it of much consequence, as, should it ever be found that there is land of value outside our boundaries, a settlement with the natives could very easily be arrived at.

The formation of the valley is very uniform throughout on both sides of the river. On the immediate river frontage are vast tracts of land, deltas formed by the mud brought down by the river and its innumerable tributaries. These tracts are known as "churs," and are covered by grass jungle of gigantic size, growing in places to a height of 25 feet. This is succeeded by plains of a few feet elevation, sufficient to ensure thorough drainage, and these again gradually ascend in steppes to the foot of the hills, and are succeeded by ranges of gradually-increasing elevation, till they reach 7,000 feet on the south, and 28,000 feet on the north side of the valley. These plains are intersected by large tracts of bheel and lowland, which becomes inundated during the wet season to the depth of a few inches, and for rice-growing is of equal value to the higher land.

As stated, the width of the valley is inconsiderable, and as the country is level, roads may be made to connect any part of it with the main river at very small cost, and form, in connection with the navigable streams, a cheap and convenient communication with the river steamers.

The river Brahmapootra traverses, in its southern course, a distance of 400 miles to the Bay of Bengal, through the Megna and Ganges, with which rivers it forms a juncture at Goalando.

At the present time, the whole of the produce of Assam and the north-eastern provinces finds its way to Calcutta, the port of exportation over the Eastern Bengal Railway, or by steamers and country boats down the Ganges, round the sea face of the Sunderbunds and of the Hooghly.

A single glance at the map will show beyond all doubt that Goalando, or some place nearer the sea, is the proper point to form a port for the exportation and importation of goods from these rich provinces, and this will be accomplished, no doubt, when Assam becomes cultivated, and there is sufficient trade for loaded vessels to proceed to that point, instead of going to Calcutta through the Hooghly.

Both these points, Calcutta, on the Hooghly, and Goalando, at the juncture of the Ganges, Brahmapootra, Megna, and other rivers, being equally convenient to the sea, the journey by rail or water to Calcutta is saved, and by this saving of distance nearly one-half the cost of freight to England from these districts would also be saved.

The time and expense of the journey for goods and passengers between Assam and England may be approximately stated as follows:—By overland route to Calcutta it is possible to accomplish the journey in 29 days. This route will be by the Peninsular and Oriental Company's steamers, *viâ* Brindisi and Bombay; the cost for a single passage, including railway fares in Europe and Asia, will be, first-class, £95; second-class, about £47. By going to Calcutta, direct through the Suez Canal, from Liverpool or London, by any of the new lines of steamers which are coming into operation, the journey can be performed in 35 days, the charge being, first-class, £50; second-class, £25. This is by far the most agreeable way of doing the journey where time is no object, and, as the figures show, much cheaper; to single men, to whom money is an object, a very comfortable passage is given in the second-class cabins.

On arriving at Calcutta, a passage may be taken in any of the numerous inland steamers to any port in Assam. This will take from six to ten days, depending on the state of the floods or the dry weather, and the distance to be travelled; the journey may be done for £20, including all expenses.

Freights are at present very high, but as the quantity of exports increases, will be much lowered. The cost of freight of tea from Assam to Calcutta is £3 per ton; from Calcutta to England £2, making in all £5 per ton. For seeds, rice, &c., it is much less. When a sufficiently large trade is obtained to enable ships to load in the Ganges, the freight from Assam to England will not exceed £2 10s. to £3 per ton. As the passage down the stream of the rivers is much faster than up, the entire passage from Assam to England, through Calcutta, occupies about 40 days. From the Ganges, the time required would not be more than 35 days through the Suez Canal.

This description of the means and cost of access to Assam applies equally to the Cossiah Hills and the Bhootan Dooars, and compares most favourably with the colonies and other parts of India. From other parts of India the carriage to a seaport is over vast distances of land, either by bullock-carts or railway, the cost of which far exceeds the whole cost from Assam to England. In the colonies of Australia there is scarcely any water-carriage, and the land transport is enormously expensive; and the sea voyage, under the most favourable circumstances, more than double in time and cost that from the Bay of Bengal.

The climate of Assam has been much discussed, and very often condemned as unhealthy; but, generally, those who condemn the climate do so without due consideration, and often from having been disappointed in other matters, which leads them to speak badly of the country in every respect.

It must be borne in mind that Assam, is, with little exception, one vast jungle, and a jungle so dense, from the richness of the soil and the forcing character of the climate, that no description can convey any conception of it. This jungle chokes up the streams and impedes the free drainage of the Bheels. Vast masses of vegetation are accumulated everywhere, which, on the drying-up of the rains, gives off malaria. Again, when land, has been under forest perhaps for thousands of years, with foliage so dense as to exclude both sun and air, the accumulation of vegetable matter in the soil is so great that when it is first cleared and exposed to the action of the sun, unhealthy gases are exhaled. But in a very short time, by ventilation through cultivation and exposure to the sun, all injury from this source disappears, and wherever cultivation exists, the climate is excellent, even in the hottest seasons. During about six months of the year the climate, in spite of the jungly state of the country, is equal to Southern Italy or Madeira in April, which is, I believe, considered the most delightful month of those fine climates. During the hot months, which do not exceed three in the year, the thermometer seldom reaches 90° in the shade[*] so that, even now, a man, with the most ordinary attention to the requirements of the country, may reckon on excellent health; and were the country brought generally under cultivation, the jungle cleared away, so as to allow free drainage and admit free circulation of air, I have no hesitation in saying that there are few if any countries avaible for emigration which offer so many temptations and possess so few inconveniences as Assam for the English settler.

In the early days of Assam tea-planting, there were some deaths and much sickness, both amongst Europeans and natives, but this generally arose from causes with which the climate had nothing whatever do, and are easily accounted for. When the tea-planting mania broke out, large numbers of young and inexperienced men were sent into Assam, who were totally unacquainted with the first principles of a settler's life in a new country, and here they had to build their own houses, and select the best sites for themselves and labourers. This generally resulted in both sites and houses being as bad and unhealthy as they could possibly be. Again, the population of the province was very sparse, and no more was grown than sufficed for its own wants; nearly all provisions were, therefore, imported, and it was at first impossible to procure a proper supply, and all alike—natives and Europeans—suffered greatly from bad food and water. Another cause was from bad roads or the total absence of all communication, the occupation of the country having been so sudden that no time had been allowed for construction; the consequence was that young men, finding themselves perfectly isolated, engaged on work they did not understand, and surrounded by people whose language was unknown to them, they, in disgust, took to that curse of India, brandy-drinking, and thus it was, with constitutions (originally not hardened by toil) weakened by bad food and worse drink, they were carried off by fevers and bowel complaints, which would have caused a well-fed, abstemious man no inconvenience. All these evils have disappeared. Roads now render communication—garden with garden, and with the different stations—easy and rapid. Fruit and vegetable gardens have been planted, and vegetables of the finest description are obtained. Sheep have been imported in large numbers, and excellent European provisions of all kinds and good beer can be regularly obtained from the numerous steamers which now run between Calcutta and

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[*] During the cold season I have known the thermometer as low as 30 degrees, and good furs and great coats, with warm European clothing, is the order of the day.

Assam as in Calcutta itself, and at very reasonable rates, and, what is of equal importance, the planters have learned by experience the best localities for houses and a more improved construction. All these things have resulted in the general good health of Europeans, and in the marked improvement in the health and strength of the imported coolie, who, after a short residence in Assam, becomes fat, and a much more able man than he ever was in his own country. This fact alone, I think, speaks well for the natural healthiness of Assam when the jungle is removed.

But that I fear to become tedious, I could give innumerable instances which have come under my own notice, which would prove that the unhealthiness of Assam arises from local circumstances quite under control and susceptible of remedy. I will give one instance. I was called on to visit a garden professionally, in Central Assam, and to report especially on the cause of the numerous deaths amongst the imported coolies (which had been appalling), and, if possible, suggest a remedy. I found that the death-rate was about 75 per cent. per annum. On examining the site of the coolies' huts, I found them in a literal sunk hole, surrounded by a swamp, on the border of a river, which became filled by the overflowing of the river, but for which there was no drainage when the river went down, thus the accumulation of vegetable matter and all kinds of filth was very great, and quite sufficient to account for the fearful mortality amongst the people. My remedy was a very simple one. I had new huts built on some high land on the borders of the swamp, but with good water and ample ventilation; the coolies were removed into them with as little delay as possible, and though many of them were newly imported (a class to whom the climate is most trying) the death-rate since has not been more than that of their own country, and yet the new site selected for the huts was not more than half-a-mile from the old one. With reference to Europeans, I could name men who have remained in Assam for thirty or forty years, without once leaving it, and have enjoyed the best health.

The rainfall of Assam is from 70 to 75 inches—rather more than Bengal—but the fall is spread over a much greater number of months, and the rainy season is not so destructively marked as in Bengal; it is, therefore, much more beneficial to planters.

We next come to the soils of Assam; there are, of course, a great variety, both in texture and quality, and the north and south sides of the valley are totally different.

On the south side the soil is of great depth, and is principally of a dull-red colour, and is composed of disintegrated latterete. The upper strata, for a considerable depth, being much discoloured by the accumulation of vegetable matter; it is entirely free from stones of any kind, and varies from stiff clay to light sandy soil and sandy loam. The soil is of great natural fertility, which is increased in richness by the accumulation of vegetable matter, shed by the jungle by which it has been covered for centuries. Of these soils, there is no doubt that, for general purposes, the light sandy loam is the best; it is more easily worked than the clay, and is richer than the lighter soils; this soil is, of all others, the best adapted for tea, not only for its richness, but on account of the large proportion of iron contained in it, the presence of iron in the soil being considered indispensible to the tea plant; it is also sufficiently friable to ensure rapid drainage.

On the north bank, the upper stratum consists of black soil, formed of decomposed basalt, and is several feet in thickness; the subsoil is a rich greasy sand. Both soils are of a sufficient tenacity to retain moisture, and at the same time sufficiently friable to ensure the necessary drainage. This soil is particularly adapted to the growth of cotton, although every plant will flourish on it with wonderful luxuriance.

I believe I shall be stating no more than the truth, when I say that Assam possesses in every respect as fine soil as any in the world; I have never seen anything to be compared with it. This, in combination with the heat of the climate, and the humidity of the atmosphere, produces a luxuriance of vegetation, both in cultivated plants and jungle, truly wonderful. All the productions of the tropics and the temperate regions grow here in the greatest perfection.

The native population of this fertile valley is very sparse. Those people who inhabit the plains are of two classes, the native Assamese and the Cacharees, who occupy a fertile district in Durrung.

The Assamese are very lazy, dishonest, and unreliable. They will only work when it suits them, and will generally fail in the completion of any contract when it answers their purpose. When a very great demand for labour existed, and large sums of money were poured into the province, the high rate of wages induced them to work; and becoming possessed of money so easily, they acquired a taste for European luxuries and opium, and this has been productive of some good, for having acquired a taste for these luxuries, they are not prepared to dispense with them, and they will work at the lighter tasks when they can be obtained in no other way; but for the general purposes of a plantation they cannot be depended on. But though these people are not useful as labourers, many intelligent servants may be obtained from amongst them. They are excellent garden sirdars, or overseers, writers, and tea-makers, and some of them are good house-servants. They are Hindoos of a very bigoted order.

The Cacharees are of a totally different class, and are evidently settlers from some other country, probably from Thibet. They are powerful, thick-set men, very industrious and independent; they contrast most favourably with the native Assamese, in that they are truthful, and will carry out their contracts most faithfully. It is to be regretted that they are a small tribe, and the amount of labourers obtainable from amongst them is very limited.

The hill tribes are at present of little use. Those gardens in the immediate vicinity of the hills have succeeded in inducing some of the Meekurs and Naggurs to work at leaf-plucking, hut-building, &c., but they only work by fits and starts, to supply themselves with some immediate want. They are perfect savages; but as the valley becomes occupied, I shall expect to see these tribes form a very valuable source of labour supply.

The cultivation of this territory must be carried on by labour from other sources than that provided in the country itself. This need be no barrier, or any cause of discouragement. At the very threshold of Assam are the teeming millions of Bengal and the rest of India. Any number of these may be obtained by employing a sirdar, or recruiter, and transported to Assam at little expense, or they may be obtained through a coolie agent in Calcutta; this is, however, the more expensive plan.

Labourers are now sent to the West Indies and the Mauritius for the use of the sugar plantations, at six times the original cost, and at four times the rate of wages required in sending them to the tea plantations of Assam. When it is considered, therefore, that the tea, cotton, and the other products of Assam are far more remunerative than sugar, the labour question need cause no apprehension. Good, able coolies may be obtained by sirdar* at Rs. 30 (£3) per head, landed on the garden, or through a Calcutta coolie contractor, for from Rs. 40 to Rs. 50., according to the demand. But when good roads are opened out from Bengal, which might be done at little expense from Dhoobree, a station on the river Brahmapootra, the distance to the tea and cotton districts from the densely peopled districts of Bengal will not exceed 200 miles; the high wages of the tea-gardens and cotton-fields will then attract sufficient labour for all purposes at a nominal cost.

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* Native garden overseer.

Laws and regulations have, from time to time, been issued by the government for the benefit of those coolies emigrating to Assam, Cachar, &c., the last of which were framed in 1869, and are appended to this paper; they appear to be fairly drawn up, and many offensive and unnecessary restrictions which existed in former enactments have been withdrawn. In speaking of the area of of land available in Assam for emigrants, I shall confine myself to that portion commencing at Gowhatty, longitude 92° east, and extending to longitude 97°, at the extreme boundary of the province; it is at Gowhatty that the tea-gardens commence. It is very difficult to arrive at a satisfactory conclusion on this matter, in consequence of no survey of the province having been made; the boundaries are very inaccurately defined, and the quantity of land actually under cultivation, or in the hands of the natives, is not known. After carefully weighing the matter, I believe that there are 10,000,000 of acres unappropriated; of this there are 2,000,000 of acres of the highest class of tea-land. Of the black land, suitable especially for cotton, there are about 4.00 .000 acres, and the rest is well adapted for the growth of rhea-grass, tobacco. opium, sugar, jute, rice, and hemp; to these may be added many plants of minor importance, but of great value, such as ginger, chillies. or red-pepper, arrowroot, and seeds of various kinds. The finest tussa-silk is grown on the jungle trees of the plains, and the hills are admirably adapted to give an unlimited supply of the finer descriptions of silk. The churs on the river are excellent for the growth of the finest indigo, and the bheels produce crops of rice, of an abundance unheard of in other parts of India. These bheels are the receptacles from the surrounding country of all the richer portions of the vegetable matter carried into them by the rains, and are seldom more than a few inches deep, so that the first rain-fall renders them ready for rice-planting, and the failure of a crop an impossibility. Thus, all the most valuable crops of commerce may be here produced in the greatest abundance, and with little uncertainty or risk. In all other parts of India and the Colonies we hear of droughts preventing the planting of indigo or corn crops, or of their being destroyed when grown, by hot winds, bush-fires, or untimely floods. None of these calamities visit the glorious valley of Assam. By watching the seasons the loss of a crop is almost an impossibility.

In referring to the land suited to the different crops, it must not be understood that that particular land is only suited to that particular crop, for the cotton land will grow splendid tea, and the tea land splendid cotton, and both, any of the other crops mentioned, with the greatest luxuriance.

Near the district of Durrung, at the western end of Assam, at longitude 92°, commence the Bengal Dooars, and the Terai. This is a district skirting the foot of the Himalaya mountains, and extends to the frontier of Nepaul, at longitude 89°, and lies between latitudes 26° and 27° north. The greater portion of this tract of land is dense forest, and grass jungle; the description of the north banks of the Brahmapootra, in Assam, its soil and productions, &c., applies to it in every way. The climate is said to be very bad, but this arises only from the jungle not being cleared; and the mountains being in such a close vicinity, houses can be built at any elevation required for health, and the farms on the low lands carried on with perfect convenience. This plan has been successfully adopted at the foot of the Darjeeling hills. The tea-gardens are being worked with the greatest success in the Terai, and the yield of tea equal to the best Assam plantations. The area of this tract of magnificent land contains about 5,000,000 acres of waste land, and while in every respect equal to Assam, it has the advantage of being closer to an unlimited supply of labour from Bengal, as a reference to the map will show. The outlet for produce is either by road or river to the Ganges and Brahmapootra; there is a capital metalled road from Darjeeling to Carigola Ghat, on the river Ganges, a distance of about 150 miles; this road is available, and in fairly good order throughout the year. The river Mahanuddy also leads through a portion of the land, and goods, at certain seasons of the year, can be sent by it to the Ganges, and thence to Goalando, or to Sahibgunge, to the East Indian Railway to Calcutta. The Teester and other streams are also near at hand, available for the carriage of produce, and run into Brahmapootra, where steamers running to Goalando are met.

From longitude 89°, latitude 28°, to longitude 80°, is Nepaul territory, and from the latter point the Terai and mountainous waste land extend through the north-west provinces and the Punjaub to the extreme northern frontier of Hindustan, at longitude 74°, latitude 34°. That there are many valuable sites for farms and much valuable land in this extent of country there is no doubt, but it is impossible to estimate the quantity; and the locality is not so desirable as those first mentioned, though the day is probably not far distant when these jungles will be cleared away, and the rich soils brought into cultivation.

The Cossiah and Jyntia Hills form the dividing barrier between Sylhet and South Cachar and Assam. They are crowned by extensive plateaux, at an elevation of from 5,000 to 7,000 feet, and are situate in latitude 25° and 26° north. These plateaux are watered by numerous streams, and are, for the most part, covered with fine grass, admirably suited for grazing. The inhabitants are a sturdy, industrious, and simple race of people, very friendly to Europeans. They are few in number, and the present area of cultivation is very small.

There are two sanitaria established, Cherrapoougy and Shillong. The former is about ten miles from the plains, on the south side of the ranges, and has been abandoned as a government station on account of the enormous rainfall, which, though not unhealthy, was found to be very inconvenient, and the government station was removed to Shillong. This excessive rainfall is caused by the hills at this point being the first to meet the rain-clouds from the Bay of Bengal, causing them to discharge themselves; this is, however, confined to a very small area, and the rest of the country receives no greater amount of rain than other parts of Bengal. Shillong is at present occupied by a native regiment, and is resorted to by the civilians of Assam and Sylhet during the hot months of the year. It is about 60 miles from Gowhatty, the head station of Assam, and is reached through a most picturesque country by a good bridle road at present, and a cart-road is under construction. This district is, therefore, most conveniently accessible, both from Sylhet and Assam, fine navigable rivers skirting the base of the hills on both sides, leading to Goalando, by a journey of from three to four days. The climate throughout the year is delightful, and is probably the most healthy of any of the sanitaria in India. The products are corn of all kinds, potatoes, and all kinds of fruit, and the cinnamon tree is indigenous. It is admirably adapted for the breeding of horses, cattle, and sheep, as all the most nutritious grasses of Europe and the tropics flourish here with luxuriance; for, though frost is unknown here, the climate for many months of the year is cold enough to render a good coal fire not only comfortable, but necessary. The area of land available for colonists probably exceeds six or seven million acres. A large portion of this is under native rajahs, but they are most anxious to induce English settlers to go there, and land may be obtained on most advantageous terms. As a home for English families, it will compare favourably with Devonshire, or the best parts of Europe.

South Cachar is the most important tea-growing district next to Assam in India. This may be accounted for from the fact that it was here that the first public tea company was formed which gave rise to the wonderful development of tea-gardens in India, and produced the tea mania which arose in 1863 and 1864. The Assam Tea Company had been in existence for some years but had attracted little public notice. Having ascertained that indigenous tea was found in the forests of Cachar, and that the soil rivalled that of Assam, experimental tea-gardens were opened by this company, and were successful; and, in 1863, these gardens were sold to a Calcutta company. The new company managed matters so that in a short time they realised large profits on their shares, and the public were for the first time impressed with an idea of the vast profit to be derived from tea-planting, and the result was the formation of innumerable companies for the growth of tea, and vast tracts of land were opened in Cachar, Assam, Darjeeling, the Punjaub, and north-west provinces. Of the suitability of Sylhet and Cachar as a home for tea is proved by the luxuriance of the growth of the plant, but as places for emigration they are not suitable, and I shall dismiss them with a slight notice.

The formation of the land in Sylhet and Cachar on which tea is grown is very hilly; it consists of a succession of small detached hills and hog-backed ridges of such steepness, that on the removal of the jungle the soil is washed off by the heavy rains. It is very expensive to work, and the use of any plough for clearing the land is impossible; and during the dry season the land becomes so hard as to render cultivation very difficult, and is also injurious to the tea.

There is little or no level land suitable for tea. The low land is too wet, and the high land too dry. The space is so limited, that it may be dismissed from our consideration as a locality for settlers.

North Cachar joins Tyntia, and at one point abuts upon Assam, but it is unsurveyed, and comparatively little is known of the interior, though, probably, there is much valuable land unoccupied similar to the Cossiah Hills.

The districts with which I am acquainted in the Himalaya Mountains are Darjeeling, Kumâon, and the Kangra Valley, and what may be said of one will generally apply to all.

Tea gardens of great extent have been opened in all these districts, and, with few exceptions, may be considered decided failures, and as districts for general colonisation I cannot recommend them. The climate is too cold for tea, which is the only plant likely to pay for extensive cultivation. There is no level land; that only which is available is the precipitous mountain sides, on which it is impossible to keep the soil, except at an expense for which the small yield of tea will not pay. The small area of level land lying in the valleys is all occupied by the natives; and even if it could be purchased from them is of little value.

The access to these regions from the plains is most difficult and expensive, and from the plains the distance to any port of exportation is so great, that the transit-cost consumes the profit. Again, the time required for a tea-garden to become profitable is about eight or ten years, a length of time quite unsuited for a man with small capital and a wife and family to feed.

There is no doubt that in these regions there are many delightful spots where a man might settle with a small income, and add greatly to that income, and find most agreeable occupation, by opening out a small farm, growing silk, cultivating a small tea plot, and various fruits, with other crops requiring garden cultivation, such as ginger, arrowroot, red pepper, and vegetables, which grow in great abundance, and in the neighbourhood of the numerous sanitaria great profit may be made by growing fowls, and the sale of milk, butter, and eggs, which realise very remunerative prices.

I have visited all the stations in the Himalaya, from Kangra, longitude 74° to latitude 34°, to Darjeeling, longitude 89°, and am of opinion that, as a home such as that last described, Kangra offers by far the greater advantages. It is comparatively easy of access from the railway at Jullunder. There is a good cart-road, leading into the very heart of the valley, and, with relays of horses, the journey can be performed easily in two days, or in one if required.

Any description of this lovely valley and surrounding scenery must fall short of the reality; its villages, surrounded by fruit trees; the neat white houses of the tea planters, dotted here and there; its mountain torrents, and the thousands of tiny streams leading to every corner for the purposes of irrigation. The fine, wooded hills, backed up by the grand peaks of perpetual snow, form a picture worth travelling almost any distance to see. I know of nothing to surpass it, but here, as in every part of the Himalayas, space is wanting, and it is difficult to obtain more land than would suffice for garden purposes.

The Cossiah hills, therefore, must be looked on as far superior as to space, and, in my opinion, as to health, to anything to be found in the Himalaya mountains.

These remarks refer only to the interior, not to the lower ranges, from which the plains in the Terai can be cultivated, and large quantities of land obtained.

Having thus briefly described the districts available for colonisation which have been brought under my own notice, it will be seen that the districts to which I attach the greatest importance are Assam, the Bengal Dooars, and Terai, and the Cossiah hills, which form one contiguous province, containing over 20,000,000 of acres, capable of maintaining in wealth a vast population, but which is now covered by jungle, the home of the tiger and rhinocerous.

As a crop for which Assam and the adjoining dooars are particularly adapted, cotton may be considered of equal value to tea, perhaps more so.

There are in these districts about 8,000,000 acres of the finest cotton land, more than sufficient to render England entirely independent of any foreign country for the supply of her wants.

In referring to this subject, I am indebted to Mr. Rivett Carnac's elaborate and able report on cotton in India, for 1868 and 1869. From this report it appears that the requirements of England, for the supply of her mills alone, is 3,000,000 bales, of 400lbs. each. Of the quantity taken by England for purposes of trade, I have nothing to do, my object being to show that England possesses on her own territory sufficient land to yield cotton enough for the supply of her own labour and machinery, and at a price which will defy foreign competition.

The supply of cotton grown in India, available for exportation to England, appears, from Mr. Rivett Carnac's report, to be 1,400,000 bales, and the total crop of India to be about 2,300,000 bales, of 400lbs. each, occupying an area of land amounting to 13,000,000 acres. There is no doubt that this is at least double what it was ten years ago, and it is a most serious question as to whether this large extent of cotton cultivation is not only a serious loss to India in money, but a serious injury in other respects. There is no reason to doubt, from the report quoted, that the cotton-crop, as grown on the old worn-out lands of India, is a very small and unremunerative one, and there is also little doubt that it is grown by reason of the pressure put on the ryot, or native farmer, by the native merchant to whom he is in debt. The figures given show that the average crop of cotton is about 70lbs. per acre; and from my own experience I am able to state that this is a high estimate. The price realised by the ryot (who is the principal person to be considered in the mattter) for his crop of cotton, it is very difficult to ascertain, and it is strange that, in Mr. Rivett Carnac's voluminous report, this question is not in one single instance referred to, except the fact of his partaking of a share of the high exceptional rates during the cotton famine, but the most important question of profit and loss to the grower as a permanent crop is altogether omitted.

Considering the nature of the soil, the inefficient system of cultivation, and the antiquated and defective manner of growing the crop, I am of opinion that no increase in the present yield is likely to be realised.

The greater portion of land on which cotton is grown is utterly unsuited for it, and the crops, moderate as they are, can only be obtained at great expense of irrigation. It is only in the Central Provinces that real cotton land is met with, and here the ryots are so poor that the necessary improvement in the quantity of the crop by superior cultivation cannot be carried out. The ryot is entirely dependent on the native merchants for advances of money, and it is a matter of perfect indifference to them whether he grows 20 lbs. or 200 lbs. per acre; they get the produce at the same price, and nothing would induce them to make advances to enable the farmer to procure manures and appliances absolutely necessary to secure a paying crop. Calculating, then, that the quantity of land recently brought into cultivation by the cotton famine to be 7,000,000 more than would be ordinarily grown, and the yield 70 lbs. of cotton per acre, and the value of that 70 lbs. to be 8 rupees to the ryot, the total value of the 7,000,000 acres will be 56,000,000 rupees.

If, instead of cotton, corn and food stuffs had been grown, at the same expense of cultivation, the crops would have been worth 20 rupees per acre, or a total of 140,000,000 rupees, thus involving the ryots in a loss of no less than 84,000,000 rupees annually. I am supported in this view by Mr. Robinson, of Central India, who states, in reply to a question addressed to him on the subject, that a crop of 200 lbs. of cotton per acre would not pay the ryots so well as their ordinary corn crops. The ordinary crop of cotton being only 70 lbs. per acre, this would go to show a greater loss to the ryot than I have stated. But this loss I think the least serious part of the question; it is important to consider how far India is prepared to give up such a vast extent of food-producing land. It is well-known what an inexpansive country India is, and it is only reasonable to surmise that no sort of adequate extension of corn-growing has taken place to compensate for this diminution of the ordinary corn cultivation. This 7,000,000 acres of land under corn would have produced 140,000,000 of maunds of food, and it is well worth ascertaining how far this loss may bear on the famines which appear to have become chronic in India, and the hideous loss of life consequent on them.

With these facts, there is little doubt that the growth of cotton will decrease, as the ryots will get tired of growing it at a serious loss, and the merchants will give it up for more remunerative crops when the price becomes less. It is, therefore, to the north-eastern provinces that a permanent supply of cotton equal to that of America must be looked for, if the Manchester manufacturers wish to secure themselves against the possibility of a second cotton famine, and a supply of cotton at a price which will enable them to compete with the whole world.

The greater part of the land especially suited to cotton consists of large level plains, singularly adapted to the steam plough and cultivator. The cost of producing a crop of cotton of 400 lbs. to the acre is given in the appendix. This yield I consider to be a fair estimate, as on the older lands of America we hear of 800 lb. an acre being grown, and, as the soil and climate of this part of India are quite equal to America, there is no reason to doubt that similar crops may be grown here. The account shows that cotton may, therefore, be grown and delivered in England at sixpence per pound, leaving cent per cent. profit, even at the low estimate of 400 lbs. per acre.

The original cost of the land and clearing it will be much the same as for tea—that is, grass land £1 per acre, and forest £2 10s. per acre. The greater portion of cotton land is under grass jungle.

No detailed instructions are required as to the cultivation of cotton similar to those given for tea-growing. The natives are well versed in the management of the crop, and there are are many books of instructions for carrying out the American system. The general system adopted in India is to be entirely avoided, as altogether unsuited for these new and fertile lands, and cotton may be grown either as an annual or perennial crop, and there is no doubt that, with deep cultivation and a proper selection of seed, as fine and valuable cotton may be grown as was ever produced in America. I may mention that when last in Assam, I took samples of cotton, gathered at random, which had been grown on the native system, which could hardly be called cultivation, and from seed which had never been changed or selected for probably one hundred years, and it was valued in Calcutta at 9d. per pound, nearly equal to the best in India.

The quantity of land available for cotton gives ample scope for the annual production of 3,000,000 bales; and the question arises, how far India could compete with America if that quantity were produced. The soil and climate being equal, it resolves itself almost entirely into a question of labour supply, and in this India possesses a great advantage. America has only the uncertain supply from the free negroes on which to depend for her labour, and is already obliged to import men from China, which must be done at great expense, and to only a limited extent. Assam has at command, not only the cheapest labour in the world, but what is of more importance, the supply is practically unlimited. In steam machinery the Indian planter is on an equal footing with the American as to supply, and with magnificent coal in the district to work it.

With reference to the best cotton districts of India, there is nothing to apprehend. In all parts there is a great outcry for canals, railways, roads, and other works of enormous expense, to enable the ryots to work their lands profitably, and develop the resources of their districts by irrigation and cheaper carriage. In the north-eastern districts, all these requirements are supplied by nature. The rainfall is ample and regular in its supply. The sources of the streams are close at hand, at a sufficient elevation to render irrigation (should such an unlikely want arise) quite at command, at the cost of the planter, and the great highway of the Brahmapootra is available from all points of the country, at no more cost than is within the means of the planters themselves.

To cotton-growers I would urge the necessity of growing a variety of other crops, as I have already done in connection with tea. Any one who has had anything to do with the cultivation of land will understand the necessity of this. In taking up a large tract of land, a variety will be found fitted for almost any crop, and it is of course to the advantage of the owner to allow as little to remain idle as possible. By a variety of produce, success is made more certain. As prices fluctuate, one crop may pay better than another, and thus produce a favourable average. It will also enable the planter to keep his cattle and labourers constantly and profitably employed.

The rice crop is not by any means the least important to be grown in Assam. The richness of its bheels and lowlands render it the most easy to grow and least liable to injury of any known crop; it is also the most profitable. The annual cost of a crop of rice will not exceed ten rupees per acre, under most unfavourable circumstances. The yield will be thirty maunds per acre of cleaned rice, worth, in the wholesale market, at least one rupee per maund; and if sold to the coolies on the spot, two rupees per maund; thus giving in one case 200 per cent., in the other 400 per cent. profit. The time required to mature a crop is less than six months. There are also certain kinds of rice from which two crops may be grown in the year. There is sufficient land suitable for rice in those districts, which are worthless for any other purpose, to produce not only sufficient for any consumption which is likely to arise in the districts themselves, but to leave a surplus for exportation of 200,000,000 of maunds to the poverty or famine-stricken districts of India, or to Europe.

The cultivation of the rice crop is so well understood by every peasant in India that no detailed instructions are necessary. There are a great variety suited for all land, some requiring to be grown in water, other kinds growing on high land and on hill sides, the latter kind being of the more delicate, used by Europeans; it can be grown by transplanting or sowing broadcast, like a wheat crop, the latter plan being generally applied to the high lands.

The three crops now especially referred to may be considered the leading or staple commodities of these districts —crops which may be considered of somewhat minor importance, though equally profitable—are, Tussor silk, fine silk, indigo, jute, sugar, rhea, and all the spices of the East. What may be called the indigenous productions are, Tussor silk, india-rubber, madder, and lac; all these can be procured in the forests, with little cultivation.

To give full instructions in the production of all these articles would be too tedious and unnecessary. The planter having established himself in Assam, will, as occasion requires, learn all that is necessary for himself on the spot. I would, however, refer to the forest trees, suitable to the production of Tussor silk. All parts of the jungle abounds with trees fit for food of the worm producing this silk, which is grown in these districts, of much finer quality than any other part of India.

The plan adopted by the natives is to clear away any of the jungle surrounding these trees, and then to turn the silkworms loose on the trees, where they will remain till every leaf is eaten up, when they descend to a receptacle prepared for them at the base, and are removed to another tree, the only care being required to keep off the birds, who prey on the worms. In clearing forests for tea-gardens, I would therefore recommend that the silk-bearing trees be left standing; they are of light foliage, and will not perceptibly interfere with the growth of tea or other crops, and will form a valuable source of income with very little expense. This silk is now eagerly sought for by the silk manufacturers of France, and realises high prices in the district; it sells for 10s. per pound.

Rhea grass produces the finest—the most durable and valuable—of any known linen fibre, and can be grown as a perfect jungle. It is perennial in its nature, and when once planted, will last for years, two and three crops being gathered annually, the rich, low land and forcing climate of these places being singularly adapted to it.

The chur land on the river is of very large extent, and forms the very best indigo land.

The timber of Assam is of a very valuable class; the most valuable are known as sâl, nahoar, kerai, and pomah. The sâl is well-known as the most valuable in India for building and all railway purposes. The nahoar is equal to the English oak; the kerai is a kind of iron-wood, almost indestructible; all three are impervious to white ants, a most valuable quality in a country infested by these pests. The pomah is a kind of mahogany, invaluable for furniture, and floors of houses, and interior fittings.

When the plains of these rich districts become peopled by a numerous population of Europeans, the supply of meat, cattle, and horses will form an important consideration. For this purpose the surrounding hills are wonderfully well adapted. A day's ride takes you, on one side to the delightful plateaux of the Cossiah hills, on the other to the Himalaya mountains. On the Cossiah there is ample room for the production of millions of sheep, cattle, and horses, and farms may be carried on in connection with farms of the plains. Nor would the supply from these plains be the only market available. Calcutta is suffering greatly from the scarcity and dearness of provisions, in consequence of the supply not keeping pace with the rapidly-increasing European population; and cattle and sheep can be conveyed from these hills in four days to Calcutta, and government would become a great customer, both for meat and horses. At present, the government pays nearly £70 per head for the unsuitable brutes sent from Australia, and the remounts from the government studs cost £100 per head. Horses of better quality than either could be produced and supplied at £40 per head, leaving a fair remuneration to the breeder. There are numerous other advantages which present themselves to the English settler, but one becomes almost tired of enumerating them. Nature seems to have exhausted herself in the formation of these glorious regions; every soil and every climate under heaven are compressed within the boundaries of these districts.

But extraordinary as are the vegetable productions, it is probable that they are exceeded by the mineral wealth. On the Cossiah hills and the Meekur hills there are vast seams of coal of the highest quality, said, by engineers who have tested them, to be equal to the best Welsh steam coals. These seams, unlike those of England, lie on the surface, and can be obtained at the smallest cost of labour, and without the aid of machinery. Iron of high quality is found; and petroleum springs, of great productiveness, are running to waste in the surrounding soil. Gold, silver, and precious stones are known to exist, and with the spread of Europeans will doubtless be found of great commercial value.

While my chief object has been, in the foregoing imperfect pages, to show the advantages of the north-eastern frontier of India as a profitable field of enterprise for small capitalists, it is equally favourable for companies with large capital. Those already in existence who devote their entire attention to the production of tea, although called into existence under the disadvantageous circumstances described, are paying large dividends. These dividends would be greatly increased by growing a variety of crops, as advocated by me. I have learned with great satisfaction, since this paper was commenced, that one firm, growing tea on a large scale, have adopted this system with great success.

The stranger going to this part of the world will find himself far more at home than in the colonies. Tea-gardens are scattered throughout the district, and the kind hospitality of the garden managers is proverbial; the stranger is sure of a hearty welcome, and every assistance is given him.

The profits to be expected may appear exaggerated, but every day's experience proves that they are not so, and there is no doubt that a company started for the cultivation of land may safely calculate on fifty per cent. for their outlay, even allowing for the extra expense unavoidable in the affairs of a public company. What I have stated has been after long experience and due consideration, and I am prepared to maintain my position with facts against the closest criticism, and I am confident of the support of every planter in Assam.

As regards the climate, in its effects on the English race, there is no doubt that it will compare favourably with any of the English colonies. Within a convenient distance, homes may be formed for the retreat of families during the hot months of the plains; and it is perfectly optional with the residents to select any climate most suitable to the constitution, the mountains varying from an English winter to an Italian summer, according to the altitude selected. As to the diseases to which the new comer is liable, there is but one which will be found troublesome, and that is fever, and this only till the land is cleared, and is confined to the plains; this, however, can be guarded against by avoiding bad water and bad spirituous liquors, and by obtaining a good supply of flannel dresses. I can state, from experience, that the local disease peculiar to these parts, is far less dangerous and inconvenient than ophthalmia and lung disease are in Australia, and influenza, cholera, and many others in England. In fact, I may state, without fear of contradiction, that this part of India possesses, in every respect, every qualification needed by the English colonist to be found elsewhere, and many advantages which no other country presents.

The government of the country presents little to complain of. Taxation is almost unknown, and in this respect is vastly superior to the colonies. The government officers and magistrates with whom he will come in contact are gentlemen in every sense of the term, who are ever ready to listen to his wants, and carry out his wishes as far as their duties to the State will permit.

To the directions given for settlers in this country in the foregoing pages, I have purposely avoided being too minute; enough has been said, if strictly adhered to, to lead to success; all minor details can now be gathered in the country itself better than from any book.

To the new settler, a book written by Mr. Hull, published by King and Co., Cornhill, will be found of great use. It is an interesting guide as to outfit, Indian etiquette, customs, and living. It also contains many valuable medical prescriptions, and much useful advice for a family man.

It is impossible to foresee, or calculate even remotely, the benefits to England and India, if the lands under consideration were brought into cultivation by English capital and enterprise, to go no further than cotton, tea, and rice. The value of tea from foreign countries appears to amount annually to £13,000,000. Assam could supply the whole, and would give employment to £20,000,000 of capital.

The present amount of money spent in America for cotton cannot be less than £20,000,000 annually. To produce this in our own territory would give employment to £40,000,000 of capital, which would yield an annual profit of 50 per cent.

The value of rice would be greatly felt by the Indian government, as it would place a permanent and cheap supply on which to depend for the prevention or amelioration of famine in other parts of India. From a social and political point of view, the colonisation of India is of vast importance, and the benefits must extend to every part of India. Beside providing for the failure of crops in other parts of India, it would offer profitable employment to millions of those who now suffer from poverty and starvation. Schools provided by the planters for the children of their labourers, in which the English language would be taught, would, in a short time, create an English-speaking community consisting of many millions of inhabitants, and through them it would spread to every part of India. Such a province in India would be a greater source of strength and prosperity than anything that could be achieved by a government. A constant influx and efflux of labourers would be going on, the poor to seek to enrich themselves; those who had accumulated money, returning to their families and country to invest it in trade or agriculture; and a vast number would find permanent employment, and settle in the district itself. Whereever the Englishman establishes himself, a rich community of natives is created, and wealth increased. The greater the spread of English settlers, the greater the prosperity, the contentment, and security of the country.

Every indigo factory is surrounded by a well-to-do and well-affected class of natives; they look to the planters as the source from which to enrich themselves, and the poorer classes are benefited by good wages and by many acts of kindness to their families in sickness or need. Such things as these will do far more to reconcile natives of India to English rule than the best government that could be devised.

The extent to which the wealth of this country would be increased it is impossible to calculate; it would not be confined to the planters themselves. Steam machinery, in the shape of ploughs, cotton-gins, threshing machines, rice-huskers, tea-rolling machines, and various other implements would be required in vast quantities. Manchester goods and hardware would find an extensive market. The natives, as they become rich, are lavish in their expenditure, and delight in European goods. A large demand for the improved breeds of sheep, cattle, and horses from England would be created. Of the mineral resources little comparatively is known; but it would be difficult to explain why millions of gallons of petroleum are allowed to run waste into the soil, while the Americans can obtain large profits from it; or why the richest coal should lie unappropriated, within four days' water-carriage of Calcutta, when large quantities of an inferior article are brought 10,000 miles from England. All these sources of wealth, in addition to those of an agricultural nature, will, ere long, no doubt be fully developed.

It is worth the consideration of Manchester how far a manufacturer could become a cotton grower. It appears to me that Manchester may expect vastly increasing competition, as not only are the Americans using every endeavour to increase the home consumption of cotton, but mills are springing up in India, which pay remarkably well; and it should be remembered that India possesses a population singularly adapted to mill work, and is practically almost unlimited in number. I have learned from overseers in Indian mills that the Indian child will learn all the details of the work in one-half the time required to teach an English child of the same age. In the face of such competition, the price of cotton must be of serious consideration; and, as I have shown, the cotton grower in India can produce his cotton at threepence per lb., such a price would place Manchester above all fear of competition, or the recurrence of the horrors of another cotton famine. It is for those interested to decide how far they will adopt the suggestion thrown out, of becoming both growers and manufacturers of cotton.

It is a general complaint, that in England no interest whatever can be created in matters relating to India; but if once the English public invest one hundred millions of capital, realising 50 per cent. revenue per annum, in the soil of India, the case would be greatly altered, and everything relating to India would wear a very different aspect, and Indian affairs would receive that attention from the public of England which could not fail to have the most beneficial effect on that country.

Much prejudice exists in the minds of the people of England against any investment in land in India, caused by the amount of failure in the tea-planting interest. I have now shown, I hope clearly, the cause of that failure, and that this prejudice is without any foundation. Manchester has shown considerable interest in the cotton question as relating to India; and, although the Manchester manufacturers might not become large cotton-growers, they might create a vast extension of its growth by establishing a farm of 1,000 acres as a nucleus for further extensions. If such a farm, on which I could guarantee them fifty per cent. for their money, were established, and the balance-sheet showing the fact duly made public, the vast results of which these districts are capable would very quickly be realised. All the causes of former failure are now well understood, and very few now exist; and I am confident that as much desire to obtain land would be again created as was manifested in 1863 and 1864.

In conclusion, I may state that I am not connected, either officially or otherwise, with Indian affairs, and have been actuated in writing these pages by the sole desire to see the waste lands of India brought under the management of that Anglo-Saxon energy which has created such countries as the United States and our magnificent colonies, under adverse circumstances, such as would be unheard of in India, and thus make India in reality, what it is now only in name—"The brightest jewel in the British Crown."

A discussion followed the reading of the paper, which will be given in a future *Journal.*

ANNOUNCEMENTS BY THE COUNCIL.

FOOD COMMITTEE.

The Committee met on Wednesday, the 13th instant. Present—Mr. Benjamin Shaw (in the chair), Mr. F. A. Abel, F.R.S., Dr. Blakiston, Sir Antonio Brady, Dr. Pitman, Messrs. E. B. Savile, J. T. Ware, and J. A. Youl.

Mr. Ash attended, and described a ventilating and cooling meat van, now in use on the Great Western Railway.

Mr. Stephen Darby attended, and gave evidence in reference to his preparation of meat, termed "fluid meat."

A full report of the proceedings of this meeting will appear in a future *Journal.*

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscriptions paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family.

Members willing to aid the Council in this work are requested to fill in the Form for this purpose which has been sent out, with the amount of Subscription, and return it to the Secretary not later than Thursday, the 21st instant, when the first Subscription List will be published. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport.

BARRY'S ETCHINGS.—NOTICE TO MEMBERS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, are about to have a limited number of sets of the 29 plates etched by the late James Barry, printed. The impressions will be taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary not later than the 30th inst. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, will be £10 10s.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

General Purposes Committee.—His Royal Highness the Duke of Edinburgh presided on Saturday, March 9th, at Clarence-house, at a meeting of the General Purposes Committee appointed by her Majesty's Commissioners for the Exhibition of 1851, to carry out the current series of Annual International Exhibitions. There were also present the Marquis of Ripon, the Marquis of Lansdowne, Mr. E. A. Bowring, C.B., Mr. H. Cole, C.B., Mr. T. F. Gibson, Dr. Lyon Playfair, and Major-General Scott, C.B., secretary.—[The names of the Marquis of Lansdowne, the Earl of Granville, and Mr. Thring were accidentally omitted from the list of those present at the meeting of the General Purposes Committee, held on Wednesday week at Clarence-house.]

Jewellery.—Her Royal Highness the Princess of Wales has signified her intention to lend some of her modern jewellery to the Exhibition, which will be entrusted to the special care of the Crown jewellers.

Fine Arts.—Mr. Frith's celebrated work, the "Railway Station," will be one of the exhibited pictures this year.

Reception of Exhibits.—The work of reception goes on with great vigour, and already upwards of 4,500 articles have been received, so that there is no doubt of the Committee of Selection having a sufficient number of articles from which to make their choice; and as the great majority of the works are of a high class, the articles finally chosen will represent the best features of the various manufactures and classes that are included in this year's programme. In Classes 1 and 12 over 1,500 articles in each have been sent in; in Class 8, 8,532; in Division III. over 300.

Location of the Exhibited Articles.—The following are the locations fixed for the exhibition of the various classes of goods:—The machinery will be exhibited, as before, on the ground floor of the western building, room 1 being devoted to cotton machinery, and rooms 2, 3, 4, 5, and 6, with the iron shed on the east side, to the machinery connected with paper, stationery, and printing. British fine art is, as before, in the western galleries, oil paintings in rooms 6 and 10, miscellaneous art in rooms 7 and 9, and water-colours in room 8. The first room, No. 11, on the ground-floor of the eastern building, will be taken up with stringed and wind instruments, the four other rooms, 12, 13, 14, and 15, on the same floor, being devoted to jewellery. The upper floor of the same building has been appropriated as follows—Rooms 16 and 18 to foreign fine art, 17 to reproductions, 19 and 12 to French fine art; paper, stationery, and printing will be found in what have been numbered rooms 21 and 22, which are at the rear of the southern entrance, at the eastern end of the refreshment buildings, the scientific inventions being, as before, at the western end. Cotton fabrics will be placed in the glass corridors which connect the side galleries with each other through the great conservatory of the Horticultural-gardens. The quadrants underneath these corridors have been brought into use this year, and in them will be placed architectural drawings, engravings, lithographs, and photographs. No portion of the Albert Hall will be used for purposes of exhibition this year. The floor of the quadrants just mentioned has been laid with encaustic tiles, and the walls and ceilings decorated very effectively. The ceilings are white, with a cornice stencilled in gold colour, relieved, on the side opposite the windows, with crimson oblongs, on which various names are painted. On the side nearest the window, the crimson forms a continuous band of half-ovals. The walls are a light chocolate, relieved by bands of dark-brown and gold colour. A dado, four feet high, runs the whole length; it is of dark-blue, relieved with olive-green and dark-brown. The walls are broken at intervals by pillars, which have been coloured white, pannelled with fawn-colour. Altogether the effect is very pleasing, and the utilisation of these quadrants adds considerably to the space available for exhibition purposes.

CORRESPONDENCE.

TRINKETS AND THEIR MANUFACTURE.

Sir,—To the remarks made by Mr. Larkins in his paper on the above-named subject, as to the regulations in France with regard to the standard of gold, I should like to add further, that no one is allowed to sell imitation jewellery without stating that it is so; and shopkeepers who exhibit such imitation jewellery for sale are obliged also to exhibit conspicuously the fact that they are selling mock gold wares. Mr. Larkins' remarks as to the improvement likely to take place in our export trade by the fixing of a standard in this country, and echoed by Mr. Brunton in the discussion, are so trite, that I hope some effort will be made to secure that fixed standard.—I am, &c., A Manufacturing Jeweller.

HOME COLONISATION.

Sir,—As my letter on the above subject has received an approving commentary by your correspondent, Mr. George Wallis, perhaps you will allow me space for some further remarks upon the project of home colonisation? The project is one which, I think, deserves the attention and earnest consideration of both capitalists and workmen, suggesting as it does a base of operation from which it may be possible to effect an amelioration of inequalities in the employment of labour, and, consequently, the alleviation of much social distress. But nothing can really be done till a systematic registry of workmen throughout the kingdom be established. Such a registry was proposed by the Committee of the North London School of Drawing and Modelling many years since, and has, I believe, been advocated by the Council of the Society of Arts, and also by the Institute Union. This important preliminary step, which, if it did nothing more than show, throughout the length and breadth of the land, where any special class of handicraftsmen were in excess and deficiency, would furnish valuable information to the workmen; and not only this, but the reliable data upon which alone any scheme of home colonisation could be prudently attempted. If, for instance, there happened to be an excess of 200 engineers over demand in the north and a deficiency of about the same number in the south, the "workmen's register" would at once enable the inequality to be corrected. But suppose a case in which the register should show an excess of any special kind of labour, north, east, south, and west, it would not then so readily suggest the remedy. It would be useless to re-aggregate these men upon the same kind of work in any part of the kingdom. They would either have to wait a revival of demand for their special kind of labour, or turn their hands to other kind of work; and if revival of demand were hopeless, they would have to do this, whether they remained in the old country or emigrated, or inevitably be reduced to pauperism. In this case, also, the register of workmen would be valuable, for it would show the employments in which labour was most deficient, and to what kind of work "hands" could be turned. In all probability, the principal openings for the employment of surplus labour would be found by capitalists seeking to produce at home many things for which we are now large customers to foreigners. Corn is, I believe, one of those commodities of which our home consumption is far in excess of production. If this be the fact, and there be a large area of cultivatable land still unworked, the production of more corn would form one basis of experiment. How, by "distribution," we are to "undo excess," is, I know, a very complex and difficult question; but I feel persuaded that we should soon find the proper avenues to success, if once the work were commenced systematically, and upon principle.

A great service might be rendered to the nation if the faculty would point out the kind of constitutional weaknesses for which our several colonies are best adapted. The climate of Australia, for instance, is wonderfully efficacious in checking lung disease. The weakly would then be more extensively drafted off by emigration, both to their own and the country's advantage.

In conclusion, I would broach another suggestion. I have a conviction that there must be alternating industries—industries in which the ebb of one and flow of the other are consistent—and if so, and it were practicable, it would be well that "hands" should be instructed in both.—I am, &c.,

W. Cave Thomas.

March 9th, 1872.

THE VINEYARDS OF SPAIN AND PORTUGAL.

Spain has always been one of the foremost viticultural countries of the world. The mountains which run along its extensive coast-lines or accompany its rivers, offer the most favourable situations and the most fertile soils for viticulture; the southern position ensures a sufficiency of sunshine to mature the grapes with more or less perfection every year, and the proximity of the Atlantic on one side, of the Mediterranean on the other, brings the moisture by the aid of which the vine luxuriates. In consequence of these natural advantages, the wines grown in almost all parts of Spain have much taste and bouquet, and great strength and durability, provided they are subjected to proper treatment. Although there are no red wines which can compare with the Medocs and Burgundies, in the preparation of white, dry, fortified wines, such as Malagas, the Spaniards excel all other nations. Andalusia produces the wines which are of most importance to English consumers. In the province of this kingdom, which has Seville for its capital, is situated Xeres de la Frontera, with the convent of Paxarete, and the belt of vineyards producing the "vino secco" and the "abocado." There, also, is Rota, which produces the best red wines of Andalusia. Second to these are Moguro, Neigo, Rancio, and Seville itself. Catalonia yields annually 20,000 butts of wine, which is mostly red. The plain of Ampurdan is covered with vines, and of many other parts of this kingdom four-fifths of all cultivatable land is occupied in viticulture. Valencia produces annually 100,000 butts of wine. Granada, with its famed Malaga, produces wines and raisins. In the mountains the vine attains almost tropical luxuriance, and bears three harvests every year. Arragon produces dark-coloured, strong-bodied wines, of good taste and flavour, from the celebrated vines, the "grenache," of Sabayes, and the "carmena," and delivers them up to the trade of Saragossa. The rough climate of Navarre does not admit of much viticulture, while Galicia produces a little good wine for export, such as that of Ribadavia and Tuy. Biscaya, the most northern province of Spain, produces much wine, which is, however, unfit for exportation. New Castile produces the lightest and least coloured, but most agreeable wines, such as the muscat, of Juencaral, near Madrid. The Spanish governments have frequently encouraged the production of wine, which forms the most notable source of wealth of the inhabitants of the peninsula. The main obstacle has been the difficulty of transport, but this difficulty is being rapidly removed, particularly by English enterprise and railways.

The sherry wines are, generally speaking, the products of the district of Cadiz. Cadiz is the most important maritime trading town of Spain, situated on the bay which bears its name, on the island of Leon, and has 75,000 inhabitants. The district further includes Xeres de la Frontera, around which the principal vineyards are situated, San Lucar de Barrameda, upon the banks of the estuary of the Guadalquiver; Trebujena, to the north of San Lucar; and Puerto de Santa Maria, to the south of Xeres, and upon the western banks of the estuary of the Rio Guadelete, which forms the eastern frontier of the sherry district. The vineyards of all qualities in the district of Cadiz amount to 23,355 English acres. There are four descriptions of soil which determine different qualities of wine. The "albariza" is the soil of the higher ground of the various sub-districts which surround Xeres de la Frontera, and is composed of carbonates of lime and magnesia, mixed with clay. This produces the finest wine. To this follows the "barros," or red iron ochre soil, which produces a very fine wine, inferior only to that grown on the "albariza." In these two soils, only about three butts to the acre are obtained. The "bugeo," or alluvial soil, and the "arenas," or sands, produce inferior wines, in quantities of from five to six butts to the acre. East or north-east of the Xeres district the soil appears unproductive. The dominating wine seems to be the "palomino;" next in frequency seems to to be the "perrimo" and "canocaso." The "mantuo castellano," and the "beba," are also frequently met with.

Many producers of grapes and proprietors of vineyards are also makers of sherry, but the occupations do not necessarily go together. Like the manufacturers of champagne, the makers of sherry buy much more must or wine from other growers than they produce themselves. The best wines, which come under the description of "vino fino," "amontillado," and "manzanilla," are used for the production or keeping up of "soleras." A solera is a thing kept by itself, being a choice old "cabinet" article, not ordinarily used for drinking, but for blending with other sorts, to give them quickly the appearance of age and ripeness. The solera is replenished, and becomes a mixture of the best wines. Like most essences, it is absolutely nasty and undrinkable, but commands prices of from £800 to £1,000 per butt, on account of the large quantity of flavourless wine which a certain small amount of the mixture will infect with the desired sherry flavour. The solera wine is thus seen to correspond to the liqueur used in the manufacture of champagne.

At Alicante, in Valencia, the wines are grown on the hill-sides and in the plain. They are the produce mainly of a kind of vine which occurs in a white and black variety, and passes through the world under the name of "alicante." Its name at Alicante is "tintilla." It is a large plant, with long canes; the points of the young shoots are woolly, the leaf-stalks long, the leaves five-lobed, deeply incised; the bunch is very large, the berries are fleshy, juicy, provided with a thick skin, and resemble much the berries of the Hambro' grape, so well known in this country. The vine has to be cut with long canes and short spears at the same time. The bunches must not be exposed to the sun, as the stalks have a tendency to become scorched, and to drop the grapes. The blue alicante is immensely fertile, steady in blossom, but ripens late, so that it yields good wine only in good situations of its warm fatherland. The most renowned viticultural district of the province of Granada is that of Malaga, termed Axarguia. The climate is exceedingly warm and moist up to a height of several thousand feet above the level of the sea, and enables the vines to produce three crops of grapes every year. The first harvest takes place in June, and is used for raisins exclusively. The second vintage takes place in September, and yields a dry wine, somewhat resembling sherry. The last vintage takes place in October and November, and gives the particular wines known as malagas. The amount produced annually is 80,000 arrobas, or 2,666 butts. Of these, the greater part is exported, mainly to America. Much also goes to England, and the wine for both countries is prepared equally, the practice of making up wines specially for the English market not prevailing at Malaga.

The wine districts of the Douro commence at the entrance of the river into Portuguese territory. But here in the highest part the area of cultivation is yet limited, and the conformation of the soil not so favourable as in the middle of its course. It is on both sides of a tributary of the Douro, which comes from the north, the river Corgo, that the vine succeeds best. The district which had the most ancient cultivation is that west of the river Corgo, usually termed the Lower Corgo. As the demand for port wine increased, cultivation ascended the Douro, until it occupied the whole of the available soil, of an area extending about thirty miles (English) along both banks of the Douro, from east to west, and ten miles from north to south, including the valley of the Corgo, the Penhao, and some smaller rivulets. A great extent of the districts known as the wine country is not suceptible of any other cultivation but that of the vine. The exceedingly stony nature of the soil throughout, and particularly in the Upper Corgo, renders the use of the spade impossible; and even the ordinary hoe, the general implement of hand-labour in Portugal, cannot be employed. The tool used is a hoe (*cuxada*), having two strong prongs instead of the usual cutting part, and a heavy mass of iron on the opposite side. With the forked part the soil and the large stones in the vineyard are turned over; with the other they receive one or two blows, which break them up, and expose their fragments to the decomposing action of the atmosphere. The average daily wages, with food supplied, for a vine dresser, is 1s.; for a common labourer with the hoe, from 8d. to 10d.

There are a great variety of vines grown. The "souzão" grapes imparts the darkest colour of all the Douro grapes used for wine; but the wine requires much brandy for its preservation, and is deficient in bouquet and flavour. The "verdeilho" yields a fine peculiar wine. It is the wine which Australian settlers have selected from the sets of the Douro for their distant plantations. There are the "mourisco," the "bastardo," the "alvarilhao," in the Lower Corgo. The vines which form, the general sets of the Upper Corgo are not so fertile but the wine obtained from them has more body, a very full colour, and a remarkably coarse flavour. The most frequent are the "touriga," the "tinta Francisca," the "tinta caa"; the two latter are mainly grown for the sake their colouring matter. The vines are grown close to the ground, but not creeping over it, nor supported on pollards or trellises, as in most other parts of the Peninsula. This culture is the most economical and the most rational for the production of good wine. The vines are cut very short, so that each of the two or three or more main branches of the vine is allowed but two or three eyes for the bearing branches, and one eye with the subsidiary small eye for the growing of wood. It is the same cut as that in the best situations in the Rheingau, with the exception of the long-bow, which is not frequently used on the Douro. Stakes are used here and and there. The vintage generally takes place during the time between the 29th September and the 10th of October. The grapes are thus allowed to hang on the vines for some time after they are actually ripe, in order to produce a concentration of their juices. At the time of the vintage, great numbers of labourers flock to the wine country from the adjacent villages, and from Gallacia, hence called Gallegos; amongst these, women and boys preponderate. Their wages are, on an average, 7d. a day and food, which, however, does not include bread. Many of the vine-growers make wine themselves; others sell their grapes to the manufacturers. The larger houses, particularly the English firms engaged in this trade, are the most careful in their processes. However, there are here all kinds of processes and utensils in force, such as are known in other lands producing red wine. The grapes are trodden by men on platforms, and the juice, mixed with the stalks and husks, is removed to stone-built vats. The process of removing the stalks is not practised. Hence all port wine has a great amount of astringency, which requires much time for its partial subsidence and modification. When the fermentation has so far proceeded that the amount of alcohol formed counterbalances the specific gravity of the remaining sugar so far as to bring the glucometer to the zero point, the fermenting mass is greatly agitated, either by means of tools or by men, who go into the vats naked. The stalks and husks are now mixed with the new wine so intimately, that most of the colouring matter is extracted from the husks. This done, the wine is immediately drawn off by pumps, syphons, or taps, always guarded inside by some kind of filter, and placed into tonnels, varying in capacity, averaging thirty-five pipes.

In good years, when the must contains more sugar than can be decomposed by a first fermentation, the addition of brandy to newly-drawn wine completes the first preparation; but in years in which sugar is deficient, this, as well as alcohol, and not rarely colouring-matter, have to be supplied. Colouring-matter is supplied to grapes which seem to require it by sprinkling them, during the process of treading, with the necessary amount of dried and powdered elderberries, or a particular kind of black-coloured cherries. In good years grapes contain a sufficient amount of colouring-matter to give to the wine the desired tint, particularly when there is a sufficient mixture of the "tinto" vine in the set of the vineyard, extraneous admixtures. become unnecessary, even in middling years. But in a few of the very best years the port assumes a sickly, brownish-red colour, which has to be improved in tone by the admixture of something more purple, and then anything is resorted to, from elderberries and cherries to extract of Brazil-wood. These improvements, however, take place later, and not during the process of vinification. The wine is left in the tonnels, until the cold weather of the autumn arrests what little fermentation the addition of brandy had allowed to go on. Towards the middle of November the wine has deposited its lees, and being now clear and bright, is drawn off into pipes, containing each about 115 gallons. In this state it remains in the sheds and cellars of the Douro district until the early spring of the following year. It is then brought by boats down the river Douro, and stored in the warehouses or lodges of the merchants at Villa Nova and Oporto.

No port wine comes to England that contains less of adventitious brandy than half an almude, or 16 quart bottles, or nearly three gallons, to the pipe. But the heavy-brandied, so-called rich, wines, contain from 15 to 17 gallons of adventitious brandy in each pipe of 115 gallons. The principal reason for the addition of brandy to port wine is, that it is the quickest and most certain means to make the wine the most marketable and valuable to the consumer. The wine is not made drinkable any earlier than it would have been without the addition of brandy; on the contrary, it would have matured quicker in its natural state, but the brandy brings it into a quiescent condition. It is not liable to any subsequent little fermentation; it may be exported to climates hot and cold; in other words, with 40 per cent. of proof spirit in it, port wine will keep; but it tastes of spirits of wine, and must, therefore, be kept six or eight years in bottle before it loses the taste of spirit of wine or brandy, and regains the roundness of wine. If the Oporto wine-producer or merchant added no brandy to his wine, he would be obliged to keep it for five, six, or even seven years before he could safely ship it. But the addition of brandy enables him to ship the wine three or four months after the vintage, if so inclined, or during any period exceeding that time. Thus the producer and merchant shift the onus of maturing the wine upon the consumer. Much of the brandy used with port wine is distilled from common wines of Portugal, produced out of the Douro district, of which nine pipes give one pipe of brandy; but many thousands, up to 12,000 pipes are annually carried to Portugal from Great Britain, to be used in the manufacture of port and "jeropiga;" the latter is used for doctoring the common wines. If the manufacturers of port wine did not use brandy, they would be obliged to mature their wines in deep, cold cellars, of which they have not any at present sufficiently capacious to hold even a small proportion of their stock. The natural port could not, with advantage, be matured in the present structures called lodges. If the merchants had to keep all their wines until ripe without brandy, their capital would be engaged much longer, and their operations would, consequently, be much contracted. It is therefore clear that, as long as the makers and merchants can sell their port wine as at present, they will continue to make it as hitherto. But should a new method be found by which port wine can be matured in less time than with the addition of brandy, there can be no doubt that such methods will be used by many, and the public will be able to obtain the natural wine at more moderate cost. Much fresh land could easily be brought into cultivation, and much that is already cultivated could be improved into producing more wine, under the influence of a regular and increasing demand. It has been stated that the proportion of good, of abundant, and of average vintages is, when compared to bad and deficient ones, larger in the Douro district than in other producing countries. According to some information, gained by conversation with the wine-shippers of Oporto, Mr. Consul Crawfurd was led to conclude that, out of twenty-five vintages sixteen are good, four are of average quality, and five only are bad.

GUNMAKING BY MACHINERY.

At a recent meeting of the Birmingham Gunmakers' and Inventors' Club, Mr. W. Ashford read the following paper on "Gunmaking by Machinery":—The ordinary rough walnut stocks used are thoroughly dried before being operated upon. The first operation is that of the stabbing-machine. The stock is placed on a slide flatwise, and by means of a revolving disc a straight cut is taken along that edge in which the barrel groove is eventually formed. This surface, which we shall call A, serves as a guide for the future work. Cuts are next taken across the "butt" and fore-end, to bring the stock to the standard length. In the centreing machine the stock is placed again on its flat upon a plate, and pressed tightly against an iron form, which fits the face A. Attached to the same plate, towards the butt-end of the stock, is a slide, fitted with four projecting points. By a blow, the four points are driven into the butt-end, making four holes in their proper relative position to the prepared face. A centre is then bored with a small cone-drill in its front end.

The machine for turning the fore-end comprises an iron form, with a "centre" to fit the front hole in the stock; a plate, with four points to fit into the holes at the other end, which is drawn up by a screw-clip passing over the end; and also a flat, narrow plate running down the surface A. This form revolves upon two bearings, one placed near where the lock will be situated, being hollow, to admit of the stock being inserted, and fitted with a screw to press the true face down on to the narrow plate, and another at the fore-end. The stock is inserted in this, and screwed tight in the direction of the length of A. The narrow plate clears the cutters as they do their work. These cutters consist of a pair of revolving discs, fitted with hooked teeth, and mounted on levers, pivotted near the ground-line. An iron mould, or copy of the fore-end of the stock, is placed below the latter—revolving slowly at the same speed. The levers carry friction-rollers, which, as they travel over the irregular surface of the copy in a spiral direction, impart a corresponding motion to the cutters, and thus the form of the copy is repeated in the stock. A great economy of time is attained in using two cutters, one commencing in the middle, while the other starts at the extreme end. The general arrangement of the machine for shaping the butt-end is the same as the one described above, excepting that the stock revolves on a centre line, running nearly through the length of the butt, its fore-end being passed through and clipped tightly in a hollow tube supported at the farther end by an oblong face-plate, carried by a small spindle, from which the rotary motion is given. There is only one cutting disc, and the cutting block is fitted with hooked cutter teeth of different forms, which are used successively for the roughing, middle, and finishing cut. The cutters revolve about 3,000 times a minute. The next process is that of "spotting" the stock, or preparing upon the sides certain perfectly true spots or planes necessary in the accurate fixing required in the finishing machinery. In the spotting machine, the stock is held down by two spring clips upon a plate the width of the surface A. This plate works in vertical guides, and is made to descend by means of a treadle, thus bringing the stock into contact with seven small circular saws, so disposed as to form the seven spots required, one at each side of the butt, one on each side of the extreme fore-end, and three intermediate spots on one side. This completes the roughing process. In the machine for bedding the barrel in the stock, the stock is inserted into a recess in a long movable table, which is caused to traverse by means of a rack and three pinions. To fix the stock in position it is clipped at the five spots made on the long side, and pressed up against two horizontal clips projecting a little over on each side of the top of the recess made to receive it by studs from below. This ensures the stock being in line and level with the trued surface. On the further side of the table is a form or mould similar to the barrel bed, and three upright revolving spindles fitted to a cross frame, with guide-pins fitted at their sides working in the form, which ensure their cutting out and following in the proper shape in the stock. The first spindle is fitted with a hooked-nose cutter. It is brought into position, and then lowered by a handle, the feed being given by rack and pinion. This process forms a taper-groove, the full length of the barrel bed. The next spindle cuts the hole for the "breech-pin;" the third, the bed for the tang. The groove receives the finished taper from a cutting spindle suspended from a cross bracket, which is vibrated by a handle, so as to follow the curve of the mould. The fifth and last process is to square the breech end of the groove. This is done by a horizontal revolving spindle, which can be lowered into the groove. The fore-end may now be cut to the finished length. The machine for bedding the lock is complicated, carrying five small vertical cutter spindles in a frame revolving round a central axis. Each spindle is brought in succession to the work. The stock is fixed upon a slide, its position being regulated by a mould or form, against which the barrel groove is pressed. Alongside of the stock is an iron counterpart of the recess to be made, and each cutting-spindle has alongside a tracing-spindle, which is made to follow the said counterpart in all its details, the cutting-spindle repeating the pattern in the wood of the stock. A fan and a couple of nozzles are used to blow away the chips, so as not to interfere with the cutters or the tracer. The first spindle cuts the recess for the lock-plate, the depth being regulated by a cross-bar on the tracer; the second, recesses for the screw-heads; the third, a hole for the "sear" tang; the fourth, the recess for the main-spring; and the fifth, which carries a very small tool, finishes the same. The machine for bedding the trigger and guard consists of an iron bed, with cast-iron brackets on each side, connected by a horizontal bar, which forms a bearing for the central axis of a revolving frame carrying four cutting spindles, very much the same as that used for recessing for the lock, and, like it, provided with guide-pins and levers having a vertical and horizontal motion. A similar arrangement has also been adopted as regards the driving-strap, which runs horizontally above, and which can be brought down over any of the pulleys required as soon as they are in place. The stock in this case is secured in a vertical position, and is clipped in the manner before described. The frame or carriage to which it is fixed rests upon two bars of an irregular form. The carriage is moved by a rack and pinion, the rack being attached to the carriage. The first spindle being brought into position, where it is retained by a self-acting stop, the tool is brought into contact with the work, and a forward curvilinear motion imparted to the carriage, thus making the recess for the guard. The second tool is then brought into play, which makes the recess for the "bosses." The third forms the screw holes, and the fourth a deep recess required for the trigger, and also one for the ramrod stop. This machine, too, is fitted with a small fan and two blowing nozzles. Having cut out all the complicated figure required for bedding the lock and guard, and made a bed for the butt-plate, the next process is to fit the fore-end to receive the bands and "nose-cap." The band machine is a very simple and effective machine, and consists of a low frame fitted with a "form" made to the barrel groove, and not to project so far forward as to interfere with the cut. This form is connected with cams, which are of similar shape to the bands, but of a larger size. It revolves in two bearings, and is fitted with a wooden hand-wheel at one end, so that it can be turned round at pleasure. The stock is screwed down tightly upon the form, concentric with the hollow cams. Revolving cutter-blocks are provided, of the required width, to cut the band and nose-cap recesses. These cutter-blocks can be brought forward at will, and are hung upon vibrating levers, weighted so as to cause them to lie away from the work, and fitted with treddles, so that on the application of the foot they can be advanced at pleasure. All being ready, and the stock fixed in its place, the blocks are brought forward, and the man, having his hands at liberty, can turn the wheel round to give the required feed. The fore-end of the stock has now to be finished to shape, by rounding the parts between the bands. The machine for cutting away the wood between the bands is similar in many respects to the last, consisting of barrel-mould, to which the stock is clipped, and vibrating cutters, to follow a form. As the amount to be taken away is large, the length between each band is finished by two cutter-blocks, one placed in front and one behind the stock. The front and back pair are alternately brought into action, and the whole length smoothed down and finished by the rotating motion given by the hand wheel. This does away with much of the vibration which would inevitably take place were the whole length of the cut taken at one time. All the tools and cutter-blocks of these machines run at very high velocities, and the surfaces which they leave are very good, and in fact a slight friction with a piece of glass-paper, placed upon a cork-rubber, is all that is required. The machine for second turning consists of a strong cast-iron open frame, with a planed top-suface fitted with two long projecting fillets, on which slides a double head-stock, with its connecting gear. Resting upon a plate which carries its other extremity is a hollow spindle for clipping the lower end of the fore-part of the stock. This plate is moved along upon the fillets by means of a screw which is driven from a shaft running below. The cutter block is fitted with hooked teeth, and has a guard over it. It is also driven by the lower shaft, and the frame on which it vibrates is fitted with a light friction-wheel, which runs upon the form, revolving with a similar motion to the stock itself. To retain the sharp angles, the mould, or form, is at the corresponding points brought out so as to lead the cutter-block beyond the flat furface, which, it should have been remarked, has already been produced by a simple planing cutter. By this means the friction-wheel can be allowed to travel over a rounded surface, which is a better motion for it, while at the same time the angles of the stock are left sharp. On taking the stock out of this machine, its outward form is perfect, but it has still to pass through two or three machines. The machine for grooving for the ramrod consists of a planed plate working upon V's, and moved forwards by means of a rack and pinion. On this plate is fixed a mould to fit the barrel groove. The stock is clipped down to this, which ensures its position; and the first groove, which has parallel sides and a semi-circular bottom, is cut in the fore-end by means of a small cutter-block fitted with round-nosed teeth. After this, it becomes necessary to undercut it, and for this purpose a spherical tool is used, the spindle of which works through the top of the groove already formed. The machine for bedding the rod spring consists of a plate on which is bolted a form which fits the barrel groove. This is raised from its surface so as to allow the stock to bed horizontally. The tool for cutting the recess is horizontal, and we find here also the same arrangement of guide-pin and mould to ensure the right form being made. After the recess is cut, the hole for fastening the pin is made. The hole being very small, it has been found advisable to drill it from both sides, and this is effected by means of two vertical spindles, with drills placed in line, and running at great velocity. There are some other small holes to be drilled. This is done in a machine similar to the above, and the stock is then complete. The above description refers more particularly to the stocking machinery used at Messrs. Tranter's, of Birmingham, which is similar in many respects to the Enfield machinery.

VENTILATION AND PURIFICATION IN FACTORIES, &c.

Just previous to the late war, M. Charles de Frécinet, mining engineer, was charged by the late Imperial government with a commission to visit the most important factories and workshops in England, France, Germany, and Belgium, and to report on the means adopted to prevent the ill effects of the various deleterious agencies on the health of the operatives. The results of this investigation were printed in four large volumes, but the very voluminous nature of the work, and the stirring events that followed upon its appearance, have caused it to be but little noticed, except by a few scientific men. It will therefore be useful to note a few of the observations of M. de Frécinet, and especially of those which refer to foreign countries.

After speaking of the good effects produced in Durham by the construction of tall chimney-shafts for the coke ovens, M. de Frécinet says that in Belgium all the new coke furnaces are compelled by law to have chimney-shafts of 45 feet to 60 feet high, in order to ensure the carrying off of the gases.

In the wine-making districts of France, it has been found that exhalations from the lime and brick kilns have a most serious effect on the quality of the grapes, the wine extracted from them has an unpleasant taste of soot, and the proprietors of the kilns have often been compelled to pay heavy damages to the wine-growers. The construction of tall chimney-shafts therefore became an absolute necessity, and the case of St. Etienne is cited as one in which the mischief caused by the numerous coke furnaces around the town was completely stopped by the adoption of tall shafts.

Ventilation by means of fans placed in the buildings themselves, or applied directly to the engines, is pretty generally adopted in the French white-lead, tobacco, and leather-dressing manufactories, and in woollen and cotton mills. In other cases, water is used to condense injurious vapours; and in the soda works high stone towers are employed to condense the smoke.

The dangers which those workmen run who have habitually to make use of quicksilver are too well-known to require description. In the works at St. Gobain, Circy, and Chauny, the men are not employed more than three days in the week in the silvering of looking-glass, and the windows, which are provided with good ventilators, are kept open whenever possible. The tools, covered with flannel, by means of which the mercury is spread on the tin-foil, have handles four feet long; the mercury is kept in hermetically-sealed receptacles, and the cloths through which it is passed, in order to remove impurities, are beaten in well-closed boxes and in the open air.

In silvering by means of mercury, by the method of MM. Bonin, of Paris, an admirable method is adopted to get rid of the fumes. Over the fire by which the mercury is driven off in the form of vapour is an open chimney, covered at the top with a large glass globe, and the workmen are protected by a shield, through which they pass their arms.

Some manufactures have not been much benefited by science; for instance, no means have been found of reducing the unhealthiness of the chromate of potash works. At those of M. Clouet, of Havre, most of the workmen are subject to cancer, which attacks the nostrils, and which is produced by the particles of chromate which float in the air. The production of sulphate of quinine is no less dangerous; it affects in a singular manner those who have to manipulate it. The operation of millstone cutting is extremely unhealthy. The population of La Fertésous-Jouarre, the chief centre of this important trade, is decimated by the introduction into the lungs of the silicious particles which are in suspension in the air, and it is calculated that ten years' employment in the business generally produces fatal disease. The charcoal dust used in the iron and bronze founderies for covering the moulds is also found very injurious to the health of the men engaged, and in consequence potato flour is now generally used in Paris, in place of charcoal, with good results. In bark grinding and other works, where simple ventilators have generally been used, reservoirs are now added, so that the dust is both withdrawn and collected, and does not contaminate the air.

In the cotton mills of M. Fauquet, at Oisel, the principal room, which is nearly 3,000 feet long, and is used both for carding and spinning, is constructed in a special manner, with the triple object of securing uniform temperature, driving out the impure air, and supplying fresh air. In order to prevent the variations of temperature arising from change of weather, the vaulting of the roof was covered with honeycombed work, in the following manner:—A number of glass bottles were arranged upright and in alternating rows, mortar was then poured into the interstices, and, the bottles being removed, left a spongy, porous coating, which was afterwards covered on the top with plaster. By this means a double ceiling was produced, enclosing a stratum of warm air contained in a multitude of cells. Two powerful ventilators in a subterranean gallery carry off the impure air and supply fresh, the circulation of the latter being secured by passages beneath the flooring, having thirty openings into the room. Lastly, a jet of water is used in the fresh-air gallery when additional humidity is requisite.

In the tobacco factories, uniformity of temperature is not requisite, and the dust is much less than in cotton and other mills, but there are exhalations from the fermenting tobacco to be removed. In the French government factories, ventilating fans are used, and eight cubic metres of air per hour are allowed for each workman. The factories are heated with calorifères, with tall chimney shafts.

In some white-lead works, and where lead enamel for telegraphic isolators is ground, the millstones are enclosed in tight cases, and are in direct communication with the ventilating fan. In M. Kestner's factory at Thann, the rooms in which chlorate of lime is made have leaden pipes, which carry off the gases to the main chimney shaft; a register is opened an hour or two before the men arrive to their work, a strong current is established, and the air of the place completely renewed.

In the lead foundry of M. Lepau, at Lille, each furnace has a cupola which communicates, by means of a flue furnished with a register, with the bottom of the cinder-hole of the steam-engines. Similar arrangements are adopted in nearly all the French factories employing mineral oils and greases, and where pyroligneous acid and sulphuretted hydrogen are produced. The method is considered applicable to all works where organic substances are treated, and the economy of combustibles is considerable. In some soap works, the boilers are furnished with iron hoods, which have pipes which convey the gases beneath the steam-engine furnace, where they are dispelled by a jet of steam.

At Aix-la-Chapelle, the Prussian authorities have strictly prohibited the grinding of needles, except in shops provided with thorough means of ventilation and for carrying off the atoms of metal. In some of the shops at that place, each stone is furnished with its own ventilator. In the chemical works of M. Mercks, at Darmstadt, where great quantities of belladonna are prepared, a large hood connected with a chimney is brought down over the grinding-mill, and never allowed to be raised until the grinding is done and all the dust carried off. In many other drug works the grinding-mills are enclosed and ventilated in like manner.

In the chemical works of M. Gundelach, at Mannheim, the men who repair the leaden chambers for the manufacture of sulphuric acid and chloride of lime wear a head-piece, connected by flexible tubes with an air-pump, as in diving. The same plan is adopted at Worms and at Heilbronn.

The severity of the Belgian government in such matters has caused the manufacturers to adopt many ingenious devices. In M. De Hemptine's works, at Molenbeck, St.-Jean, near Brussels, the platinum still for the concentration of sulphuric acid is built into a wall; over the still is a cover, in the centre of which is the man-hole, which, when the mill is at work, is closed hermetically by a leaden plate, and from the space thus formed between this cover and the top of the still a leaden pipe carries off the vapours into the main chimney-shaft of the works.

In the extensive paper-mills of M. Godin, at Huy, where chlorine gas is used for bleaching the pulp, the gas is carried off by means of stone channels, which are in communication with a central chamber thirty feet high, where absorption is effected on a grand scale.

At Ghent and Dusseldorf, white-lead is ground in oil or water, in order to prevent the dispersion of the fine particles. This substance used to be employed in bleaching lace, but it caused such mortality amongst the workmen that the government interdicted it. In the chemical works of M. Zimmer, at Sachenhausen, near Frankfort, the bark for the preparation of sulphate of quinine is ground in a state of fermentation in mills hermetically sealed. In the purification of the sulphate, the evaporating vats are placed in a special room, and under domes furnished with special shafts.

At the lucifer-match works of M. De Roubaix, at Heurixen, near Antwerp, the five buildings in which the various preparations are made are ventilated by means of a great central chimney-shaft, which receives the gases from the steam furnaces, and the draught of which is aided, when necessary, by a special furnace. A spacious subterranean channel runs round the base of each building, and terminates in the central shaft. An opening is made in every part where phosphorus is employed, with a channel leading to the main one above described.

At the woollen works of MM. Hauzein, Gérard and Co., of Verviers, the carding machines are situated in a separate building, provided with ventilating fans. The wool is placed on a rack, forming one side of an otherwise closed case; a powerful fan acts within this enclosure, while a current of hot air is directed against the walls of the building. By these simple means, the workpeople are relieved from all the dust and other matters which would contaminate the air.

At Ypres, the lime used in the purification of gas, upon being withdrawn from the purifiers, is immediately mixed with cinders, which destroy the unhealthy odours, and the mixture is eventually sold as manure.

After the previous accounts from other countries of the aid rendered by science and humanity, it is hard to have to transcribe the following expressions in relation to our own country. M. de Frécinet says:—"In England, the manufacturers, forming a part of the government, and not fearing any censure, neglect to apply in their works the preventive systems adopted elsewhere." Were this true, it would be one of thee most serious statements that were ever made against a nation or a government; but M. de Frécinet is able to find "some exceptions," and amongst these are Messrs. Rodgers, of Sheffield; Thomas, of Redditch; Price's Patent Candle Company; Crossfield, of St. Helen's; and Elkington. Any Englishman at all acquainted with the subject could multiply these so-called exceptions by a good number.

The value of M. de Frécinet's work lies, however, in his accounts of what has been done on the Continent, and these deserve serious study.

THE TRADE OF BORDEAUX.

The most complete account, just published, of the trade of the port of Bordeaux, and the proportion that it bears to the totals of the other seaports, and to the general trade of France, as well as the degree in which it is carried on with the United Kingdom, appears in the commercial reports of the foreign office. We are informed by Mr. Consul T. C. Hunt, that the statements from which he has prepared this summary are derived principally from the annual tables of commerce printed by the French government, from particulars communicated by the local Custom-house and Chamber of Commerce, and the shipping lists of the consulate. It appears that in 1868 there were in France seaports to the number of 177, trading with foreign countries for an aggregate real value, exports and imports taken together, of £220,000,000 sterling. The trade by land made an addition of about £100,000.000, the total weight of goods exchanged being 19,000,000 tons. Of the fourteen principal ports, of which there are ten on the northern and western coasts, and four in the Mediterranean, the whole quantity of exchange was 8,000,000 tons, and the value £190,000,000. On this list, Bordeaux stands third as to quantity, and fourth as to value, Marseilles and Havre taking precedence in both, and Boulogne in the last.

The port has great natural advantages for lucrative intercourse with foreign countries, in the situation, soil, and climate of the department (the Gironde) of which Bordeaux is the chief town. The town itself lies at about the same distance from the sea as London (seventy miles), removed from every hostile attack, offering safe navigation for vessels of the largest present ordinary tonnage, half-way up the river to Pauillac, and for 800 tons the whole way up to the town; while, by river, canal, and railway, it communicates with the Mediterranean, with Spain, and with the manufacturing centres of France. In extent the department measures about 100 miles from east to west, and 80 from north to south, containing an area of 2,500,000 English acres, or about one-fiftieth of the whole of the country. The population numbers about a million, or about a fiftieth of France, and that of the chief town 200,000. Its state of affluence is considerable, both the agricultural and trading classes being better supplied with capital than in most of the other departments. A very superficial view serves to show the nature of the soil, varying as it does with its elevation above the great intersecting rivers, the Garonne and the Dordogne. The soil is an alluvial clayey loam along the banks of these rivers, and in the low valleys of a similar origin, an ochreous marly clay on the hills, gravel in an earthy cement on the low, undulating beds above the river banks, and peat, mixed with transported soil, in the heathery plains of the Landes.

Abundant crops of grass and ordinary wine are produced by the moist river lands; corn and better wines, including the unequalled nectars of the Sauterne vineyards, and the well-known clarets of Medoc, by the raised gravel beds. On the light, peaty plains, and sandy downs of the coast, extensive plantations have been made of sea-pine, supplying railway sleepers, pit-props for mines, smaller wood for fencing and firing, and resinous commodities, all articles of considerable demand. The productive land of the department has been ascertained to extend over about 85 per cent. of the whole area, rather more than a third yielding valuable crops of corn and wine. Latitude and proximity to the ocean render the climate comparatively equable, the heat of summer being often tempered by a sea-breeze, and the cold of winter seldom requiring an overcoat for exercise in ordinary health. Such a climate is calculated to make, and may be said to have made, the Gironde a country of corn, and oil, and wine, for even in occasional duration of a ten days' frost in the cold, or the occurrence of a night's in the warm months, the harm done to plants seems to be less than the good effect of killing insects that feed on and paralyse them.

Under favour of her position, Bordeaux has taken a large share of the benefits conferred on France by the system of commercial freedom adopted in 1860. While the total value of French trade rose, between 1859 and 1869, 42 per cent., and in the sea-ports separately 36 per cent., the increase at Bordeaux was nearly 50 per cent. No materials are to be had for an inquiry into the share taken by the United Kingdom in the whole trade of Bordeaux; but as regards the whole of France, there was, between 1860 and 1868, an increase of 37 per cent. in the total trade, and 38 per cent. in the trade to the British dominions. There can be little doubt that nearly the same proportions would be found in the trade of Bourdeax, where over a third part of the laden tonnage is occupied with trade to and from the British dominions. In the accounts of the same period, the real value of the exports as to the whole of France show an increase of 18 per cent.; as to the sea-ports, 13; and Bordeaux 36. In exportation, therefore, the increase at Bordeaux since 1860 has been double as much as in France generally, and nearly treble as to the trade of the other sea-ports. In quantity, the increase has been less than in the value, a fact to be accounted for, no doubt, by the greater use of the port for the shipment of manufactured articles to South American ports, and a greater shipment of wine. The staple export is wine, amounting in value to one-half of the whole shipments of the port; as it also is about one-half of the whole quantity produced in the department. Out of the 105,000 tons despatched upon an average of years, about a fifteenth part, mostly of the choice kinds, is shipped in bottle, the remainder going in casks, of the content of 47 imperial gallons. The demand for England has trebled within the last ten years; and it is evident that the consumption of the cheaper red wines which can be shipped is rapidly extending.

Great as the increase of exportation has been within the last ten years, the rate has been surpassed in the importation—more than trebled in the general and seaport trade of France. For the whole country, the increase has been at the rate of 65 per cent.; for the seaports, 52 per cent.; and for Bordeaux, 54 per cent. The proportion borne by the latter to the rest of the country is reversed as compared with the exportation, in consequence of the great specific value of the land imports from Germany and Switzerland, and the advantage possessed by all the other chief seaports in being nearer to the centres of manufacturing industry. The details of the commodities show, on the one hand, that France can buy her wares cheaper than she can make them, and, therefore, has but little increased her consumption of foreign metals, while she has largely extended her purchases of English, German, and Belgian products; and, on the other hand, that, whilst she keeps in advance as a manufacturer of tissue and leather goods, she is improving her system of agriculture by the free use of guano and other imported manures. It is clear that, as wealth increases in other countries, she can command a continually extending market, and that a perseverance in the encouragements given to the enterprise of her merchants, during the last ten years, must open new sources of lucrative employment to her skilled labour, and of wealth for her whole population.

Of the merchandise entering into the trade of France, about a twelfth part passed into and out of the country under the regulations during the year 1868, the whole being about 20 per cent. in weight, and 35 per cent. in value less than in 1860. The position of Bordeaux, making the port a convenient one for the warehousing of Transatlantic cargoes, her warehousing business has not fallen off in the same degree as that of other ports of France. Her rate of decrease during the last ten years appears to have been only a fifth in the weight, and one-half in the value of the goods. The transit trade of France, in which she chiefly serves England, Germany, Switzerland, Belgium, and Italy, as dispatching, and that with the Americas, Spain, Turkey, and the East, as receiving countries, amounted in 1860 to over 212,000 tons of goods, of the value of more than £24,000,000. In 1868, the quantity of goods was 100,000 tons more, but their value had decreased by £400,000. At Bordeaux, in 1860, the quantity imported in this trade was 410 tons, and exported 366 tons; increased in 1868 to 5 314 tons, and 4,537 tons. There is no account of the value. The imports of 1868 were chiefly for Spain and the Mediterranean, and the exports from Germany, Switzerland, and Spain. Taking from the account of the commodities composing the whole transit trade of France those which are likely to have passed through Bordeaux, they would appear to be from North and South America, coffee to Switzerland, and refined rock oils to that country and Spain; from Spain, iron to the United States, and corks to the Americas; from Germany, prepared tobacco, and arms to the Americas; from Germany and Switzerland, silks, cottons, linen, made-up clothing, leather goods, plate, and jewellery; and from those countries and Belgium, woolleens, all to the Americas. During the late war, the transit trade with Germany was, of course, suspended, and the occupation of the railway lines for the conveyance of troops interrupted the expeditions to and from other countries.

Although trustworthy means of knowing the trade with England are wanting, the details of the navigation show the importance of British trade at the port. In the general foreign trade of France, in which (taking the year 1868), the whole laden inward and outward tonnage is 4,250,000 tons, three-fourths are British. At Bordeaux, in ordinary years, this flag takes about one-third. In the whole burthen of shipping, Bordeaux has about a fourteenth of the receipt and a twelfth of the delivery of the goods entering into the trade of the whole country. Her chief share is in the trade with the north of Europe, South America, and the East, of which she has, with respect to the whole of France, 15 per cent. of the inward, and 30 per cent. of the outward tonnage. France has a mercantile marine of about 12,000,000 tons; but the average burthen, little over 60 tons, shows how large a part must consist of small coasters. In 1868, she had only 1,331 ships of a sufficient size for long sea trade. The tonnage of Bordeaux was 413 ships, of 129,410 tons, an average of over 300, making about one-half of the sea-going tonnage of the whole country. This want of carrying power for a trade of nearly 16 times the aggregate tonnage of the national marine, rendered it necessary, for the interests of commerce and the good of the people in general, to remove various restrictions imposed on foreign shipping by the old Navigation Laws. This was done by the well-known measure of June, 1866, and foreign flags now import cargoes in all the reserved and restricted long sea trades, the colonies included, without penalty or surcharge. Notwithstanding a good deal of outcry with that view, it can scarcely be believed that the restriction will be re-established.

OBITUARY.

The Earl of Lonsdale died on Monday night, the 4th inst., at his residence in Carlton-house-terrace. As late as six o'clock in the evening he had been at the Carlton Club, and during the day he visited Christie and Manson's sale-rooms, where he made several purchases. The ripe age of the deceased nobleman, 85 years, is almost sufficient explanation of the cause of death. His public career, though not often coming prominently to the front, has been associated with more than sixty years of our political history. He was born in 1787, and, after studying at Harrow, he was entered at Trinity College, Cambridge, Fresh from the University, he got into Parliament for Cockermouth, in 1808. The year of his majority saw him made an academic graduate and a legislator. The next year was distinguished by his first accession to office, he having succeeded Lord Palmerston as one of the Lords of the Admiralty. In 1813, he retired from Cockermouth, and successfully contested the county of Westmoreland, which retained him as its representative till the struggle which preceded the Reform Bill. On the eve of that crisis he had to seek refuge in the now disfranchised borough of Dunwich, but he speedily recovered the more important seat, having been returned again for Westmoreland in 1832. His Parliamentary fortunes experienced no further change until 1841, when he was called to the Upper House in his father's barony of Lowther. Nearly three years later he succeeded, on his father's death, to the earldom and the extensive family estates in Westmoreland and Cumberland. These have materially improved in value under his judicious management, and he leaves besides a considerable amount of personal property. The most active part of his official life fell within the compass of the Liverpool administration. He continued at the Treasury from 1813 till 1826; and under Lord Wellington's administration he became First Commissioner of Woods and Forests. His services in that office were recognised by the government in appointing him a Privy Councillor. When Sir Robert Peel brought back the Conservatives to power, the late Earl was first made Treasurer of the Navy, and subsequently Vice-President of the Board of Trade. Under Sir Robert's second administration he was for four years Postmaster-General. When the Earl of Derby took office in 1852, he offered Lord Lonsdale the Presidentship of the Privy Council, which was accepted. There the ambition of a long and successful career checked itself. The late Earl declined a seat in any of the more recent Conservative Cabinets, and his active participation in politics gradually declined. He is succeeded in the family honours by his nephew, Mr. Henry. Lowther M.P. for West Cumberland (for which county he was first returned in 1847) eldest son of the late Colonel Hon. Henry Cecil Lowther, by Lady Eleanor, daughter of the fifth Earl of Harborough. The late Earl was elected a member of the Society of Arts in 1825.

NOTES ON ART.

The private view of the fifth of the exhibitions of the New British Institution Gallery took place on Saturday last, and was well attended. There are nearly two hundred works on the walls, and it is a great thing to say that there is scarcely one which is not seen to advantage. Another feature in the arrangement deserves notice, namely, that the price of admission (one shilling) includes a copy of the catalogue. The large majority of the remarkable pictures are by foreign artists, and the works of many of these are not well known to the London public. Amongst them may be named a remarkable picture by J. Van Lerius, "The First Sail," an idyll of the age of innocence, of extraordinary originality and beauty; "A View at Moulins, near Dinaut," a landscape with water and cattle, by one of the best living landscape-painters, J. Van Luppen, an exquisite work; two rivals, also landscapes with cattle, and "The Environs of Haarlem and Amsterdam," contrasting admirably in style with the preceding by another master in his art, E. de Schampheleer. Then there is a beautiful view of "The Environs of Antwerp," by H. De Cock; "A Delicious Morning on the Dunes, with Cows," by De Haas; "A Glade by the Dee," by A. de Breanski; "An Approaching Storm," "Sheep Cowering beneath a Willow-tree," by A. Plumot; so that the exhibition is strong in landscape. Amongst works of other classes will be found pictures by G. de Yonghe, C. dell'Acqua, B. Van Moer, O. Von Thoren, José Yimenez-y-Aranda, F. Stroobant, and V. Lagye. In addition to the exhibition proper, there is one of those many-leaved stands in the middle of the gallery, on which is placed an exhibition of small pictures in oil and water-colour drawings, for immediate sale, and which may be constantly replaced. These, of course, are not included in the catalogue.

The proceeds of the first three out of four days' sales of MM. Péreires admirable collection, amount to nearly £56,000. The prices are, in many cases, very high, but not all; it is evident that fashion rather than severe taste ruled the biddings. The following are the most remarkable items:—*Modern School.*—"Pilgrims returning from Mecca," by Bida, 6,500 francs; "Pasturage, by Brascassat, 16,000; "Gleaners," by Breton, 18,200; "Catherine de Médicis at the Château Chaumont," Comte, 10,000; "The Flight into Egypt," a remarkably fine work of Decamps, 15,150; "The Miracle of Saint Benoit," after Rubens, by Delacroix, 18,000; another copy of Rubens by the same artist, "Henri IV. confiding the Regency to Marie de Médicis," 2,650; "Portrait of a Youth," after Raphael, by the same, 3,750; "Mary Magdalen at the House of Simon," by Paul Delaroche, 9,200; "Marie Antoinette after her Condemnation," the first sketch of the well-known work, by the same artist, 6,100; "The Return from Harvesting," by the same, 11,500; "A Mendicant," by the same, 4,350; "Venus and Cupids," by Diaz, 12,500; "Nymphs and Cupids, by the same, 8,900; "Pifferari at Rome," by Gérôme, 17,200; "Entrance of the Valley of Lauterfrunnen," by Karl Girardet, 5,800; "A Marine Piece," by Gudin, 9,300; "Œdipus and the Sphinx," by Ingres, 25,600; "Saint Symphorien," by the same, the original drawing, 9,100; "Landscape," by Koekoek, 8,200; "Louis the Fifteenth and the Spanish Ambassador," water-colour drawing, by Lami, 7,500; "Mass in the Pyrenees," a reduction of the original, by Landelle, 4,000; "The Flute Player," by Meissonier, 26,100; "After Breakfast," by the same, 25,200; "Pifferari before the Shrine of the Virgin," by Léopold Robert, 40,100; "Young Neapolitan Fishermen," by the same, 18,800; "Charles V. at the Monastery of St. Just," by Robert Fleury, 40,000; "Michael Angelo tending his Sick Servant," by the same, 8,900; "Landscape after Rain," by Th. Rousseau, 9,300; "The Banks of the Oise," by the same, 13,100; "Bernard Palizzi giving a Lesson on Geology," by Louis Roux, 5,300; three splendid flower and fruit pieces, by Saint-Jean, respectively, 17,900, 9,200, and 9,700; "The Margaret at the Fountain," by Ary Scheffer; 56,000; "The Mother Convalescent," by the same, 7,600; "The New Market at Amsterdam," by Van Schendel, 6,920; a "Kermesse, Evening," by the same, 6,950; "The Promenade on the Ramparts," Tissot, 2,750; landscape with animals, by Verbroeckhoven, 4,750; "Christmas Fêtes," by Wald Müller, 16,500; "View in Holland," by Verveer, 2,850 francs. *French School of 18th Century.*—"Venus and Cupid," Boucher, 12,600; "The Mouton Chéri, or the Messenger," the same, 9,000; "The Rose-bud and the Bird Escaped," same artist, 9,600; "Return from Market," De Marne, 3,850; two works by Fragonard, "Main Chaude" and "The Broken-down Horse," fetched together 10,400; "Italian landscape, Claude Lorrain, 5,600; "A Young Girl," Greuze, 32,500; "La Camargo," Lancret, 9,900; "La Salle," same artist, 6,200; "Portrait of a Man," by Carl Van Loo, 2,700; "Pygmalion and Galatea," Lagrenée, 3,100; "Magdalen," by Mignard, 3,050; four works by Pater, "Plaisirs Champêtres," 19,200, "Repose in the Park," 18,200, "The Vivandières of Brest," 18,400, "The Halt at the Inn," 10,000; "The Youth of Bacchus," by Nicholas Poussin, 2,320; "The Visit to the Port," Joseph Vernet, 11,000. *Spanish School.*—"Portrait of the Duchesse d'Albe," by Goya, 6,000; "Portrait of a Child," by the elder Herrara, 12,800; "Christ on the Cross," by Moya, 600; "The Vision of Sainte-Rosalie," by Murillo, 11,200; and "Sainte-Rosalie," by the same, 25,500; an "Infanta of Spain," Velasquez, 10,700 francs. *Italian School.*—"Madonna," by Boticcelli, 1,750; "Flowers," by Margarita Caffi, 2,000 and 1,520; "Madonna and Child," Carpaccio, 5,600; "Calvary," by Fra Angelico, 1,320; "Portrait of Leonora d'Este," Luini, 2,000; "The Queen of Sheba at the Foot of Solomon's Throne, Tintoretto, 1,300. *German School.*—"Portrait of an Old Woman," by Amberger, 1,450; "David before Saul," by Dietrich, 750; "The Good Samaritan," Elzheimer, 1,400; "Portrait of Charles III. of Spain," Mengs, 820; "A Bacchannal," by Plazer, 2,000. *Dutch and Flemish Schools.*—"Animals by the side of a Canal," by Nicholas Berchem, 42,000; "The Rencontre," same artist, 7,000, and "The Pass of the Mountain," 6,000; "Italian Landscape," by Jean Both, 2,200; a Cuyp "Landscape, with Animals," 9,200; "Starting for the Chase," 4,900; and "Portrait of a Woman," 3,150; "Portrait of Henrietta, Queen of Charles I.," Vandyck, 9,100; "Portrait of a Woman," F. Hales, 21,000; "A Kermesse," Van Hellemont, 5,600; "The Entrance of a Castle," Van der Heyden, 10,900; Three splendid works, by Hobbema, "A Dutch Country House," 50,000; "The Entrance of the Forest," 81,000; and the "Water Mill," 30,000; "A Dutch Interior," "Pieter de Hooch, 20,200; "A Bouquet of Flowers," Van Huysum, 3,020; "The Geographer," by Van der Meer, 17,200; "The Astrologer," same artist, 4,000; "Portrait of Admiral Van Tromp," Micris, 8,500; "Seduction," same artist, 4,600; "Landscapes," Van der Neer, 5,400, 5,200, and 8,200; four works, by A. Van Ostade, "The Card Party," 8,000; "The Beerhouse," 8,100; "A Drinker," 23,000; and "A Card Party," 5,000 francs.

GENERAL NOTES.

Swiney Lectures on Geology, 1872.—By permission of the Lords of the Committee of Council on Education, and with the approval of the trustees of the British Museum, the course of twelve lectures will be delivered by Dr. Cobbold, F.R.S., in the Theatre of the Royal School of Mines, Jermyn-street, on Saturday evenings, commencing March 16th, at 8 o'clock. Admission free.

The Public Libraries of Paris.—An examination has been made of all the public libraries and depositories of records, to ascertain if the books and manuscripts had been untouched during the commune, and the result is that, with the serious exception of the library of the Louvre, which contained 90,000 volumes, many of great rarity, and a few works belonging to the Cour de Cassation, all have escaped uninjured. To the report are added the following notes:—The Bibliothèque Nationale possesses 1,800,000 volumes; the library of Sainte Genevieve, 110,000; the Mazarine Library, at the Institute of France, 150,000; that of the Arsenal, 230,000; and of the Sorbonne, 10,000.

Institution of Naval Architects.—The Council of the Society have granted the use of the Hall for the meetings of the Institution of Naval Architects, which will be held as follows:—Thursday, March 21st, morning meeting, at twelve o'clock.—1. Annual report of the Council. 2. Address by the President. The following papers will then be read and discussed:—1. "On the Protection of Ships against Torpedoes," by Herr J. N. Moerath, Chief Engineer," Austrian Navy. 2. "On the Construction of Vessels in Relation to the Changed Modes of Naval Warfare," by Captain John Harvey, R.N., Associate. 3. "The Effect of Torpedoes on Naval Construction," by C. W. Merrifield, Esq., F.R.S., Associate and Honorary Secretary. 4. "On Steam Launches," by F. J. Bramwell, Esq., Associate. 5. "On the Masting of Armour-plated Ships," by Admiral Pâris, C.B., French Navy, Associate. 6. "On a New Form of Armour-plated Ships," by Captain J. Wheatley, R.N. 7. Armour-plated Ships," by J. M. Hyde, Esq. Evening Meeting at 7 o'clock.—1. "On Legislative Interference with the Construction, Stowage, and Equipment of Ships;" by William Young, Esq., Associate. 2. "On a Rule for Determining Free-board;" by Herr Gustave Mitzlaff. 3. "On the Rolling of Ships;" by Professor W. J. M. Rankine, F.R.S., Associate. 4. "On the Elements of Design Affecting the Sailing Qualities of Ships, with Especial Reference to the Ships of the Navy;" by J. G. Wildish, Esq., Member. 5. "On Ships' Lights;" by M. Cole, Esq. 6. "On a Salvage Buoy for Life and Property;" by M. Cole, Esq. Friday, March 22.—Morning Meeting at 12 o'clock.—1. "On the Corrosion of Iron Ships;" by Robert Mallet, Esq., F.R.S. 2. "On a System for Registering the Wear and Tear of Iron Ships;" by William Taylor, Esq. 3. "On Strengthening Worn-out Iron Ships;" by William Poole King, Esq., Associate. 4. "On the Strengthening of Ships of Extreme Proportions;" by Herr J. N. Moerath, Chief Engineer, Austrian Navy. 5. "On a New System of Longitudinal Shipbuilding;" by J. E. Scott, Esq. 6. "On the Design and Construction of Yachts;" by Henry Liggins, Esq., Associate. 7. "On Raking Stern Ports;" by Dixon Kemp, Esq., Associate. Evening meeting at 7 o'clock:—1. "On Channel Communication;" by Henry Liggins, Esq., Associate. 2. "On International Communication between England and Europe by Special Harbours and Train Steamers;" by John Scott Russell, Esq., F.R.S., Vice-President and Member. 3. "On the results of Modern Practice in Ocean Steam Navigation;" by Herr J. N. Moerath, Chief Engineer, Austrian Navy. 4. "On Economy of Fuel, by T. S. Prideaux, Esq.;" 5. "On Economy of Fuel;" by Captain Mac Dakin, late 42nd Highlanders. 6. "On the Uniformly Increasing Spiral in Naval Guns;" by Commander Dawson, R.N. Saturday, March 23.—Morning meeting at 12 o'clock—1. "On Perpetual Sounding for Ships;" by M. Cole, Esq. 2. "On the Steering of Ships;" by Robert Saunders, Esq. 3. "On the Amount of Force Exerted by a Rudder in Turning a Ship, with a Ready Method of Calculating the same in Horse-power;" by Henry Ransford, Esq., Associate. 4. "On a Floating Temporary Rudder;" by J. C. Dixon, Esq. 5. "On the Fishtail Rudder;" by Dr. McGrigor Croft. 6. "On a New Mode of Screw Propulsion;" by F. G. Harrington, Esq.

The Haberdashers' Company have resolved to grant four exhibitions of £50 each, tenable for three years, to children and grandchildren (male or female), or apprentices of liverymen of the company, and another of £50 to a scholar of any school of which they are governors; also £150 per annum towards the education of children and grandchildren of their liverymen (not being members of the court), and the yearly sum of £100 for prizes to the actual inventors of new patterns, designs, or specimens of articles of haberdashery proper, such inventors not being manufacturers or dealers.

CALENDAR OF MEETINGS.

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ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

March 20th.—"Notes from a Diamond Tour through South Africa." By Thomas Wm. Tobin, Esq.

March 27th.—*Passion Week.*

CANTOR LECTURES.

The Sixth Lecture, on "Mechanism," by the Rev. Arthur Rigg, M.A., was delivered on Monday evening, March 11th. These lectures will be published in future *Journals.*

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon......Social Science Association, 8. Mr. Frederic Hill, "How far are the Rules of Ordinary Arbitration applicable to International Arbitration."
London Institution, 4. Prof. John Ella, "Elementary Music."
Royal United Service Institution, 8½. Mr. T. Symes Prideaux, "Economy of Fuel in War Steamers."
Victoria Institute, 8. Dr. Bateman, "The Bearings which recent Researches upon the Seat of Language have on Darwinism."
Entomological, 7.
British Architects, 8.
Medical, 8.
Asiatic, 3.

Tues. ...Civil Engineers, 8. Mr. Isaac Lowthian Bell, "On the conditions which favour, and those which limit, the Economy of Fuel in the Blast Furnace for Smelting Iron."
Statistical, 7¾. Mr. Archibald Hamilton, "On the Colonies."
Pathological, 8.
Zoological, 9
Royal Institution, 3. Dr. Rutherford, "Circulatory and Nervous Systems."

Wed.....**SOCIETY OF ARTS, 8.** Mr. Thomas Wm. Tobin, "Notes from a Diamond Tour through South Africa."
Geological, 8. 1. Mr. C. J. A. Meyer, "On the Wealden as a Fluvio-lacustrine Formation, and on the relation of the so-called 'Punfield Formation' to the Wealden and Neocomian." 2. Mr. S. J. Whitnell, "Notes on Atolls or Lagoon-islands" Communicated by Prof. N. S. Maskelyne. 3. Mr. J. R. Dakyn, "On the Glacial Phenomena of the Yorkshire Uplands." Communicated by Prof. Ramsay. 4. Rev. W. Bleasdell, "Modern Glacial Action in Canada" (second article). Communicated by Prof. Dawson.
Royal College of Physicians, 5. Lumleian Lecture. Dr. Quain, "On Diseases of the Muscular Walls of the Heart."

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. Mr. George Bentham, "On the Geographical Distribution of the *Compositæ.*"
Chemical, 8.
Numismatic, 8.
Royal Colonial Institute, 8. Mr. Hyde Clark, on "Capital available for Colonial Development."
Royal Institution, 3. Prof. Odling, "On the Chemistry of Alkalies and Alkali Manufacture."
Institute of Naval Architects. (At the House of the Society of Arts.) Morning Meeting at 12. Evening Meeting at 7.

Fri.......Royal College of Physicians, 5. Lumleian Lecture. Dr. Quain, "On Diseases of the Muscular Walls of the Heart."
Royal Institution, 9. Mr. J. Norman Lockyer, "On the Results of the last Eclipse Expedition."
Institute of Naval Architects. (At the House of the Society of Arts.) Morning Meeting at 12. Evening Meeting at 7.
Quekett Club, 8.

Sat.......Royal Institution, 3. Mr. Moncure D. Conway, "On Demonology."
Institute of Naval Architects. (At the House of the Society of Arts.) Morning Meeting at 12. Evening Meeting at 7.
Royal School of Mines. Swiney Lecture. Dr. Cobbold, "On Geology."

Journal of the Society of Arts.

No. 1,009. Vol. XX.

FRIDAY, MARCH 22, 1872.

All communications for the Society should be addressed to the Secretary John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

COUNCIL MEETING—RAILWAY CARRIAGES.

The Council, at its last meeting, ordered that the Secretary address a letter to the Chief Railway Companies, and particularly those carrying passengers in the neighbourhood of London, urging them to make some arrangements to prevent the noise and inconvenience of the constant slam of the doors; and to state that the Society of Arts is willing, if there be any difficulties in obtaining this object, to offer a silver medal for the best proposal, as shown by a working model, and to exhibit the same at the Society's rooms.

CHANNEL PASSAGE.

The Committee met on Monday, the 11th inst. Present—Lord HENRY G. LENNOX, M.P., Chairman of the Council, in the chair; Mr. F. A. Abel, E. Chadwick, C.B., Major-Gen. Eardley-Wilmot, Admiral the Right Hon. Lord Clarence Paget, K.C.B., Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Mr. E. J. Reed, C.B., Rear-Admiral Ryder, Capt. Scott, R.N., and Mr. Seymour Teulon.

Mr. John White, of Cowes, attended, and gave evidence in respect of the fittings for ships.

Mr. Henry Bessemer attended, and gave a description of the mechanical means which he proposes to adopt for keeping the cabins steady, with a view to the prevention of sea-sickness.

The Committee met on Wednesday, the 20th instant. Present—Mr. Seymour Teulon, Vice-Chairman of the Council, in the chair; E. Chadwick, C.B., Major-General Eardley-Wilmot, F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., and Mr. E. J. Reed, C.B.

Mr. G. C. Muckrow, of the Thames Iron Works, and Mr. Henry Liggins, attended, and with Mr. E. J. Reed, gave evidence.

The evidence given at both meetings will appear in full in subsequent *Journals*.

MOSCOW POLYTECHNIC EXHIBITION, 1872.

The Committee of the above Exhibition are desirous of forming, for reference in Moscow, a collection of catalogues or price lists of makers of machines and tools of all kinds, and of mathematical instruments. Parties willing to assist are requested to send at once to the Secretaries of the London Committee for the Moscow Exhibition, now sitting at the Society of Arts, Adelphi, London, two copies of each such catalogue or list (illustrated preferred), and the same will be forwarded to Moscow, free of expense.

Members of the Society are requested to give publicity to this notice, as it is very desirable to render the collection as complete as possible.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy aud agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

The Council invite members of the Society to forward to the Secretary, on or before the 29th of April, the names of such men of high distinction as they may think worthy of this honour.

EXTENSION OF POST-OFFICE MONEY-ORDER SYSTEM TO INDIA.

The following Memorial has been sent to the Secretary of State for India:—

To the Right Honourable the Secretary of State for India in Council.

The Memorial of the Society for the Encouragement of Arts, Manufactures, and Commerce, Incorporated by Royal Charter.

Sheweth,

That whereas the benefits of the Post-office Money Order system have already been extended to Belgium, Switzerland, Denmark, Germany, Egypt, America, Canada, the Argentine Republic, British Columbia, New South Wales, New Zealand, and many other places, they have not yet been extended to our Indian Empire, where we have 60,000 English soldiers, and daily increasing numbers of English *employés*, to whom it would be eminently useful.

That from an answer given in the House of Commons on the 4th instant by the Postmaster-General, to a question put by Sir John Pakington (in the absence of Lord Henry Lennox, the Chairman of the Council of this Society) on the subject, it would appear that the delay which has taken place in bringing into operation this desirable measure rests with the Indian Government.

Your memorialists, therefore, humbly pray that the Secretary of State for India in Council will be pleased to take this matter into consideration, with a view to directing the proper authorities in India to arrange for the speedy introduction into our Eastern empire of a system which your memorialists believe to be attended by no difficulties which practical men cannot satisfactorily overcome, and which is calculated to be of the greatest utility to many of her Majesty's subjects. And your memorialists will ever pray, &c.

Sealed with the Corporate Seal of the Society for the Encouragement of Arts, Manufactures, and Commerce, this 20th day of March, 1872, in the presence of (L.S.)

P. Le Neve Foster,
Secretary.

BARRY'S ETCHINGS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, are about to have a limited number of sets of the 29 plates etched by the late James Barry, printed. The impressions will be taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary not later than the 30th inst. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, will be £10 10s.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Glasgow, Young Men's Society for Religious Improvement.

CANTOR LECTURES.

The Third Course of Cantor Lectures will be by Professor Barff, on "Silicates, Silicides, Glass, and Glass Painting." The Lectures will be on Monday Evenings, commencing Monday, 8th April.

Lecture I.—Monday, 8th April.

On Silicon, Silica, and compound of these with other substances—Fluorine, &c.

Lecture II.—Monday, 15th April.

Solvents of Silicic Acid—Silicates—Glass (composition of)—Different Kinds of Glass—Methods of Making Glass.

Lecture III.—Monday, 22nd April.

Manufacture of Glass (continued)—Coloured Glasses—Glass Staining—Glass as a Decorative Material—Glass Painting.

Lecture IV.—Monday, 29th April.

Glass Painting (continued)—Mosaics—Enamels.

Lecture V.—Monday, 6th May.

Styles of Glass Painting—Illustrations with the Electric Light, illustrative of the Nature of Colour.

Lecture VI.—Monday, 13th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose will be issued with the *Journal.*

THE LIBRARY.

The following books have been presented to the Library:—

Report of the British Association for the Advancement of Science, held at Edinburgh in August, 1871. Presented by the Association.

Report of a meeting of the Agricultural Labourers' Improvement Society, held at Brampton-hall, Herefordshire.

Speech of S. R. Graves, M.P., at the meeting of the Liverpool Chamber of Commerce, held on January 24th, 1872.

Journal of the Linnean Society. Vol. XIII. No. 66. Presented by the Society.

Statistics of the Liquor Traffic. An examination of Professor Levi's Letters to M. T. Bass, Esq., M.P., by the Rev. Dawson Burns, M.A., F.S.S. Presented by the author.

Nineteenth Report of the Executive Committee of the United Kingdom Alliance, 1871-71. Presented by the Executive Council.

Reports on Experiments made with the Bashforth Cronograph, 1865-1870. Presented by Professor Bashforth.

Description of a Chronograph adapted for measuring the varying velocity of a body in motion through the air. By Professor Bashforth. Presented by the author.

Quarterly Weather Report of the Meteorological-office. Presented by the Meteorological Committee.

Statistics of the Colony of Victoria, for the year 1870-71. Parts V. VI.

The Piston Process of Freezing. Presented by Mr. Ash.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscriptions paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society.

SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

FIFTEENTH ORDINARY MEETING.

Wednesday, March 20, 1872; EDWARD CARLETON TUFNELL, Esq., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Adye, Brigadier-General John M., R.A., C.B., Woolwich-common, S.E.
Clow, Henry, 182, Trongate, Glasgow.
Crawford, Capt., Frederic Augustus Buchanan, R.N., United Service Club, Pall-mall, S.W.
Highton, H., 2, the Cedars, Putney, S.W.
Holt, Nathaniel, J. W., 5, Cowper's-court, Cornhill, E.C.
Lane, J. W. Beaufoy, 17, Alexander-street, Westbourne-park, Bayswater, W.
Packard, Edward, jun., F.C.S., Grove-house, Bramford, Ipswich.
Peters, Leonard, 85, Bartholomew-road, Kentish-town, N.W.
Rigby, John, 7, Meal-street, Mosley-street, Manchester.
Seligman, Isaac, 3, Angel-court, Bank, E.C.
Simmons, B. D., 68, Upper Thames-street, E.C.
Sumner, Edmund, 14, Godliman-street, Doctors'-commons, E.C.
Taylor, R. Minton, Tile Works, Fenton, Stoke-on-Trent.
Wade, Charles, 79, Great Tower-street, E.C.
White, H. C, 88, Great Tower-street, E.C.
Will, J. Shiress, 3, Pump-court, Temple, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Ballesteros, José Merino, 95, Alexandra-road, St. John's-wood N.W.
Boyes, Rev. John, Frome, Somerset.
Hopkins, W. R. Innes, Grey Towers, Middlesborough.
Kemp, Dudley, 74, Old Broad-street, E.C.
Norris, Charles, 124, Wood-street, E.C.
Pyke, Alfred, 32, Ely-place, E.C.
Richards, W. H., 5, Catherine-court, Tower-hill, E.C.
Ridley, Isaac, 27, Crutched-friars, E.C.
Wade, Charles, 79, Great Tower-street, E.C.

The paper read was:—

NOTES FROM A DIAMOND TOUR THROUGH SOUTH AFRICA.

By Thomas William Tobin, Esq.

It is my pleasant duty this evening to record some of the reminiscences of scene and thought which I experienced while on a tour last year in search of diamonds. I feel almost confused, amongst so much subject-matter and so many incidents, to select such as will prove of general interest and importance, without deviating into the bye-scenes of adventure, recreation, and enjoyment. Of its grand scenery, its magnificent rivers, its stupendous mountains, cloudless atmosphere, and a thousand other charms, Africa has already had observers abler than myself to record, and whose descriptions my efforts to emulate would be futile. I will not, then, occupy your time this evening in detailing our adventures on the road, nor, indeed, even if time permitted, treat of the social aspect of this interesting country, but, without further introduction, proceed to enlarge upon my notes referring directly or indirectly to the diamond fields of South Africa.

It is interesting to know that the discovery of diamonds at the Cape was not wholly due to accident. Science had sown her seed, and distinctly foreshadowed these wonderful diamond discoveries. To the casual observer, a more uninteresting locality than these fields could scarcely be conceived—barren, sterile, at best an arid wilderness; unpopulated, in parts even unexplored only some comparatively few months ago. A diamond was found by accident; and now some forty thousand civilised people are inhabiting this once desert. The story of that first diamond reminds us more of an "Arabian Nights" fiction than as bearing any impress of reality. I quote the facts from the *Cape Monthly Magazine*, February, 1871, as follows:—

"The young son of a poor boer, or farmer, named Jacobs, living on the place De Kalk, near the Orange River, collected as playthings for himself and sister a number of the pretty stones common enough in the neighbourhood of the river. Among these stones there was one particularly brilliant, which attracted the notice of the child's mother. Some time afterwards, she mentioned the circumstance to a neighbouring farmer, named Van Niekerk, who was visiting the family. This Van Niekerk had heard some years before, from Baron Von Ludwig, a government land surveyor, of the probability of valuable stones being one day found in the bed of the Orange River, and he was curious to see the 'mooi klipie,' as the stone was termed. On asking the children, however, for it, the stone could not be found; subsequently, it was discovered a few yards off from the door of the house, where it had been thrown by some of the little ones who had played with it. Van Niekerk had no idea it was a diamond, but considered it a rare stone, which he should like to inquire about. He, therefore, asked to purchase it from Mrs. Jacobs, but she laughed at the idea of selling a stone, and told him that if he had a fancy to it, he might keep it.

"That stone was taken first to Hope-town, then Colesberg, subsequently it found its way to Graham's-town, one of the largest towns of the colony. Some believed it worthless, some thought it might be a diamond, while others ridiculed the idea. Dr. Atherstone finally settled the dispute, pronouncing it a diamond of the first water, $21\frac{3}{16}$ carats in weight, and valued it roughly at £1,000."

This is but one of the early discoveries that nature seemed determined to thrust upon human industry.

And, now, to be in order, I will turn to that part of my note book referring to our journey outwards. It is due to Mr. Streeter to state that the expedition which took me to Africa was organised by him, in the autumn of 1870, and we started on the 23rd of November of that year. I need not describe here the voyage, which is generally performed by steamer, from England to the

Cape of Good Hope. The Royal Mail ships of the Union Company run once a fortnight, and perform the voyage generally in about five weeks. I will, therefore, assume that we have arrived at Cape-town.

Cape-town, distance about 750 miles. Roads are good, and easily travelled over. Inland Transport Company run wagons twice a week, at a charge of £12 per head, including a reasonable amount of luggage per passenger. Time occupied from seven to ten days.

Algoa Bay, distance about 500 miles. To explain the difficulties of this and the following route, it is necessary to first become acquainted with the climatic conditions of the country passed through. For about nine months of the year, viz., autumn, winter, and spring, owing to the constancy of the wind, little or no rain falls. The three summer months (December, January, and February), are accompanied with sudden and severe atmospheric changes, giving rise to storms, accompanied with large quantities of rain towards the close of every day. During the dry season, owing to the lack of foliage and herbage, it is exceedingly difficult to find nourishment for cattle or horses. In the summer season, on the other hand, the rivers are swollen, and the excessive rainfalls prevent progress. The mode employed for transport is generally the ox-wagon, a rudely-built vehicle, capable of being pulled to pieces in crossing a stream, drawn by a team of 14 or 16 oxen. The rate of progress is, under favourable circumstances, from 12 to 15 miles a day.

Natal. The distance by this route is about 510 miles, and much that applies to the last-mentioned is equally applicable to this. Of the three routes, this is perhaps the less civilised, and therefore the more romantic and picturesque.

Cape of Good Hope is the principal of the number. Natal, Orange Free State, Transvaal Republic, and various tribes of coloured population, "more or less civilised. The Orange and Vaal rivers. On the banks of the Vaal river stood a missionary station, Pniel, that and the adjacent country being the disputed territory before alluded to, and the present diamond fields."

Having thus given you a brief description of the various roads to the fields, I propose to confine myself in the subsequent notes to one only in particular, viz., that through Natal. I select this for several reasons, and not the least being that it is undoubtedly the most important in relation to the diamond fields in a scientific point of view.

We start from Durban, a small seaport town, and passing through some of the finest and most picturesque scenery that it has ever been my good fortune to witness, make for Pietermaritzburg, the capital of Natal. The rugged rock formation of this portion of the journey is grand in the extreme. I cannot pass without remark the grand waterfall of the River Umgeni, about 14 miles from Maritzburg. The falls are nearly double the height of the celebrated Niagara; in width it varies, but at the extreme summer flush the volume of water would be some 20 yards or more across. The scene is awe-inspiring and grand. The remainder of the country passed through, until the Drakensberg is reached is characteristic of African scenery in general—rapid rivers, fertile soil, flat-topped hills or table mountains, and, occasionally, small, but pretty little villages, or towns, as the colonists in their warmth are apt to name them.

We arrive now at the Drakensberg, and make our pass at an elevation of 5,400 feet above the sea-level. This is indeed an interesting portion of the journey. Not only is the situation at every minute opening fresh and stupendous scenery to the traveller, but we have come to a most important point relating to the history of the South African diamond.

This range of mountains furnishes the sources to the Orange and Vaal rivers, as we have already seen. The road from hence to the fields embraces the watershed of these important streams; therefore it becomes important, before we proceed further, to examine somewhat in detail the geological construction of the country, furnishing, as it undoubtedly must, some light on the origin of the gem.

Before, however, I leave this descriptive portion of my paper, I will show you, by means of coloured diagrams, taken from sketches I made while on my tour, representation, of, first, the origin of the Vaal river 10,000 feet above the sea-level; also a scene near Harrismith, near the summit of the Drakensberg.

I will now direct your attention to a sectional representation of the country from the sea-coast to the diamond fields. For convenience of reference it is taken nearly north and south, and follows the line indicated on the map. I feel here a great delicacy in touching on a subject of such enormity as the constitution of a continent of all others the most mysterious. Always has it been in history and science a Sphynx, and until the present day unsolved. Of its geology we have only the faintest notion; its richness in mineral wealth seems to have been but recently brought to light, and the present diamond discoveries were as unexpected as they have now become great and valuable.

In this section and the accompanying rock specimens, which I collected to illustrate it, we can trace out, although somewhat obscurely, some of the more general divisions of geological era. The base is, of course, granite, (tinted pink), metamorphic rocks, (purple), silurian, (blue); old red sandstone, (brown), new red sandstone, (light brown); a small portion of supposed jurassic formation, (grey).

I again repeat that these divisions are based on my own observation, and in many instances without even seeing the rocks alluded to; but, having only descriptions, these therefore must be looked upon as giving only a general idea of the distribution of the rocks in general.

I think I need scarcely remind you how these rocks have been formed; how that similar agencies were at all times, and in all places on the surface of this planet, producing similar results; how that a vast ocean once covered the whole of the African continent, throwing down its deposits of mud, sand, and organic remains, layer upon layer. Let me illustrate this to you by means of a diagram of this great rock agency, representing the bottom of an ancient or modern ocean.

In the abstract, this is the epitome of geological science, the formation of, and action upon, by other causes, these sedimentary rocks; the same deposits occur over and over again, and the geologist is enabled to determine their age only by the fossils embedded, and the amount of induration presented by each substance.

Now let us see how this applies to South Africa. Here are the lowest rocks—metamorphic overlying the granite, which was once in a fluid state, and, cooling down, allowed these first sediments to overlie it. All traces of combustible matter entirely obliterated, all signs of organic life—if any existed at that time—have been confused into the mass of stone. Both granite and metamorphic rocks form the base of Table Mountain, of which the accompanying series of specimens will serve to illustrate.

We have then (and I am dealing in broad and general divisions) the silurian rocks, containing supposed traces of organic life. The upper portion of Table Mountain, and much of the coast-line, consist of this formation. It assumes, as it were, a transitional link between the fossil-bearing deposits and the igneous rocks, granite, &c. There are distinct traces of carbonaceous matter, but of so altered a character as to render it impossible to assign any certain laws as to its formation. At one time, peat, moss, or marine plants—perhaps forests—covered the area of the soil, which subsequently was converted by the overlying strata into coal, again to be transformed into anthracite. Like transformations are still going on in the present day.

The next system I shall speak of embraces a large series of deposits. It will be seen that the country, from a certain marked division, is formed by a succession of paralleled layers, consisting of an extensive basin. This is supposed to be the result of an enormous lake; hence the term "lacustrine" has been given to these rocks by Bain and other African geologists. The deposition is regular throughout, and records much in the early history of the continent. It shows that the unknown interior, as far as at present explored, was a vast lake, or land-locked sea, devoid of organic life to a remarkable degree; that the waters have gradually retired, and by no convulsion of nature, as at previous times, was the land at this period formed. It is, by comparison with our British order, ascribable to that period, known as the old and new red sandstones; first, because it contains the coal measures intervening; and secondly, inasmuch as an extinct form of life, co-eval with the *Labyrinthodon*, lived in the waters, called the *Dicynodon*.

With regard to the coal, in quality, it is considered by competent judges to be excellent; with regard to quantity, if, as there is every reason to suppose, it is equally distributed, some thousands of square miles exist in area.

Now, while under the ocean, these strata have been fractured, or broken laterally, by outbursts of igneous matter; this I can better explain by the aid of a diagram, showing the eruption of greenstone.

The projected matter we will refer to this evening under the general title "greenstone." And when the water of the ocean receded, it left the hard, brittle substance exposed to atmospheric influence, until boulder after boulder was riven asunder, and the appearance is presented to the observer of the present day, indicated by the diagram of a water-worn greenstone hill.

This brings us to the tertiary deposits. Ignoring as irrelevant the small portion of jurassic or oolitic formation, shown on the map, and in no way connected with the history of the diamond, it is in three tertiary deposits that the diamonds of South Africa, as in common with those of Brazil and India, have been hitherto discovered.

Thus reviewing and comparing with our British rocks, the formation of South Africa presents the following brief contrast:—1. The lower rocks, up to and including the new red sandstone, are fully developed, especially the latter. 2. That since that era no great disturbance of elevation has taken place. 3. The jurassic division of rocks are partially developed, while the chalk is remarkably deficient. The *debris* forming the tertiary deposits is composed of shales, hard sandstones, and igneous rocks, together with the agates, whose origin is derived from the flint-like secretions in these igneous rocks, and amongst these substances, in the form of water-worn pebbles and sand, the diamonds are found to exist.

We are now in a position to take to our waggon from the point we left it, viz., in the scorching desert over the Drakensberg. We follow the line of route on our section, and we find how, through denudation, the rocks have been worn into unequal surfaces. The general inclination of the country is towards the point marked Stormberg, a range of mountain-like escarpment corresponding with the Drakensberg; from thence to the fields the country is highly barren, indeed, it forms one of the borders to the great desert supposed to exist throughout the whole interior.

We will now presume our arrival at the fields. The aspect of the country alters remarkably within a distance of some five or six miles of the Vaal river, undulating and slightly wooded, with abundance of water-worn pebbles under foot. Diamonds have been found transported with water-worn pebbles some miles away from the river's bank, evidently showing that the origin of all the gems is at no higher distance up the stream.

Perhaps it will be as well to confine our attention now more particularly to the subject of the constitution of the diamond as a substance, and its occurrence in nature. What is a diamond? Carbon and an element, as shown by the experiment of burning a diamond. Thus we see that diamond is but equivalent to cinder or charcoal. Chemists call it carbon.

Here are some valuable facts with which I happened to become acquainted, through a practical engineer, who had had great experience in rock-boring by the aid of diamond-drills. He said:—"All those pieces of carbon or boart having a decided fracture, without glaze, are useless, being considerably too soft for our purpose; but by heating the same pieces of substance (without exposure, I presume), we can sometimes achieve that glaze, but at others, strange to say, the diamond becomes rotten, and falls to pieces when set in the drill." Thus the adamantine quality is peculiar to the polished or glossy surface. By reason of this bright surface is the diamond easily distinguished from other and like transparent stones. A child could select a diamond from a number of pebbles, as has been often verified at the diggings in children picking them up accidentally after the rains.

Thus little do we know about the diamond. How it occurs in nature; how it has been formed, and where, are mysteries obscure in the extreme. In India, and other places where diamonds have been discovered, evidently rivers and floods have brought them, in common with other and softer, and therefore water-worn, pebbles from higher localities. In Africa the same observations equally apply, as I will now endeavour to explain by my next diagram, which is that of a section of Vaal River, the bed of which is rock; greenstone the first deposit; the second clay; and the third "diamondiferous." From this we learn:—1. How the first diamonds were discovered on hills. 2. Many have been washed into the ocean, &c.

I told you that there was little difficulty in distinguishing between a diamond and many other pretty stones found in conjunction with it. I will endeavour to demonstrate that fact practically by an experiment of a diamond amongst pebbles. But the best and most unerring test is that of specific gravity. Specific gravity, or relative weight to water, is taken as shown by the experiment of taking specific gravity.

We have now come to a most important and interesting portion of my notes. Hitherto I have told you what has already been known in substance about the diamond. I have now to describe to you something which has never before been known associated with the gem. I say interesting, because it promises to throw light on that difficult and mysterious problem, the matrix of the gem; and important, because, commercially, it is calculated to enrich not only this country but the whole civilised world.

It is no idle speculation which endeavours to solve this problem, otherwise rather it is in the legitimate scope of science as enriching the useful arts. We know all about iron and coal; we can estimate our prosperity, and know the extent of our wealth in this respect, because we know their origin and where to find them; and could we apply the same remarks to the diamond, its search would become an industry instead of a speculative lottery. I am aware of the fact that, should a certain source be discovered, diamonds would no longer hold the high market value they now command by reason of rarity; but there are many uses they could be applied to in the arts, and many more could no doubt be discovered, sustaining a regular market value very little less than the rough stone now commands.

With regard to my note. About thirty miles from the principal of the camps, Pniel, stood a Dutch farm-house occupied by a boer, Tan Wyk, who found diamonds plastered accidentally in the walls of his house. The mud came from a neighbouring pond. The surface soil all over the farm was of the same nature, and contained small fragments of diamonds. And then they came to the bed-rock, and abandoned further work. This bed-rock I will describe. It was not the pot-clay of the river, but a hard, yet rotten substance; it contained agates, broken and sharp, and here is the curious part of the story. The lower they dug into it, which in some places seemed with limit in depth, larger diamonds, more perfect in shape, were brought to light. On the river banks it is just the reverse. The diamonds were found embedded in this substance, and larger diamonds, with few exceptions, than have been found in the whole history of the gem, discovered in the short space of a few months. The diamonds were so plentiful that a given space was almost invariable in in its yield of prizes, and when the richer portions were discovered, fabulous prices were given for claims. Recent mails from the fields inform us that a small portion of a claim sells at £10,000; and the *Times*, only a few weeks ago, remarked, in a very descriptive and well-informed article, that while at the Vaal River claims, one is successful out of every four who search for diamonds at this curious locality, three out of four are favoured by fortune.

Now, it is curious that such should occur in this special locality, but the following facts seem to put another face to what might appear at first a series of fortuitous circumstances favouring the diamond seekers. The locality I am referring to, known in the accounts sent to England under the title of "Dry Diggings at Du Torts Pau," "De Beer's Farm," &c., is situated between and on the water-shed of two rivers, the Mooder and the Vaal; neither river, therefore, could have brought the diamonds to this locality. There is no sign of water action (except as rain), and the diamonds are unassociated with any substance which shows marks of water-wearing.

Are we not justified in now building up a suggestion, not as yet developed sufficiently to call it an hypothesis, of this being a diamond centre, and that instead of water transporting them to, it has taken them from hence to the river, as we have already seen from collateral evidence that, where three exist, only one has been washed away.

A few more words on this subject. Two substances are generally found associated with the diamond, as at the "Dry Diggings," viz., garnet and peridot. Peridot is technically olivine, one of the basic substances of greenstone; the second is garnet, and garnet, in the neighbourhood of the Vaal River, is invariably associated with greenstone. Now, I will briefly illustrate a few facts about this garnet. The old proverb reminds us that a man is known by his companions, and perhaps that might equally apply to many other things, especially the diamond.

Here is a specimen of garnet in matrix-shale, found at Graham's-town; angles sharp, &c. Here is another, green; but the greenstone dykes have passed through and broken these strata, and probably brought up these garnets in a confused state, as in these two specimens. If the garnets and agates, which we know are of the same formation, why not the diamonds, and in the manner this, my last diagram, represents.

And now I must conclude, applying our knowledge and experience in the value of this great diamond discovery at the Cape. As to the extent of the diamonds on the banks of the river, only small portions have been searched. Diamonds no doubt exist along their entire banks. Diamonds have been washed into the sea, and lower down the Vaal and Orange rivers. The limit of the Tuffa rock, and on the north side is as yet unknown, and probably the extent of this diamond formation also.

A diamond was burned (supplied by Mr. Streeter), to demonstrate the constitution of the gem. This and many interesting diagrams and a large map of the diamond-fields, by Wyld, of Charing-cross, forming illustrations to the paper.

DISCUSSION.

Professor Tennant said it was just twenty years since a paper of a similar kind was read in that room, on the results of the Great Exhibition of 1851, calling attention to the jewels in that Exhibition; and at the conclusion of that lecture the probability was suggested of such stones being found in new localities, amongst which were mentioned Australia and Cape Colony, in both of which places diamonds had since been found. It was just five years since the first diamond was found at the Cape, namely, on the 12th March, 1867. It was sent over to this country; a model was exhibited in the Paris Exhibition, and he saw the gentleman in the room who had cut it. It originally weighed 21½ carats, but after cutting it was reduced to 10½, and was now in the possession of Messrs. Garrard. During the first two years about 20 diamonds came over. Sir Roderick Murchison was one of those who disbelieved in their existence, and he (Professor Tennant) had had the greatest difficulty in convincing him that diamonds were really found there, though he did eventually do so, having challenged him to inspect one of the stones. He must differ somewhat from Mr. Tobin's geological statements. It was a rather debatable subject as to garnets being always found in greenstone rock; they were found most commonly in micaceous schist, and only sparingly in the greenstone. They were also found in gneissous and in many volcanic rocks. With regard to the specific gravity of diamonds, there were other stones heavier, and the topaz, which was a white stone, was of exactly the same specific gravity. The diamond was, however, easily distinguished by its hardness, for a piece of corundum would scratch the topaz, but would not touch the diamond. This was an easy test therefore, but it was not at all wise to try to scratch one diamond with another, because, diamond being very brittle, it might easily be split. With regard to agate, that was found in abundance in igneous rocks, more especially that called amygdaloid, which was liable to decomposition when the agates were washed out. They were found in considerable quantities in Germany, also near Perth, Dunkeld and Montrose, but no diamonds were found there. On the table there was a very good collection of specimens from the Brazils, showing the diamonds and the associated minerals with the green peculiar sandstone with which they were generally associated in that country. It was the collection of the Rev. Mr. Nichola. He would add that there was a series of very interesting papers on the geology of South Africa in the last three numbers of the *Geological Journal.*

Mr. Streeter observed that, so far from the discovery having reduced the value of diamonds, small stones under a single carat in weight had gone up about ten per cent.

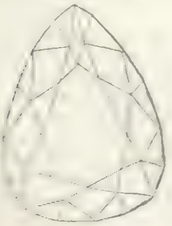
Mr. R. Rawlinson, C.B., said that up to the recent discoveries the price of diamonds had been as the square of their weight, but this rule would not obtain any longer, and he had recently seen considerable quantities sold in London, under the hammer, at figures which showed that this rule could not now be applied. If a diamond of the purest water of one carat was worth from £20 to £25, then a diamond of two carats of the same quality and colour would be worth four times as much, according to the old rule, but he thought these prices were not now obtained. With regard to the use of diamonds for drilling, it was not the jeweller's diamond which was so used, but a material of the diamond character, though without its beautiful appearance, called carbonado. Its price, as used for gem-cutting and other purposes, was formerly about five francs per carat, but about twelve months ago the price had gone up to thirty francs. Whether the real gem itself, if imperfect in colour, would take the place of that material for such purposes, he could not say. He had been much interested in the paper, though he could not say he was much instructed by the geological discussions of the author, who, he thought, had still much to learn as some of his statements would not pass muster in any congregation of geologists; and although he thought he had discovered what was the true matrix of diamonds, from his own description it appeared they were as far off that discovery as ever, for it was quite clear that this rock, which so easily disintegrated, was a modern formation, not a true rock, but more of a conglomerate. He had seen several specimens sold at Messrs. Debenham's of what was called the diamond in its matrix, but it was quite evident that they were only erratic diamonds imbedded in a conglomerate. It had yet to be discovered whether the diamond had a true matrix like other gems. Some chemists and mineralogists were of opinion that it was not of mineral formation at all, but was a crystallised gum, as amber was a fossilised gum. It was certain that they were found of all colours, with cavities, and with foreign bodies in them, and up to this time there was no reliable record of a diamond having been found in what could strictly be considered a matrix. Again, it was not at all necessary to believe that the floods in former times were greater than at present; the action of a river through so many centuries was to oscillate from side to side, and thus gradually to wear a larger channel, although the original channel might have been no larger than at present. With regard to greenstone and trap dykes, they could have nothing to do with the diamond, for they were as general as the crust of the earth, while the diamond was only found in certain places and under peculiar circumstances. What the past history of the country may have been, and what was the parent of the diamond, was still unknown. Almost all that was known was as had been shewn by the beautiful experiment that evening, that it was almost pure carbon, with a very slight trace of earthy water in it, and the purer the colour of the diamond, the more perfectly would it be consumed.

Mr. Streeter said that no judge of diamonds would think of buying stones by a rough rule of squaring the price according to the size. It all depended on the quality. He had known a diamond of two carats fetch £112.

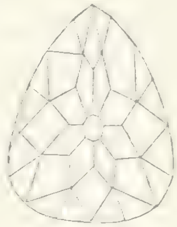
The Chairman said that diamonds were not only useful for purposes of adornment, but also in many purposes in the arts. He had in his hand an instrument consisting of a hollow cylinder, with a few diamonds arranged round the end, which Mr. Streeter informed him was used for boring the hardest rocks, and nothing could withstand it. There were many other processes which would be facilitated if there were a more plentiful supply of diamonds. He concluded by moving a cordial vote of thanks to Mr. Tobin for his valuable and interesting lecture.

A Gentleman present said he had a son at the Cape, who had recently written to say that from a small claim on the diamond fields he had taken 140 diamonds, one weighing 67 carats.

Professor Tennant kindly lent the following three woodcuts of the finest diamond received from the Cape, which weighed when found 83½ carats, and which had been named "The Star of South Africa":—

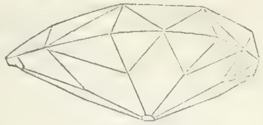


Face.



Back as Cut.

Exact size, 46½ carats.



Side.

THE COORG FORESTS.

By Lt.-Col. Wragge.

In the paper I read before a meeting of the Society, on the 1st December last, on "Indian Forests and Indian Railways," I referred to the great extent of forest in the province of Coorg, and contrasted its forestal production with that of the other British and native forests in India; and therefore perhaps a short description of the Coorg forests may be interesting to some of the members of the Society.

The small province of Coorg lies in the south-western corner of Mysore, and is formed by the summits and eastern declivities of the Western Ghauts, which separate it on the south and west from the forests of North Malabar and South Canara, while its northern and eastern boundaries merge into the table-land of Mysore. It is about sixty miles long by forty broad.

It possesses a very moist climate, except in the dry eastern districts, and during the month of July, when the monsoon is at its height, as much as 74 inches of rain have been registered, and for several days in succession as much as five or six inches of rain have fallen within twenty-four hours. During the cold months, from October to January, the daily mean temperature is 65° Fahr., and during the warm months, or from February to May, the daily mean temperature is 70°, while in the monsoon season, or from June to September, the temperature is very equable, ranging between 60° and 75°.

The prevailing winds are westerly just before and during the monsoon, and N.E. directly afterwards, and E. to S.E. during the rest of the year. During the monsoon the sun is often not seen for weeks, and the greater part of December is foggy.

One of the most beautiful views obtainable in Coorg is that presented to the spectator from the summit of the Brahmagiri hill, on its western borders, close to which the river Cauvery takes its rise, from whence, as far as the eye can reach, looking north-westerly and south-easterly, you behold ridge after ridge of grassy or forest-clad hills, now gently sloping down in wavy lines, now bold and abrupt, raising their steep summits into the clear blue air, while the distant hills in Mysore and the Wynaad, with those of Dodabetta, &c., over 8,000 feet high, on the Neilgherries are clearly visible, and in the west, at a distance of about thirty miles below the steep Ghauts appears the line of coast of North Malabar and South Canara, intersected by broad, bright, serpentine rivers, and the dark-blue Indian Ocean.

Extensive forests clothe every mountain range almost to the summits, save here and there, where the clearing of a coffee plantation, or other patches of cultivation, or park-like, open glades, with their beautiful green sward and varied foliage, afford a charming variety to the landscape; while the more level eastern districts are covered with bamboo jungles, interspersed with such trees as are peculiar to those localities; but in vain the eye searches for the usual indications of civilised life, such as towns and villages, churches, castles, &c., and it is only here and there, in nooks and corners, ensconsed amongst groves and clusters of cultivated trees, and betrayed by a wreath of smoke, can one discover the thatched houses of the Coorgs, who love a solitary abode near their fields.

The general appearance of the country varies considerably in the different districts. In the north, the hills are gently rounded, alternating with sloping glades, interspersed with clumps of forest trees, resembling the finest park scenery. Near Mercara, the capital, centrally situated, the hills are closer together and more abrupt, with deeper and more wild ravines, while towards Fraserpet, on its eastern confines, the country assumes the champagne character of the adjoining Mysore plateau, with scattered solitary hills; and to the south of Mercara the country is open, with woods neither dense nor high, but having beautiful grassy downs, rising from extensive rice-producing valleys. The Eastern frontier, between the rivers Cauvery and Lakshmana-tirtha, exhibits an almost uninterrupted and impervious forest.

The table-land of Mercara averages an altitude of 3,500 feet above the level of the sea. Looking upon Coorg with the eye of the forester, the most superficial survey will not fail to discover valuable timber trees, scattered all over the province. Small as the country is, there are, nevertheless, distinct tracts with trees peculiar to them. The two prominent zones are those of the hill forests and the hillock jungles. Botanically, they may be classed as evergreen and deciduous forests, the former clothing the Ghauts, the latter the eastern hill-tracts. All along the slopes of the Ghauts the poon is dominant, attaining, when matured, the height of 100 feet; its wood is clean, tough, and elastic, and is better adapted than any other tree for ships' masts and spars. By its side is found the black dammer tree, which also attains a great height, and is readily distinguishable at a distance by its peculiar red foliage; it yields a valuable resin. The Alexandrian laurel affords a fragrant resin, its seeds yielding the "pinnay" oil. The gamboge and the wild cinnamon tree abound, and other trees of common occurrence are, the ebony, the wood-oil tree, the jack-tree, the iron-wood tree, the white and the red cedars, the wild clove, and wild nutmeg trees.

The forests of the Ghauts are so dense and tangled by thorny underwood and creepers, that they can only be penetrated by beaten paths, and under the guidance of those familiar with their formidable mazes. The many densely-shaded mountain rills and torrents are generally embanked with a great variety of ferns, among which the stately fern tree is prominent. The most common ferns met with in Coorg are *Acrophorus immersus* and *pulcher*; *Adiantum lunulatum*; *Alsophila latebrosa* (common tree fern); *Angiopteris evecta*; *Asplenium furcatum*; *Blechnum orientale*; *Cheilanthes farinosa*; *Davallia tennifolia*; *Gleichenia dichotoma*; *Hemionitis cordata*; *Lastrea aristata*, *cochleata*, *falciloba*, and *ochthodes*; *Nephrodium molle* and *terminans*; *Hephrolepis exaltata* and *tuberosa*; *Osmunda regulis*; *Polbpodium regulosum*; *Pteris aquilina*, *cretica*, *longifolia*, *pellucida*; *Sagenia coadunata*; and *Schizoloma ensifolium*. The following tree ferns are also common, viz.:—*Asplenium planicaule*; *Botrychium virginicum*; *Davallia bullata*; *Diplazium polypodioides*; *Pleopeltis irivides* and *oxyloba*; *Trichomanes filicula*; and *Vittaria elongata*.

In other places, delicate reeds stud the more humid banks of streams. Stout rattans, with terrible spines and slender flagelli lashing the air, to keep, as it were, intruders at a distance, climb in all directions in the forest, and surmount with their feathery leaves the highest trees. Favoured by the constantly moist atmosphere, the stems of many of the trees are speckled with lichens, or covered with rare orchids, mosses, and other parasites. Festoons of wild pepper and gigantic creepers, which again support the more slender herbaceous vines of convolvulus, thunbergia, ipomœa, &c., stretch from tree to tree in the most fantastic interlacings, and gorgeously decorate the grand timber trees, verdant with their foliage and many-hued flowers.

The soil, almost everywhere covered with a humid rich stratum of vegetable mould, highly favours the growth of plants loving moisture, such as the Indian arrowroot, the long-rooted turmeric, the wild ginger, and especially the highly-valued cardamom, of the cultivation of which I will speak hereafter.

Wherever the hills are denuded of forest, they are clothed with a dense, coarse grass, which at times greatly impedes their ascent.

As the western forests are left, and the eastern districts approached, many of the trees before mentioned are still met with, in addition to those more characteristic of a drier climate. On entering into the more open country, we find upon the grassy glades smaller trees and shrubs, disposed with an artless grace, that the landscape gardener in vain seeks to imitate. Here, spring and summer, in sweet embrace, hold perpetual sway, and the very air, so cool and fresh, seems imbued with life and health. Many flowering shrubs and herbs here greet the eye, among others, the aromatic jasmine, with its pure, white flowers; the Coorg rose, in its rustic simplicity; the *Gloriosa superba*, with its flaming corolla; the *Melastoma malabaricum*, with its strange-looking ribbed leaves, and splendid mauve-coloured flowers; the Coorg lilac, with its small, racemes of flowers, and the *Adisia humilis*, with traslucent rose-coloured flowers, that look as if they had been cut out of a rare cornelian.

As we approach the Coorg houses we encounter thriving groves of orange, lime, guava, pomegranate, and clumps of plantain trees. The bastard sago is much esteemed for its toddy, and the areca palm occasionally keeps it company; and their foliage, blended with the dense crown of the stately mango or jack-tree, forms a beautiful background to the large rice-flats below.

We now enter upon the eastern, or bamboo district, whose character is indicated by the prevalence of large clumps of bamboo, interspersed with blackwood, sandal, teak, and other trees; and when this bamboo jungle is in full vigour of growth, one cannot fail to be struck by the elegance and beauty of its general appearance. Captain Basil Hall, who visited Coorg in 1813, thus vividly describes his first impression of a pure bamboo jungle:—"It seemed as if I were travelling among the clustered columns of some enormous and enchanted Gothic cathedral. . . . The ground extended on all sides as smooth and flat, and clear of underwood, as if the whole had been paved with gravestones. From this level surface rose on every hand, and as far as the eye could penetrate into the forest, immense symmetrical clusters of bamboo, varying in diameter at their base from six feet to twenty or thirty feet, as I ascertained by actual measurement. For about eight or ten feet from the ground each of these clusters or columns preserved a form nearly cylindrical, after which they began gradually to swell outwards, each bamboo assuming for itself a graceful curve, and rising to the height, some of 60, some of 80, and some even of 100 feet in the air, the extreme end being at times horizontal, or even drooping gently over, like the tips of the feathers in the Prince of Wales's plume. These gorgeous clusters stood at a distance of fifteen or twenty yards from one another, and, being totally free from the interruption of brushwood, could be distinguished at a great distance—more than a mile certainly—in every direction, forming, under the influence of an active imagination, naves and transepts, aisles and choirs, such as none but a Gothic architect ever dared to conceive."

The Coorgs affirm that there is a general seeding of all these clumps of bamboo once in about every 60 years, and after they have flowered and seeded, the clumps die, and they generally associate the seeding of the bamboos with an approaching famine.

The cutting of bamboo is a difficult matter, and is rarely well performed by any other than those expert jungle people, the Terawas and the Kurambus, who, to cut even a single stem, climb over the lower thorny mass to where the bamboo, branches out freely at about 10 or 15 feet above the ground, and cut them at that height. Should they wish to level the whole clump, the operator cuts the stem of each bamboo below and above his head, removing each piece from the thorny embrace of the rest; he thus boldly advances into the clump, and the further he progresses in his work, the greater is the danger of the whole clump suddenly giving way at the slightest breeze and crushing the unfortunate intruder.

There are several kinds of bamboo, but the thorny and hollow class are the most common; but the reeds of another kind, the *Bambusa stricta*, which are much smaller and solid, and also called the male bamboo, are also found in this district.

The *Pterocarpus marsupium*, which yields gum kino, is also abundant in this part, and the teak is a government monopoly, and sells at the wood-yards for 1s. 6d. per cubic foot, and occupies a distinct girdle along the eastern boundary of Coorg, while its large and strongly nerved leaves, rough above, whitish and downy beneath, and its numerous white flowers, in-terminal branches on the high and many branched trunk, mark its beauty and strength. In close proximity to it, and in an equally limited tract of dry and elevated slopes, grows the white sandal wood, scattered between other trees and on cultivated land; it is a small tree with a more or less crooked stem, with spreading branches, having small, light-green leaves, and yellow, or purple coloured flowers, which give it an elegant appearance, forming a marked feature in the landscape; its wood is close-grained and hard, and the heart-wood, which is highly prized for its agreeable scent, is made into ornamental boxes, fans, card-cases, paper-knives, &c., which are made chiefly in Nuggar and North Canara; it is also a government monopoly, and is collected at about 12 per cent. of its value. It matures in about 16 or 40 years, according to the nature of the soil, when it is cut down, and seldom yields a larger billet than one of five inches square, and four or five feet long. The wood is sold periodically by public auction, realising from £28 to £39 per ton, and is generally exported to Bombay. There are three kinds of sandal-wood tree, namely, the red, yellow, and white varieties, which are esteemed in the order I have placed them in. The essential oil is chiefly extracted from the roots.

All over this part of the country towers the wild mango-tree, with its lofty crown, far above its humbler neighbours; but the giant of these jungles is the wild jack-tree. Another splendid jungle tree, which flowers in February and March, is the red cotton-tree, the flowers of which are large and of a deep red, and the many-seeded capsules contain a silky cotton, used for stuffing pillows and matrasses; but its staple is so short that it is commercially valueless. Then we have the *Nauclea cordifolia*, with a close-grained wood like box, and small yellow flowers, and the *Rottleria tinctoria*, which furnishes an orange dye; and the soap-nut tree is also common, having a small fruit, producing a saponaceous pulp, which is used by the natives for washing; and the nut of the *Semercarpas anacardium*, whose shell yields a black acrid juice, which is used for a marking-ink for their cotton clothes. On the outskirts of the bamboo jungles, the Indian coral-tree, with its brilliant scarlet flowers, is frequently met with, and its branches, having a prickly bark, make good fences; and the bastard teak presents, with its scarlet flower, a very pretty appearance.

On the table-land of Mercara, the Coorg-laburnum is particularly conspicuous in April and May, by its beautiful, long, pendulous, racemes of yellow flowers; and two other plants are prevalent here, namely, the American aloe and the *Lantana aculeata*, both of which are used for making fences. The square stem and branches of the latter are prickly, and its ovate leaves, when bruised, have a strong smell of black currants, and its orange-coloured flowers are more or less blossoming throughout the year, and the shrub, when kept within proper bounds, makes an excellent fence, and it is found over nearly the whole of Coorg.

The bilwara tree, a species of mimosa, is a graceful jungle ornament, having a spreading airy crown of tiny pinnate leaves and small white fragrant flowers. The "fragrant screwpine" is commonly found near the banks of streams and watercourses, and is much used for making mats and umbrellas.

In many arid places in the east and north of Coorg, the dwarf date palm nearly monopolises the ground, and its leaves are made into mats and baskets.

Several representatives of the *Ficus* tribe are found growing in the open, and thrive there well, namely, the *Ficus indica*, or banyan tree, of which there are some beautiful specimens near Fraserpet. The *F. religiosa*, or peepul tree, grows best in the drier districts; but the *F. glomerata* is the most common of these, bearing fruit like the common fig, and which the natives eat; and the *F. elastica*, or caoutchouc tree, also occurs. The tamarind tree is rare in Coorg, and is only found growing in several places along the river Cauvery; it is a stately tree, and yields a dense shade, but the natives have a strong objection to sleep under it.

There are many other beautiful shrubs and herbs, which are annually swept away by the periodical fires that run through every jungle from February to April, and which, when once established in the high coarse hill-grass, rush madly in their onward career to the very tops of the mountains; and splendid is the sight at night of these distant serpentine lines of flame, extending over whole ranges of hills.

But I must not forget to mention a most remarkable and truly majestic forest tree, the *Lepurandra saccidora*, which flowers in October, in very peculiar catkins, something like a common mulberry, having a fruit in size and shape like a small fig, covered with a beautiful purple down; from its bark the natives manufacture very curious sacks. A branch is cut, corresponding to the length and diameter of the sack wanted. It is soaked a little, and then beaten with clubs until the liber separates from the wood. When sufficiently beaten, the sack, formed of the bark, is turned inside out, and pulled down close to the extremity, where the wood is cut off, leaving a thin piece to form a sort of slab, to act as a bottom to the sack. These sacks were formerly much used to carry rice in. Near this last tree is often found the poison-nut tree, or the *Strychnos nux vomica*, which has a hard and durable wood, with oval and glossy leaves, having small, greenish, white flowers appearing in February; it bears fruit of the size of an orange, and in its white harmless pulp are embedded many round flat seeds, from which the powerful poison strychnine is obtained.

I am afraid this letter has much extended its intended dimensions, but as I progressed I found I could not omit much, and convey to the minds of the readers the actual products and positions, &c., of the Coorg forests; and as I started with that object, my anxiety to carry it out must plead my excuse for trespassing so long upon their attention

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The Committees of Selection have begun their work upon those classes of exhibits that have been received. In the fine arts a very high class standard has been set up, and the Committee has passed every work under the most rigid scrutiny. The Committee for the Selection of Scientific Inventions has also been most severe, and no article has been allowed to pass that did not comply in every particular with the rules laid down, namely:—That the division shall only consist of objects whose excellence and novelty are considered by the Committee of Selection to be so great, and so important to the public welfare, as to render it undesirable that their introduction to the public should be delayed until the proper year for the exhibition of the manufacture. Only one specimen of each kind of object, illustrating the invention or discovery, and considered worthy of admission will be exhibited. No objects have been admitted which have been shown in previous International Exhibitions. unless very important alterations or improvements may have been added to them since the date of their previous exhibition.

Albert Hall.—The second People's Concert was a great success, not only as regards the attendance, but more especially in the matter of the effect produced in the hall by the somewhat novel combination of instruments. The "Anemoic Union," which includes the following wind instruments—horn, clarionet, bassoon, oboe, and flute, performed some concerted pieces, and the result of what may be called an experiment, with regard to the effect of such instruments in the hall, may be regarded as a great success.

CORRESPONDENCE.

THE THROUGH ROUTE TO INDIA.

Sir,—With the spring, the Ottoman government is making progress with its railway plant. One point still remains undetermined—the junction with the Austrian lines. The lines for junction with the Mediterranean are far advanced; that from Salonica (to compete with Brindisi) is complete for sixty miles (to Mirowtza) with its stations, and ready for traffic. The tunnel, and eighty miles more railway are promised for next month, so as to reach Kyupruli, on the way to Uskup. The sea line (from Dede Aghaj to Adrianople), of 110 miles, will be finished in August. The Adrianople main-line has its earth-works completed for 125 miles to Buzarjik. The provisional station at Constantinople will be completed next month.

So far for the European section, from the *Levant Herald*. As to the Asiatic section, the Skutari line and its extension are being pressed on, and it is decided that the main-line shall be on the 4 ft. 8½ in. gauge. Branches and collateral lines are to be on the 3 ft. or Fairlie gauge.—I am, &c.,

Hyde Clarke.

32, St. George's square, S.W.,
18th March, 1872.

ESPARTO IN ASIA MINOR.

Sir,—I have to acknowledge the receipt of your letter of the 29th December last, transmitting a copy of the *Journal* of your Society, and suggesting the desirability of cultivating esparto grass in Asia Minor, as a public and private experiment.

Anything which could tend to cheapen or increase the materials employed in the manufacture of paper would willingly engage my attention; but from a careful perusal of the remarks in your *Journal* about esparto grass, I am convinced that its cultivation in this island would be neither advantageous nor profitable. No farmer would listen for a moment to a recommendation to plant esparto grass upon land suitable for grain, and there are no tracts in this island which would not as successfully produce grain as esparto grass.—I am, &c.,

R. H. Lang, Consul.

British Consulate for the Island of Cyprus,
Larnaka, Feb. 22, 1872.

THE MINES REGULATION BILL.

Sir,—Permit me to call the attention of the Joint Committee of the British Medical and Social Science Association on State Medicine to a very important subject connected with the Mines Regulation Bill now before the Legislature. It is well known that the hazardous character of all mining operations is much enhanced in the case of coal-mines by the evolution of certain gases, which, in combination with atmospheric air, form most dangerous and powerful explosive compounds. These are rendered doubly hazardous by the admixture of these gases being extremely liable to spontaneous and instant combustion and explosion, irrespectively of, and in addition to, the risk of accidental ignition that may arise from the ignorance or negligence of the colliers.

It is also equally well known that an enormous amount of small coal, coal-dust, and the *débris* of earthy matter in which the coal is embedded, is allowed to remain in almost every vacant spot in the limited and confined cavities and avenues of the coal-mines, filling up all space except what is absolutely necessary for the transit of the large coal to the surface, thus materially diminishing the area left for ventilation. It may appear incredible, but this is the condition of most of the coal-mines in this country.

By every rule of common sense one would imagine that it would be largely to the interest of all the parties concerned in coal-mining operations to remove this vast amount of dangerous material, at any cost, and bring it to the surface as soon as possible. It would be profitable to do so, one would think, for it may be useful and become saleable; while, by affording more ample room for working and raising larger and more saleable coal, and by giving the miners a better atmosphere to breathe and more elbow room to work in, they would doubtless be in a condition to materially increase their amount of profitable work, and provide for their own health and safety at the same time. As a commercial arrangement there has been nothing to prevent this at any time, and if this commercial view were the only issue to decide upon, the public and the legislature could do no other than leave the colliery proprietors to settle their trade regulations in their own way. But, in a sanitary point of view, how does the case look? The enormous loss of life, as well as the great destruction of property and the waste of fuel, so necessary to the community in every form in which it can be used, has at length so aroused public attention that no government can any longer permit these frightful social evils to be perpetrated, by the absence of a controlling power that shall possess full legal authority to compel the removal of all small coal and others *débris* capable of absorbing dangerous gases from coal-mines. The pits and galleries should be cleared out weekly, under a system of inspection that should be real and effective, and at the same time responsible. It is a perfect farce to let so important a duty remain any longer in the hands of those who are so palpably unable to deal with it. The present system of inspection is quite inadequate to the occasion. A score or so of trustworthy miners, at a couple of pounds a week wages, changeable and continually moving from one locality to another, might, without any prejudice or predilection, inspect every coal-mine in the kingdom, and report upon its condition at short intervals, to one or other of the superior inspectors now in existence, and through them to a higher authority, at a cost quite infinitesimal. I do not, however, presume to suggest any detailed plan; I merely offer for the consideration of the Joint Committee a subject well-deserving their attention, while a public act for regulating mines is being enacted.—I am, &c.,

James Bird.

Seymour-street, W., March 12th, 1872.

MEETINGS.

COPYRIGHT ASSOCIATION.

On Tuesday a meeting was held, by permission of the Council, at the Society's House, for the purpose of forming a Copyright Association. The chair was taken by Dr. William Smith, and among those present were Mr. John Murray, Mr. Thomas Longman, Mr. Routledge, Mr. Petter, Sir Charles Trevelyan, Bart., Mr. C. P. Mason, Mr. Spalding, Mr. Daldy, Dr. Leary, Mr. Charles Reade, and Mr. Chappell.

The Chairman said they had not met to enter into a discussion on subjects connected with copyright property, but to form an association to look after copyright property. Two or three preliminary meetings had been held, and rules and regulations had been drawn up which were now to be substituted for approval to a larger number. The necessity for having some persons to look after their interests was shown by the passing of an Act of Parliament, introduced by the Colonial-office in 1847, which empowered the Canadian legislature to pass an Act enabling American reprints of English books to be sold in the British territories on payment of a duty of 20 per cent., which was afterwards reduced to 12½ per cent. By this measure, which received the assent of the Queen in council, the American publishers had got the command of the colonial market. If the possessors of English copyrights had had any one to look after their interests such an act would never have been passed, as this had been, without discussion. With regard to the question of international copyright also, the existence of an association would be of great value. The late Lord Clarendon, not long before his death, had sent for him (the chairman) and for Mr. T. Longman, and had been informed as to their views on the question. But they both had felt that had they at the time represented an influential association then could have expressed the feelings of such a body much more effectively than any private opinions. It would be most advisable to appoint a legal adviser to keep a look out, not only at home, but over the acts of colonial legislatures, as well as with regard to the action of foreign countries.

Sir Charles Trevelyan said the late Lord Macaulay had taken great interest in the present copyright act, which he had had the charge of in the house, and had always evinced a warm interest in anything that concerned the welfare of his comrades in literature. Sir Charles moved the first resolution, "That it is expedient to form an association for the protection of copyright property."

Mr. John Murray said the association was not intended to be a body holding meetings continually, but one which should be called together when occasion arose. A legal secretary should be appointed to watch over the interests of the owners of copyright. He seconded the resolution, which was passed unanimously.

The Chairman said that Mr. Arthur Helps, Mr. Froude, and Lord Houghton were among those who had authorised the association to use their names.

Mr. Thomas Longman said that one of the books which had been most affected by the new Canadian law had been her Majesty's "Life in the Highlands." He moved the second resolution, adopting the proposed rules and regulations, the principal of which were—"That authors, publishers, and other persons interested in copyright property be eligible as members of the association. That the annual subscription of members to the funds of the association be not less than one guinea. That the objects of the association be—To watch over the general interests of owners of copyright property. To obtain early information of all measures affecting copyright property, and, as opportunity offers, to suggest and promote improvements in existing copyright laws. That the affairs of the association be managed by a committee of twelve members, exclusive of the treasurer and hon. secretary, with power to add to their number, elected at the first general meeting, and afterwards annually by the members of the association at the general meeting; any five of the committee to form a quorum. That at the first general meeting a treasurer and an honorary secretary be selected from the members of the association, and that they be *ex-officio* members of the committee. That a legal adviser, who shall act as secretary, be appointed by the committee."

Mr. Charles Reade seconded the resolution, and said it was right to keep a look-out on the risks which both authors and publishers ran from the springs and traps of the legislature. The present was not a time to speak of international copyright, but it would interest the meeting to hear that a great triumph had been just won in America, and by the principles of English common law. Mr. Robertson, an English dramatic author, had sent over to America for performance a play in manuscript. Some printer had obtained a copy and published the play, but he had now been restrained by a series of decisions, based, not upon any legislative enactment, but upon the principles of the common law of England.

Some discussion arose as to the number of the committee, and eventually it was agreed to pass the resolution, leaving the committee to increase their number as might appear advisable. Mr. Thomas Longman was appointed treasurer, and Mr. Daldy honorary secretary, and the following committee was appointed:—Sir C. Trevelyan, Dr. William Smith, Mr. Arthur Helps, Mr. Robert Browning, Sir John Lubbock, Mr. John Murray, Mr. Bentley, Mr. Chapman, Mr. Macmillan, Mr. Routledge, Mr. Rivington, and Mr. Chappell.

It was understood that Mr. Charles Reade's name would be added at the first meeting of the committee.

INSTITUTION OF NAVAL ARCHITECTS.

The first meeting of the thirteenth session of this institution was held on Thursday morning, the 21st instant, in the Hall of the Society of Arts, by permission of the Council, the **Right Hon. Sir J. Pakington**, President of the Institution, in the chair.

The Honorary Secretary (C. W. Merrifield, Esq.) read the Report of the Council and the Balance-sheet of the Institution.

REPORT OF COUNCIL, MARCH 21ST, 1872.

"The Council of the Institution are glad to be able to report to the Members and Associates that the financial prospects of the Institution are in a satisfactory condition.

"The accounts now presented to you show that the balance to the credit of the Institution on 31st December last was £483 5s. 4d. The liabilities up to that date which have since been discharged amount to £300 11s. 10d., leaving a balance of £182 13s. 6d. to meet future charges, irrespectively of income received and expected during the present year, and, of course, of the present year's expenditure.

"At the general meeting, on 31st March, 1871, resolutions were passed:—'That the Council be requested to watch the Merchant Shipping Bill now before Parliament, with especial reference to the interests of naval architects, shipbuilders, and marine engineers,' and that 'Mr. Brassey's paper on the "Examination of Adjusters of Compasses," be recommended to the Council for their serious consideration, with a view to taking such steps thereupon as they may deem advisable.'

"The resolutions were carefully considered by the Council, and action taken upon them, as you have already been informed in the Appendix to the volume of *Transactions* of last year.

"The Council are informed that the Royal School of Naval Architecture and Marine Engineering is still progressing satisfactorily. They are glad to understand that it will be removed to new buildings at South Kensington, unless indeed it should be included in some larger scheme of naval instruction.

"The present state of the finances, although by no means such as to permit a departure from the strictest economy, has enabled the Council to transfer a large part of the duties hitherto gratuitously discharged by the Honorary Secretary to the Assistant Secretary, whose salary has accordingly been increased. The

Assistant Secretary will now be charged with the collection of the subscriptions, under the superintendence of the Treasurer, and with the editing of the Volume of *Transactions*, under the control of a Sub-Committee of the Council appointed for the purpose. The Honorary Secretary has kindly consented for the present to retain a limited supervision over the affairs of the Institution under the direction of the Council.

"This arrangement the Council propose as more in accordance with the financial position of the Institution, than the more complete, but expensive, plan of appointing a salaried Secretary, as suggested in their report of last year.

"The Volume of *Transactions* for 1871, which was in the hands of the members and associates at a much earlier period than formerly, contains some very valuable papers, including two on the Stability of Ships, a subject which, from several causes, has of late excited more than ordinary interest."

Sir John Pakington (President), said:—Gentlemen, it now becomes my duty, in conformity with the first item on the programme of our business to-day, to offer a few observations, as I usually have done at the commencement of our annual session, and I feel the same degree of pleasure which I have done on many former occasions that it now becomes my duty once more to offer to you my congratulations on the prosperous, and in every way successful, state of this very useful Institution. I am particularly glad, gentlemen, that I can commence these observations by referring to that which, I think, in all public societies is held to be the best test of prosperity—namely, improving revenues and increasing funds. There is no test so sure, and I am extremely glad that the first part of our Report, which you have just heard read, states to you in plain figures that the funds of this Institution, although not such as to exempt us from the necessity of strict economy in their administration, is still such as to place it in a more satisfactory financial position than we have ever before attained. The fact of our financial condition being in this prosperous state has enabled us to make a very important change with regard to one part of our institution, namely, the Secretariat. And here, gentlemen, I would beg leave to call your attention to a paragraph to which, last year, I directed your attention in the report of last year. That paragraph was in these words:—"The Council desire to express to the members and associates their high sense of the valuable services rendered by Mr. Merrifield as Honorary Secretary to the Institution, and trust that by the next annual meeting the finances of the Institution will enable them to attach a pecuniary compensation to the arduous duties of the Secretaryship." Gentlemen, it is to that paragraph that the present report refers in a sentence which, I have no doubt, attracted your attention towards the end of the report in these words:—"This arrangement (having described what the arrangement is to be) the Council propose as more in accordance with the financial position of the Institution than the more complete but expensive plan of appointing a salaried Secretary, as suggested in their report." That suggestion is the same one which I have just read, and which you will observe is not in its integrity carried out. Gentlemen, I cannot touch upon this portion of the subject without renewing that which, perhaps, after the applause which you have just expressed it is unnecessary for me to renew; but still I am sure that you all join with me in the very strong feeling when I remind you of the prosperous state of this Institution, that we are, in fact, indebted more than perhaps to any other cause, to the ability and the zeal with which our secretary, Mr. Merrifield, has discharged his duties. I confess, therefore, I am sorry that we have not in the present instance carried out the whole of the proposal of last year. What we have done in consequence of our improved finances is to attach an additional salary to the office of assistant-secretary, and together with that additional salary to delegate to the assistant-secretary a very considerable proportion of the more laborious part of the duties which have been hitherto discharged by our honorary secretary, Mr. Merrifield. That is the change which we have at present made; and part of the business of the Council this morning has been, in the shape of a memorandum, to draw a distinction between the duties hereafter to be fulfilled by the honorary-secretary, and those which are transferred to the assistant secretary. But in making this statement, I must add my own very strong hope that when another year has passed away we shall be at liberty, from the state of our finances, to revert to the proposal of last year, which is, I think, what every one would wish to accomplish. Gentlemen, I am happy to say that again reference is made in this report to the satisfactory progress of that School of Naval Architecture which I always regard as the child of this Institution, and a very fine and very thriving child I am happy to say it is—and a growing child—together with its marine engineering studies attached to it; and we have all of us, I think, great reason to feel satisfaction at the progress of those institutions. Now, gentlemen, you have been told by this report that it is now contemplated to remove this institution to new buildings in South Kensington, unless (the report says) it should be included in some other large scheme of naval instruction. [**Mr. Scott Russell**—"Hear, hear."] Gentlemen, I hear my friend opposite praising those words, and I think I should call your attention to the fact that those words have a distinct and very important meaning. I am sorry, or in some respects I am sorry, that the meeting of this Institution has not taken place a few days later, because if it had taken place after the statement of the First Lord of the Admiralty on the navy estimates—a statement to which I hope Parliament will listen this evening—I am sanguine enough to hope that in that statement there will be information given which will be explanatory of the words contained here with regard to "naval instruction on a larger scale." We have all of us heard a good deal of late years of the policy which has been adopted with regard to Greenwich Hospital. I will not enter now into the question whether that has been a wise and prudent policy, or whether it is not. No doubt it is a question upon which there has been a good deal of difference of opinion. But there Greenwich Hospital stands, at present applied to no really very important public purpose; and if we should this evening hear from the First Lord of the Admiralty that her Majesty's government have decided to devote that noble building to an institution for the improvement of naval instruction, I think it would be a decision to which most of us would listen, and to which I think the public would listen with great interest and approbation. Gentlemen, I must now touch for a few moments on a subject which we must all regard with very mixed feelings and with very anxious feelings; and it is a subject which I think it would hardly be consistent with my duty as your President to pass over on this occasion in silence. I mean that distressing event the loss of the *Megæra*. When I had the honour of accepting this chair, a year ago, the public mind had been agitated and excited by that dreadful event, the loss of the *Captain*. I then called your attention to that sad event in such terms as it seemed to me the occasion required from an Institution such as that in which we are now assembled, having very important duties to discharge, but those duties not being in any sense or in any respect of a political nature. Gentlemen, I cannot pass over in silence the loss of the *Megæra*. The loss of the *Megæra* has again, not in the same melancholy way certainly, but still it has greatly excited the attention of the public; and I do not think I say anything unfair or inaccurate when I say that the circumstances attending the loss of that ship have excited in the public mind a very strong feeling of indignation.

That ship never ought to have been sent to sea. She was not in a condition to take such a voyage with precious lives on board as that upon which she was sent, and we cannot but be too thankful for the providential manner, for so we must regard it, in which the lives of those on board of her were saved. The distressing event of the loss of the *Megæra* has led, as it naturally, of course, in any event, must have led, to one inquiry—in fact, this sad event has led to two public inquiries, both of which have been watched by the public with the greatest possible interest. The first of those inquiries was the court-martial, which, by the proper rule and practice of the naval service, is always held upon the officers connected with the loss of her Majesty's ships. The finding of that court-martial was, I think, such as the public would naturally have expected, and such as could only command public concurrence and approbation. The second inquiry was of a more special nature, and was conducted under a Royal Commission, specially appointed on purpose to consider the circumstances under which the ship was lost. Gentlemen, you, as the public, have now seen the report of that Royal Commission, distributing, according to the judgment of the able and honourable men who composed it, the degree of censure which they thought it their duty to attach to the different parties concerned. Now, gentlemen, my feeling is that this question of who should receive censure for an event which we all deplore and all condemn, is a question which is not for us. It is a question with which we, looking to the duties which we have to discharge in this room, have nothing whatever to do. The Commissioners have discharged what they thought to be their duty. The report which they have presented is to be the subject of discussion in Parliament very shortly, and I certainly shall not set an example, which I think would not be a wholesome or a good one, by entering into the merits of their report, or into the justice of their finding. There is only one point which, in justice to my feelings, I cannot entirely pass over, and I take that course because, although I feel strongly upon it myself, it has, in fact, very little to do with the censure for that which was really the censurable question—why such a ship should ever have been sent to sea for such a voyage. The point to which I do refer is to express my individual feeling of regret, that if the conduct of Captain Thrupp was referred to at all, it should not have been accompanied by that tribute of admiration and respect which, I confess myself, I think was due to the sailor-like, able, vigorous manner in which mainly I think, under Providence, owing to his admirable exertions, the safety of the crew of that ship was secured. But, gentlemen, although I think it would be foreign to our duties to enter into any discussion of the report of the Royal Commissioners upon the *Megæra*, or as to the opinions which they have expressed; on the other hand, I must say that I think the loss of the *Megæra* does suggest not a few very important practical questions which it does behove the Institution of Naval Architects to consider; questions which are entirely and freely open, and with respect to the consideration of which I think there cannot, in any mind, be for a moment any feeling of scruple. I am very glad to observe that, in the various papers which are to be submitted to this Institution in the course of this session, there are several which bear upon the causes of the loss of the *Megæra*. I take it, that mainly the causes of the loss of that ship were three. The first and main one was, the injury by corrosion to the plates of iron of which she was composed; secondly, that that injury took place in a portion of the vessel which, from her construction, was very difficult of access, and therefore escaped observation—I do not mean to justify that escape, but such is the fact—and, thirdly, the failure of that cement which ought to have served as a protection to the iron of which the ship was built. I find in the list of papers which are to be read to-morrow, three which bear immediately upon these practical questions. There is a paper by Mr. Mallet, on the corrosion of iron ships; there is a paper by Mr. Taylor, on a system for registering the wear and tear of iron ships; and thirdly, there is a paper by Mr. King—which, I think, we shall all hear with very great interest, for it seems to hold out a prospect which we should all be very glad to find entirely fulfilled—"On the Misuse of Cement on Iron Transport Ships, with Suggestions for making half worn-out Iron Ships perfectly Sea-worthy at a Small Cost." That may be a sanguine view on the part of Mr. King. Far be it from me to anticipate, in any degree, what his success may be; but if he is able to show us any mode of turning old ships into new ones to the extent to which he here holds out, we shall only have deeply to regret that his discoveries have not preceded the loss of the *Megæra*, in which case the loss of that ship might have been altogether averted. So, gentlemen, I feel very strongly on these occasions, and I hope that I have not violated that feeling in any way, holding, as I do, the honour of being your president, and being myself in every sense a civilian, that it is not my duty to attempt to offer anything like instruction on any of the technical and scientific questions, which instruction I should be entirely incapable to afford. It is rather my duty to point out and indicate what are the subjects, from the various events of the day, which require our attention, and to bring before your notice those subjects which are to be discussed upon the various papers which are to be read to us in the course of our proceedings. Now, it has been suggested to me that it might be well, upon an occasion like this, that, as your President, I should enter into questions of naval strategy, and as to the best mode by which the defence of this empire might be effected at sea; but such subjects are of a political character, and, I think, would be foreign to our immediate duty, and that I should be uselessly consuming your time if I were to touch upon them. I, therefore, would rather only draw your attention to such practical questions as one which I hope will be discussed, although I do not see any paper immediately upon it—I mean the very important question, which I think is still a subject of doubt, as to the masting of iron-clad men-of-war, that is to say, whether it is desirable that they should or should not be practically sailing-ships? I think that is really the practical question, and a question upon which, if I am rightly informed, a good deal of difference of opinion exists. I am led to believe that, even within our own institution, among the more eminent members of it, this is reckoned as a subject of considerable importance, and I think the Committee on Designs, which have been lately sitting at the Admiralty in consequence of the loss of the *Captain*, are not quite clear in the views they entertain upon it. It certainly is a very important practical question. Whether the paper we shall have this morning from Captain John Harvey will throw any light upon it I do not know, but his paper is "On the Construction of Vessels, in relation to the Changed Modes of Naval Warfare." I do not know what the nature of the paper may be, but within that title certainly such questions as the masting of our iron ships would be appropriate, and I, for one, should be glad to hear it touched upon. There is another question of great interest, which reminds me of the unfortunate case of the *Captain*, and our poor friend Captain Coles, who was lost in that ship, I mean the question of tripod masts, which, as you will well recollect, was a very favourite theory of Captain Coles. I allude to that subject with the greater satisfaction, because it is with an unusual degree of pleasure that I have to state that we shall hear—at least I hope and believe that we shall hear—a paper on the subject of tripod masts from Admiral Paris, to whom we have been on former occasions very much indebted for designs which the gallant admiral has been so good as to send to us, and I am sure that his presence here to-day, to favour us with a paper on this interesting subject, will be hailed by us all with a great deal of pleasure, and with sincere respect and gratitude to him for his contributions to this Institution. Such a paper will form a valuable supplement to the former contributions which we have received from him. Herr Moerath, also, will give us a paper on another subject of great, and I may say of every-day growing importance, which is the subject of what I may now, I think, call the new element in naval warfare, of tripods. We shall be very happy to hear the views of Herr Moerath upon this question of tripods—a question, I say, of increasing importance from day to day; and that new element of naval warfare has advanced to a point when it certainly does become a grave and anxious question how far the construction of our war ships should be adapted or altered, with a view to the dangers which arise from the introduction of this formidable element in warfare, Our excellent friend, Mr. Merrifield, has also dealt with this subject, and we shall have the advantage of hearing from him a paper bearing upon this question. I really can hardly imagine any question which, at the present moment, is more worthy of the attention of such an institution as this, and I hope it will receive that attention and that discussion to which certainly, for the interests of this country, it is eminently entitled. Gentlemen, I do not remember that there is any other point upon which I need detain you before we proceed to the papers of the day, with one exception, and that is this: I wish to mention the course which the council have adopted in consequence of the losses which we have sustained in the death of two of the most eminent members of the vice-presidency of this Institution. I allude to the late Earl of Ellenborough and the late Canon Moseley. You are all aware that the late Earl of Ellenborough occupied a very distinguished and well-deserved position as one of our vice-presidents, by virtue of the fact that he had at one time of his distinguished career fulfilled the position of First Lord of the Admiralty. In Canon Moseley, as you are well aware, we had a very eminent scientific and able man, and his loss is, in every respect, a great loss, not only to this Institution, but to the country. But it became the duty of the Council to select two names which they thought might worthily succeed the statesman Lord Ellenborough and the scientific man Canon Moseley, and the Council decided—for they did me that honour—to request me to intimate to his Royal Highness the Duke of Edinburgh our hope that we might be permitted to nominate him to succeed Lord Ellenborough as a vice-president of this Institution. I am afraid that I allowed this meeting to approach nearer than I was aware of before I communicated with his Royal Highness. However, I have written to his Royal Highness, but he not being in town, I have not yet received the answer, which I hope I shall receive, that we have his permission to put him in nomination at the meeting of the Council which will take place at the close of these proceedings; and to fill the vacancy which has been caused by the death of Canon Moseley, the Council have thought it well to put in nomination Mr. Froude, and I hope that this also is a decision which will meet with the general approbation of this Institution. I think that Mr. Froude has every claim to receive whatever compliment it is possible for this institution to pay him. He is most perfectly qualified, from his well-known reputation, and the happy combination that he presents of theoretical and experimental research, and from the experiments in which he is now engaged, to add to our knowledge of the theory of the resistance and of the rolling of ships. At the meeting of the Council at the close of this session, by which time I hope we shall be in possession of the assent of his Royal Highness to nominate him as vice-president, we shall proceed to the election of these and the other officers. Gentlemen, it only remains for me to add the hope that you will accede now, as upon former occasions, to the rules with regard to time. I am sure you will bear in mind what those rules have generally been. For the sake of enabling the various matters to be discussed, we have always limited the time for reading the papers to twenty minutes, and the speeches in the discussions to ten minutes for each speech, and I think the rule is, further, that the whole of a paper and the discussion upon it together should not exceed one hour. I hope that it will be the pleasure of the meeting of this Institution to adhere to these rules, and that in enforcing them, as your chairman, I shall receive that support without which I cannot hope to be successful. I believe I am only acting in conformity with the previous custom in putting to you now that the report should be adopted by the meeting.

The resolution for the adoption of the report was then put to the meeting, and carried unanimously.

The following papers were then read and discussed:—

ON THE PROTECTION OF VESSELS AGAINST TORPEDOS.

By **Herr J. N. Moerath**

(Chief Engineer, Austrian Navy, and Permanent Member of the Imperial and Royal Shipbuilding Commission at Trieste).

The damage caused by torpedos and guns to the immersed portion of the hull of a man-of-war is already well-known, and with the progress of artillery science this damage will always tend to increase. With the present system of construction, the whole surface of the ship's body below the water-line, or rather below the armour-plates, is defenceless, and for this reason I consider it the duty of every technical man to endeavour to devise some remedy against torpedos and submarine guns.

With this view, I made some trials on a small scale some years ago, and, subsequently to these, trials on a large scale took place at Shoeburyness, with cotton and cork, though not with the ingredients hereinafter described. My paper to-day is intended as a hint towards further experiments. For this purpose I have got out Fig. 1, showing how old ships may be protected, and if a good result be obtained, it will be known how to protect good ones.

I have taken wood as the building material, because I consider that wood treated with tar steam in an apparatus patented by Mr. T. Rosthorn, whereby the saturation is not merely superficial, but penetrates into the very heart of the wood, will be much used in the future.

It is known that men-of-war built of iron, laying sometimes several months continuously in a harbour without being moved, become weakened on account of the galvanic action set up in the large metallic surface bathed in sea-water. This weakness is very dangerous to iron ships as regards torpedos and other shocks under water.

The protection referred to consists of a second armour, composed of various sections, *a*, *a*, *a*, fixed with bolts to the ship's hull, and constructed of tinned sheet-iron, riveted together with angle irons, and filled in with cork shavings and hydraulic chalk, mixed with silicate of soda* (in German, *wasserglas*). This filling gets dry in a short time. The greater carrying capability of such a double-armoured ship admits of strengthening the hull by continuing the iron armour, *b*, *b*, *b*, by comparatively strong sheet-iron plates, *c*, *c*, *c*, riveted together, as shown in the diagram. The filling also, on account of its ductility, decreases the destructive effects of projectiles or of torpedos, as the velocity of the projectile diminishes in passing through this mass, so that it cannot act with its full power on the iron armour-plates, and the ship is, of course, saved from great damage, and consequently from immediate sinking, while a possibility is afforded of repairing the damage in the nearest harbour. The holes caused by repeated shots striking this armour can easily be repaired, both in the ship's hull and in the iron armour-plates, and the damaged sections can be replaced by new ones.

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* Ransome's apparatus for making wasserglas, *Technologiste*, 1857, page 867.

In addition to the great advantage of a ship's being enabled to carry very heavy guns by the adoption of this mode of protection, there is another, viz., that the internal shape may be any that best accommodates the machinery and artillery, while a suitable external form for a high rate of speed can be given by the surface of the protecting armour. In order not to diminish the ship's speed, the engine-power must, of course, be in proportion to the increase in the area of the transverse section.

ON THE CONSTRUCTION OF VESSELS, IN RELATION TO THE CHANGED MODES OF NAVAL WARFARE.

By Captain John Harvey, R.N., Associate.

As the Council of our Institution have directed attention to the building of vessels for coast defence, and to the effect that torpedos may have on naval construction, I venture to express opinions I have long entertained—and in which, I should add, I am not singular—as to the change that the employment of torpedos will, in all probability, induce in the navies of maritime states.

Though the torpedo is not a novelty, its destructive capabilities were not duly appreciated till the late American conflict, when, of the war vessels disabled or destroyed, about three-fourths of them were so disposed of by torpedos; cannon were comparatively inoperative. The torpedos used by the Americans were, however, not the perfect war engines they now are; and, moreover, they were mostly of a stationary kind, consequently were only operative when a hostile vessel came in contact with them, or within their sphere of operative action, which, unless the charges they contain are extraordinarily large and energetic, is very limited. We have now to deal with torpedos that will be used actively, and which admit of extensive application.

The defence of our seaboard is, doubtless, an important matter; but our commercial marine is, perhaps, no less important, and to which we should look, as it is thought to be our vulnerable point; for in the present state of navigation, it is much more difficult of protection than it was in days past.

If, therefore, I have taken a correct view of the subject, I should advise the construction of three classes of vessels, expressly for torpedo service; one class for harbour and river service, another for service in the narrow seas, and another for service upon the ocean and for foreign parts. Those for harbour service and the narrow seas, I would propose should be built of iron, they should be comparatively small, ranging between 50 and 300 tons. Vessels for ocean and foreign service should be of greater tonnage and timber-built, with coppered bottoms.

With so imperfect a knowledge as I have of naval architecture, I am incompetent to furnish drawings and details of construction of vessels upon which, I think, we must, in due time, depend for the protection of our shores and commerce. I will, however, remark that, in designing vessels for torpedo service, speed and handiness are essential conditions; the perfection of such vessels will mainly depend upon those conditions being satisfied. All that I can do in the matter is simply to state what is required in the contemplated constructions.

The problem of the torpedo has not yet been solved in the manner it should be; but the solutions arrived at show that our large, unwieldly vessels of war can be easily and certainly disabled or destroyed by vessels of comparatively very small dimensions. Looking carefully into the problem, as to the means of attack with and defence against torpedos, it becomes evident that monster vessels will, in future wars, be in imminent danger at sea, should they encounter a foe well prepared for, and well practised in, torpedo warfare.

I have thus endeavoured to express briefly the firm conviction with which I was first impressed, so far back as 1844, by the destruction of a barque, of some 400 tons, off Brighton. The barque was destroyed in deep water, by Captain Warner, who used on that occasion a torpedo of small size, which he designated "The Invisible Shell." Had the experiment been differently conducted, by turning the barque adrift under sail in a strong breeze, and so operated upon, the result would, in all probability, have gained the attention of the British public; but, conducted in the manner it was, it failed to show the practicability and importance of "The Invisible Shell." Enough, however, was shown to convince naval men who studied the subject, that in the then altered state of navigation, "The Invisible Shell" was a kind of arm that could be used with destructive efficacy by small and handy steam vessels, with something like absolute impunity, against the largest vessels of war armed with cannon.

In conclusion, I would say that, as various maritime states are availing themselves of the inventions for the purpose of attacking, not the top-sides, but the bottoms of vessels, we should do well to be fully prepared for such mode of attack. Taking that view of the matter, we ought, for self-preservation, to be provided with vessels adapted to the service of, and armed with torpedos. With officers and men well practised in the management of these engines of destruction under varied conditions upon the ocean, we may reasonably reckon upon an unmolested state of our shores, and, to a great extent, the protection of our commerce.

THE EFFECT OF TORPEDOS ON NAVAL CONSTRUCTION.

By C. W. Merrifield, Esq., F.R.S., Honorary Secretary.

The only submarine attacks upon vessels which are as yet known to be effective, are those of the ram and the torpedo. Submarine gunnery has not yet attained a practical form, except in the restricted shape of plunging fire from flat-headed projectiles. The object of the present paper has almost exclusive reference to torpedo attack.

I may state at the outset, that no vessel can receive with impunity the effective application of a torpedo of very large size. The work of destroying the floating capacity of a ship is out of all proportion small, as compared with the work which it is possible to store in a submarine explosive of large size; and provided always that this stored work can be applied with certainty and efficiency, there is no alternative to the destruction of the vessel.

Nevertheless, torpedos must be encountered, and our task is to ascertain the conditions under which we are likely to encounter them, and what expedients we must adopt in order to receive the smallest possible amount of damage from their destructive power.

Hasty conclusions have been stated, to the effect that, since armour-plated sides are no protection against an explosion taking place under a ship's bottom, therefore armour-plating must either be abandoned altogether, or extended to the bottom of ships. Either alternative is fallacious. We will deal with the second later. With reference to the first, that armour-plating must be abandoned, it is sufficient to consider what the ordinary use of torpedos must be, to see the error which underlies it. For torpedos used by ships at sea, the armour-plated ship will always have the same advantage as it has without the torpedo, in being able to receive with impunity the cannonade from its adversary. An unarmoured ship might certainly render pursuit difficult by dropping torpedos in her wake; but she could not venture to attack an armoured and strongly-armed ship by means of movable torpedos—for she would be destroyed by the fire of her enemy, if she ventured within any reasonable range for the use of her torpedo attack. I do not say that this mode of attack is an efficient one;

but simply that the armour-plated ship has the same preponderance of efficiency with the torpedos as without them.

If the torpedo be moored for the protection of ports and estuaries, and the obstruction of sounds and channels, I observe that it is the business of the attacking fleet to remove these obstructions. To prevent this removal, it is generally admitted to be necessary that the line of torpodos should be enfiladed by coast batteries. Here again the armour-plated ship has the same advantage as without the use of torpedos.

It is true that, with very large and very efficient torpedos, in a place well calculated for their use, and supported by very heavy and well protected batteries, a channel can be made absolutely impervious to a fleet. But these conditions must be very heavily paid for, and no nation has such resources as to be able to expend them at every point; nor even, if wealth did not fail, would there be time to place and replace them everywhere when needed. A great point is gained in warfare, when you reduce your enemy to the alternative of using overpowering force, or of abandoning his object.

Conceding, then, that there may be an irresistible torpedo attack, but observing that this is the exceptional case which we cannot provide against, and not the general case which we may attempt to meet, it remains to be considered what must be the type and what the structure of the vessel best calculated to evade torpedo attack, and to receive, without vital injury, the attack of torpedos of moderate size.

The avoidance of the torpedos themselves is mainly a tactical question. Nevertheless it largely affects naval design, especially in the type of construction. Other things being alike, a small, handy vessel, with high speed and shallow draught, will avoid torpedos better than a large ship, or than one of inferior speed or inferior power of evolution. That is evident, even when both ships have to run the gauntlet of a line of torpedos. But the small ship of light draught has the command of many more channels, and many more parts of broad channels, than the larger craft, and will thus put the landward power to a far larger expenditure of these instruments for the protection of its coasts.

The destruction of the smaller vessel by a torpedo will also be a less expenditure of life and material than that of the larger ship. It is true that if she runs foul of one, the smaller vessel is the more likely of the two to be sunk, and that is a set-off against her facility of avoiding them; but there still remains an advantage in favour of distribution in small ships rather than of concentration in a few large ships. There is, of course, a limit to the distribution, as there is also to the possible concentration.

The principle of subdivision is one of the most effective means of meeting submarine attack; subdivision from large ships to small ships, within certain limits, and for certain purposes; and subdivision of large ships into small compartments, where size cannot be advantageously reduced. Cellular subdivision should be carried out where possible.

It is worth while to point out that the partition of a ship by bulkheads does not necessarily mean cellular subdivision. A cell is a chamber which can be completely closed, and must therefore have a tight roof, as well as floor and walls. This is of especial importance in torpedo warfare, for it is very desirable to have the power of expelling the water after it has gained admission. In a closed cell, this is easily effected by forcing in air from the top, provided that the wound be low down in the cell. I do not claim the credit of this idea. It was suggested by a paper read before this Institution by Admiral Sir E. Belcher, in 1865.*

There are great difficulties in applying this principle of subdivison to the engine and boiler rooms—perhaps insuperable difficulties. I must content myself with pointing out the general advantage in this respect of the system of subdivision, and the necessity of placing as far out of reach as possible those portions of the ship to which it cannot be applied.

I find, however, that I am not singular in the belief that the whole system of the marine engine in ships of war is in need of a thorough revolution. I have no pretension to guide this revolution—I have neither the inventive genius nor the needful preliminary knowledge for it. Others, better qualified than myself to speak on these matters, have called attention to the unwieldy size and structural weakness of the cylinders—to our boiler rooms of enormous size, yet still cramped for want of space; to our hot and unhealthy stoke-holes; to our barbarous method of stoking—barbarous in respect of cruelty, as well as of clumsiness. Is it too much to hope that the unwieldiness, as well as the other defects of the system may, at no distant period, meet with a remedy?

Cellular subdivision is the most obvious and the most important principle in saving a ship from the consequences of local injury. Armour plating applied to the bottom of a ship is doubtless a protection against submarine gunnery (a danger we have not as yet to face), but it is not an efficient defence against torpedos. Armour plates are mere slabs, imperfectly connected both with one another and with the ship's structure, to the strength of which they contribute but very little, if even (all things considered) they do so at all. Apart from the probability of their being broken up by a quick-acting explosive, like fulminate or nitro-glycerine, the plates, or part of them, might be driven home upon the ship itself, in such a way that their edges might sheer the skin plating and frames. It would, moreover, be impossible to give them any great thickness, on account of their weight; for every cubic foot of iron takes 7½ cubic feet of displacement to float it.

Whenever we have to encounter the effect of violent explosions, our first object is to make as much as possible of the impact expend itself in harmless directions; our second, to endeavour to gain as much as possible the time needed to change destructive impact into mere motion. This latter is a task which a buffer performs in cushioning a blow. It gives time for the work concentrated in the impact to distribute itself through a large mass, and thus to lose the intensity which is necessary to a disruptive or disintegrating effect. By what particular device we bring this about is rather a matter of structural convenience than of defensive power. The most direct method of doing it is, doubtless, to make the explosion take place at as great a distance from the vital part of the ship—from its inner skin—as possible. Experiment and theory both lead to the conclusion that its action varies inversely as the square of the distance, and therefore the interposition of an increasing distance very soon converts its destructive effect into a mere propulsion of the ship. If it were possible to keep off the torpedo from actual contact with the ship, by any device, like the spines of a hedgehog, or a wire shield outrigged, small torpedos would hurt her but little. For various reasons these particular devices are out of the question, and I only mention them as showing a theoretical principle which we should keep in view.

For particular service, when it is the deliberate intention to make a ship force a line of torpedos, it may be worth while to make the sacrifice of speed, and to outrig either common rope netting or wire netting, at a very considerable distance from the ship's bottom. As this netting may be outrigged to a distance of six or eight feet from the ship's skin, I do not doubt that this is the best method of meeting a line of torpedos where such a line is known to exist. But the terrible impediment which it offers to speed and handiness makes it unpractical, when the object is, on the one hand, to cruise at the risk of meeting torpedos; or, on the other hand, to be serviceable for manœuvring after getting through them.

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* See his paper on "The Construction of Armour-clad Ships of War."—*Transactions, I.N.A.*, vol. vi., p. 75.

These considerations have suggested to me a device which (although not wholly satisfactory to my own mind) appears to me far superior to that of putting armour-plate on the bottom of a ship. It is as follows:—Let your ship have three skins, each divided into cellular spaces of moderate size,* the middle skin representing what is now the outer skin of an ordinary double-plated ship, like the *Hercules* or the *Audacious*—the cells perhaps somewhat smaller, and each with a man-hole fitted air-tight in the inner skin, and also with a pipe having a stop-cock and union collar opening into the upper corner of it. The space between the outer and inner skins is also to be divided into cells, the frames and longitudinals composing which should break joint with those between the middle and inner skins. Water is to be freely admitted between the middle and outer skins. The middle skin is to be deliberately weakened near the bottom of each inner cell.

I expect the plan to work as follows:—A torpedo explodes against the outer skin at T, the compartment, M N, being full of water, and, with outer surface, E F, under violent pressure, must relieve itself through the middle skin. This is weakest at H G, and will therefore give way there. The torpedo will therefore have the work to do of not only driving in the outer skin, E F, and bursting the inner skin, H G, but also of getting the water out of M N into A G, against the cushion of air which the latter contains. I should think this would exhaust the work sufficiently to save the inner skin from vital injury, unless the torpedo were very powerful indeed. Then, if many cells were wounded, the cocks, K, would come into play; air would be forced into them, and would expel the water down to the level, H.

The frames and longitudinals between the middle and outer skins should be rounded, or dished, so as not to transmit a blow to the middle skin. The edges at which they meet should be joined with a covering piece of sheet-iron of half their own thickness, which would break up easily, and thus prevent the cell behaving like a buckle-plate. The man-hole N′ would serve to take ashore for docking. I owe this very important practical suggestion to Mr. W. C. Unwin.

Without having too much faith in my own project, I prefer it very decidedly to armour-plating the bottom. I certainly add to the size of the ship, and I therefore require more propelling power. I also add to the weight, to the extent of the quantity required for all that is outside the middle skin. But this is not comparable to the weight of armour-plating, the water between the middle and outer skins having no weight in water, and therefore requiring no displacement beyond that of its own bulk to support it. Of course, the device is not applicable to small craft.

I wish to repeat that I have not written my paper to bring forward this project, but that the project occurred to me in the task which I had set myself, of considering what would be the probable effect of torpedos on the construction of war-ships.

As regards quantities or scantlings, I do not consider myself in a condition to decide upon these points until I have before me the results of more experiments than have yet been tried, or at least published. There is no difficulty in calculating, with more or less exactness, the mechanical work due to the explosion of a certain quantity of gunpowder under certain circumstances. But when we want to know, not the total work, but the destructive impact under the influence of circumstances which have not yet been experimentally studied, we are quite at fault. For instance, I do not at all see my way to answering the question whether it would be preferable to expend the cost of protection chiefly in the thickness of the outer skin, or rather in its distance from the middle skin; still less do I know the point at which there is equation between these. Again, I have nothing to guide me as to whether it would be better that the cells of the outer skin should or should not include an air-cushion or a water-cushion.

On all these points we must await actual experiment. I am glad to hear that experiments upon torpedos have been undertaken, and I shall consider that a great part of my object in writing this paper has been accomplished, if it has the effect of furnishing hints for the useful direction of such experiments.

To return to the main subject of the paper. The introduction of the torpedo system greatly increases the inevitable risks of ships of war—that is to say, those risks which must be run with full knowledge of the hazard encountered, and even with the distinct notion that some not inconsiderable loss of ships and of human life is certain to occur. It is, therefore, above all things important to reduce to a minimum the crews of ships of war. To crowd together more men upon one ship than are needed for working and fighting is a deliberate waste of our most valuable resource.

One thing more. A large iron-clad of the present day is a vile place to live in. Small iron-clads, or even large iron-clads, divided into cells, will be very much worse, insomuch that every man will be a nuisance to his neighbour. With every squadron, therefore, we must send other ships, not fitted for fighting—an admiral's yacht, a hospital ship, and a floating smithy at the least. It will be much cheaper to provide accommodation separately for these purposes, than to build fighting-ships to receive non-combatants.

I believe this paper contains the first suggestion which has yet been made public for providing structural means of enabling a ship to resist torpedo attack. I regard it as a first step only. I think it just possible that, as a first step, it will be welcomed by my audience, partly for its own sake, but far rather as the harbinger of more.

In conclusion, I wish to point out that the introduction of torpedo warfare has not had for its strategic effect the paralysis of naval attack. On the contrary, it has only gone part way to neutralise the enormous preponderance which at one time the introduction of steam-power and armour-plating appeared to give to an assailant. I do not propose to discuss details which belong to the military rather than to the constructive branch of our profession; but I have much misunderstood our contemporary history if I am wrong in my belief that, torpedos and railways notwithstanding, the seaward enemy is far more dangerous now to the landward power, than when sails and oars were the only means of propulsion. The command of the coast still follows the mastery of the sea.

Note.—It may be worth while to call attention to a plan for fishing up or cutting torpedo wires, which I published in the *Engineer* for 18th November, 1870, p. 343.

ON A NEW FORM FOR IRON-CLADS.

By Captain John Wheatley, R.N.

In Captain Colomb's paper "On the Attack and Defence of Fleets," read at the Royal United Service Institution last April, after showing the great loss of power of the gun as a weapon, he states:—"This seems to me a very startling conclusion to arrive at, and one which lies at the root of all construction and armament. It is not as though it were certain that gun must meet gun, and therefore the recession was common to both sides of the equation, but it is that some other weapon or weapons are making tremendous strides, and are beating the gun in competition. It may mean also that the manner of constructing the carriage—that is, the ship—is at the bottom of the recession. In any case I can conceive no more important subject for inquiry than whether my figures and deductions are correct. If they are, I can only express my belief that we are close upon a very extraordinary reconstruction of our navy."

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* It is an axiom of iron ship-building that no subdivision or cell should be so small as that a man cannot be sent into it and reach every part of it.

Thus, in the opinion of a most competent judge, of an officer who has made an especial study of his subject, none of our present ships are efficient, not one fit to cope with the new conditions of naval warfare. The weapons alluded to as beating the gun are, first, the ship used as a ram; second, the torpedo; this latter, however, making the ram a very hazardous mode of attack.

Taking the torpedo as by far the most important weapon, but without excluding the others, it will be my endeavour to bring before you a form of vessel more adapted to the altered condition of naval warfare than any now extant. Formerly, broadside on was the mode of attack, because bringing the greater number of guns to bear; with ironclads, presenting the broadside is their weakest position, as presenting the greatest extent of penetrable armour, and laying them more open to ram and torpedo attacks. The form of vessel, of which the diagrams are before you, is taken from the Eastern type, prevalent from Egypt to Japan inclusive, and of which the Bombay cotton boat is one of the best specimens; but in my vessel the projecting bow will be prolonged to a form approaching that of the cigar-ship, for reasons which I will explain later. Her extreme length is to be 300 feet; beam, one-fourth of length, 75 feet, enabling her to carry 14 35-ton guns, weighing, with 23-ton carriages, 812 tons, little more than two turrets with their guns. These 14 guns are to be mounted on Captain Moncrieff's system, having, without altering her position, a greater weight of all-round fire than any existing form, while exposing less vulnerable surface, the guns being mounted in an oval, terminating forwards in an acute spherical angle. Her best mode of attack being stem on, she will bring eight guns firing ahead or astern parallel to the keel, the beam gun and contiguous gun firing alternately. The length of the major axis of the oval is half the extreme length, 150 feet; any increase of the length of the oval would diminish the defence by exposing a larger surface to an attack on the broadside, while any diminution would cramp the space for working the guns. The ketch rig gives a clear deck for the same purpose, and the lateen form of head sails tends more than the present form to lift the bow, ease the pitching motion, and so to increase the speed. On looking over vol. v. of your "Transactions," I found that one of your vice-presidents, Admiral Sir Edward Belcher, had proposed, in 1829, to sail an 18-gun brig stern foremost and ketch rigged, so I trust that this proposal to carry out similar principles on a larger scale will obtain his approbation.

The proposed beam is necessary to admit of a powerful battery firing ahead or astern in attacking or retreating, and only seems excessive through the size our ships have attained; proportionately it is not greater than that of our former wooden ships.

I now come to the long projecting bow. In the discussion on Captain Colomb's second paper, "On the Attack and Defence of Fleets," at the Royal United Service Institution, on the 15th of January last; the question was asked, "How would you attack an enemy's fleet, supposing each ship of the enemy towing a Harvey torpedo on each side?" It appears to me that the result, whether with fleets or single ships, would be in favour of the party giving the first hits with the torpedo, and that this would be best obtained by an outrigger of the length of a late first-rate's jib-boom, about seventy feet, with a housing of twelve or fifteen feet from the projecting stem of my vessel. Again, this form of stem would tow two other torpedos, one on each side, with not more than three or four fathoms of line, all three at the requisite depth under water to secure an effective explosion, while the form of stem under water exposes less surface to an attacking torpedo than any ship of the present form. Should an enemy's ship approach with an intention to ram, the towing torpedos may be allowed to run out the line till the torpedo has crossed her course; and then, the break being applied, she will be at once destroyed.

Vessels of this form will have greater buoyancy than those of the present form, and therefore would carry thicker armour, and if requiring ballast to steady her in rolling, it might be applied in thicker bottom plates; but these are subjects that specially belong to the naval architect.

Another advantage of this form is, that it gives greater rapidity in turning, thus enabling her more readily to avoid sudden attacks by ram or torpedo, and punishing the attempt with her stem or her guns.

As to guns, without disputing the superiority of the rifled gun when, as on shore, the platform and the object are both fixed, at sea I should prefer the smooth bore, giving the advantage of ricochet firing, where platform and object are both in motion, and the range ever changing, and also for the power of using grape-shot.

In the encounter between the *Royal Sovereign* and the *Camel*, with Harvey's torpedos, it may be assumed that had the *Royal Sovereign's* 25-ton guns been smooth bores, and using grape-shot in proportion to the round shot they would throw, the *Camel* would have been defeated on her first attack. As the case now stands, this torpedo success condemns the whole turret system. A 35-ton gun would probably admit of an 18-inch bore, throwing an 800lb. shot; and a cluster of grape of, say twelve 7-inch 50lb. shot, would, with disk and rod, be of about the same weight, and speedily settle any unarmoured or light-armoured ram, gun, or torpedo vessel venturing within range, and thus, in some measure restoring some of the lost power of the gun.

According to my experience, every vessel moving through the water, except before the wind, raises a sea against her in proportion to her bulk, speed, and weight. This is visible even in the gentle movements of an aquatic bird in water, elsewhere as smooth as a plate of glass, and in buoys and piers of bridges in a tide-way. In an account of the visit of Commodore Perry, of the United States Navy, to Japan, I find it stated that "the heavy sea at the landing-place caused a long delay in embarking. . . . . . . At last, when all were embarked, a further advantage of the Japanese boats, whose superior speed was already known, was manifest in the fact that all who were in the Japanese boat arrived at the ship quite dry, while those in the American boats were thoroughly drenched." From this fact, I put it to the consideration of naval architects whether, seeing that ramming is hardly possible in the face of the torpedo, a total change in the form of the bow of the breastwork monitors to that on the principle here proposed might enable them to face the sea, which more than one example shows that they are now not able to do.

To conclude. Considering that living on an island not producing sufficient food for the population, our commerce is our life, that we could not exist in our present numbers without it, a hostile fleet at sea unopposed would be even more fatal than a landing on our shores; that thus the absolute necessity of attack is forced upon us; and that, as far as I am aware, no answer has been given to the question, How is that fleet to be attacked with a reasonable chance of success? it has been my endeavour, according to my ability, to show how this may be effected.

ON ARMOUR-PLATED SHIPS.

By J. M. Hyde, Esq.

I need hardly say to the Society of Naval Architects that the subject of armour-plated ships for coast defence, or, indeed, for any other duty, is of the deepest importance at the present time. No one knows so well as those who have given any attention to naval construction, how difficult it has been to arrange a ship that shall contain all the requisites necessary for a ship of war, even under the old system; modern invention has given us material so vastly different to anything known to the men who fought our great naval actions in former days, that the entire system of actions will have to be changed when the next great fight takes place.

Your society has thought fit to place the subject of armour-plated ships for coast defence the first on its list. The prominence so given proves that they esteem it a subject of deep interest, as well as one needing discussion and investigation, thus showing that at present there is some doubt as to what is the proper form of ship for coast defence. The contest between the guns and the armour plates has not ended, for so long as the guns progress in power so must the armour advance in strength; this is shown by the increase from four inches, the first thickness of plates employed, to the present, 10 inches and 12 inches, thus attempting to keep pace with the guns. Artillerymen will tell you, that, no matter how thick or complex the armour, if placed vertically they will be able to destroy it; no matter how thick the armour, it can be broken up by the modern shell. If this is conceded, if it is acknowledged that the guns can destroy the armour on a ship's side, then it seems to be desirable to examine if there is not some other system of construction that shall stop the guns in their victory. Much professional ability has been given to the arrangement of ships with low free-board, offering small resistance to the enemy's fire. Such ships admit of thicker plates being carried than those with high, lofty broadsides, and are, no doubt, with their turrets fitted on a breastwork, the most formidable of all the ships yet built; but still they are vulnerable, and, being so, are not of so much value as they should be. All vertical structure, both hull and breastwork, can be penetrated, and the question will be very naturally be asked, Why not seek some other form of construction, so that the men who may have to fight the future naval battles of England may have a chance of escape given them?

In offering for the consideration of your society a different form of vessel from that hitherto adopted, I am quite aware of the very searching criticism that will be given to it; indeed, the importance of the subject demands that every possible investigation experience and experiment can bring should be brought to its careful study; and I am quite sure that the members of this institution will receive with attention any reasonable suggestion, even from so humble a person as myself. Permit me, then, to say that, so far back as 1854, I began experiments with angular targets, quite believing even then that the guns would succeed in penetrating armour-plates. I am fortunate in having a letter still in my possession from the late Admiral Sir Byham Martin, referring to a proposition made and submitted to him for the construction of armour-plated gun-boats. I refer to it to show that this question of angular sides for ships has been of long continuous investigation, and I am not aware of anyone having given earlier attention to it.

The difficulty and cost of constructing ships with vertical sides equal to resist the impact of modern projectiles is now generally acknowledged. It therefore becomes necessary to make some other arrangement, and, in the absence of a better, I am permitted to bring before this society my system of double deflection. The models and drawings now produced represent that system. In suggesting this form for a fighting-ship, I have kept in view all the essentials necessary. These are, first, stability and safety; second, invulnerability; third, light draught of water; fourth, comfort and accommodation for the crew. The first of these essentials, stability and safety, can be illustrated by the sectional models. These show sections of two vessels, one the ordinary ship of low free-board, the other a section of a double deflecting ship. They are arranged to be both of equal displacement, there being the same number of square inches in each midship section. An experiment with these models shows that in the first a given weight placed on the decks will capsize it, but the same weight placed on the deflecting model, in the same position, will have very little effect indeed, and even when placed on the outside of the deck will not have the same influence, thus proving the stability and safety of the one over the other. Actual experience thus shows the great advantage of an open-sided ship, especially its ability to carry heavy weights, such as turrets and guns, at a greater height than the ordinary vertical-sided ships. And as regards the invulnerability of deflecting ships, I am quite prepared to assert that no projectile can penetrate the hardened surface of a sloping or deflecting side. What I mean by the hardened surface is this, I do not propose to use the very soft material now employed in the manufacture of armour-plates, such as our present ships are plated with. Modern guns will send their projectiles through the thickest plate yet made; and, according to the highest authority, even 24 inches of iron will not resist the gun power that can be produced. If this is so, why not try the effect of a deflecting side to a ship, and give the plates a hard surface on the outside? Material can be produced, a sample of which I have here, that is soft on the one side and hard on the other. The effect of a shot upon the hard surface is like the blow of a hammer on the face of an anvil; it is the velocity of the projectile that makes it penetrate; and a hardened surface will deflect any projectile that strikes it with even the highest velocity at an angle. I therefore propose that the side of a fighting ship should be formed with an angle above and below the water-line, as is shown by the model on the table, and that the apex of the angle should be arranged to be some three feet above the water-line; thus, such a ship would be difficult to hit fair, there being no face of the surface square to horizontal fire, neither at the sides nor ends. The decks and bottom must stand the same chance as in other ships; these will no doubt have to be made very much stronger than in our recent ships. The bottoms will have to be made to offer some resistance to the torpedos, and instead of being only half-inch thick, I should submit two inches at least, and not less than one foot of timber on the outside; in any case, the bottom of all the future ships must be made, or at least they ought to be made, to offer a greater resistance to an explosion than the water in which they swim; this can only be proved by experiment; and in the present condition of this great question it would be a wise expenditure to construct a section of a ship, with say a two-inch bottom and one foot of timber, for the purpose of an experiment. We hear a good deal about ramming when the ships of the modern days are spoken of. Now, it occurs to me, that a deflecting ship, such as this model represents, would offer a good deal of resistance to that manœuvre; and I am inclined to think the apex of the angle of such a ship would do more injury to the ramming ship than she would receive from such an attack. There is also another advantage, and not the least in the arrangement of a fighting-ship, and that is the superior accommodation for the crew. Now, this is certainly a matter of very great importance, and however much ingenuity is expended in the design of a fighting-ship, it should not be forgotten that the men who must fight the modern ships will be a much more valuable class, from the fact of the complexity of the machinery requiring a higher education, and therefore should be taken every possible care of. Now, a ship that requires artificial ventilation, like a coal mine, is not particularly agreeable as regards comfort for a closely packed crew, for should the machinery of the blowing arrangement get out of order during the excitement of a fight, the crew may stand a fair chance of suffocation for want of air. In the case of the deflecting ship, the deck being above the water-line, ample room is given for the crew, without the necessity of there being artificial means employed for obtaining the necessary air to breathe—in fact all the essentials of a fighting ship can be obtained by this system—invulnerability, steadiness of gun platform, easy draught of water, comfort for the crew, and moderate cost of construction. I produce samples of iron fired at vertically by a model gun, and also of tempered steel, fired at an angle of 22°, clearly showing the advantage of angular structures. I also produce samples of wood used to deflect the same projectiles. This also proves that even timber, when placed at so low an angle as 22° to the line of fire, is capable of resisting a projectile of the more modern type. In submitting this particular form of ship for consideration, I am quite sure all who are interested in the success of the British navy will give me credit for a desire to maintain that power our common country has hitherto possessed; for, however brave our sailors, and however skilful the officers, our ships should certainly have every possible advantage that united ingenuity can give them, or the skill and bravery of those who handle them may be wasted in fruitless combat when the pinch comes.

LEGISLATIVE INTERFERENCE WITH THE CONSTRUCTION, STOWAGE, AND EQUIPMENT OF SHIPS.

By William Young, Esq.

I confess that, after bestowing a great deal of thought upon the subject, I had determined to withdraw altogether my offer to appear before you, as I found that the more consideration I gave to the matter, the more convinced I became that there ought to be little or no legislative interference in any private enterprise. Looking, however, to the fact that my own occupation in life is that of an underwriter and insurance broker, and that but for the effect of marine insurance upon commerce generally, self-interest would be a perfectly sufficient guarantee against shipowners sending to sea vessels which were not in an efficient state as regards their hull, spars, equipment, or cargo, I have come to the conclusion to appear before you, even if it be in the light of a "necessary evil," and I do so all the more readily as I find that no other member or associate has offered to bring the subject before you—a subject, I beg of you to bear in mind, of real importance, not only to us particularly, but to the world at large.

The word "ship" has been construed in the courts of law as including "whatever is on board a ship, for the object of the voyage or venture in which she is engaged, belonging to the owners." I might, therefore, take construction and equipment together, and treat stowage as a separate subject. But, in the main, I prefer to take all three as one subject, thinking, as I do, that all must sink or swim together. At present, practically, there is no legislative interference with the ship, except in the 17 and 18 Vic. cap. 104, which provides that at least three bulkheads should exist in every iron steamer over 100 tons, intended to carry passengers. There are also certain clauses in the "Merchant Shipping Act" which relate to lights and signals, and the adjustment of compasses, but I think it hardly necessary to enter into such minute details in a paper such as this.

With regard to stowage, there are at present no legislative enactments, except the usual restrictions of dock companies and harbour commissioners empowered under local Acts, which need hardly be taken into consideration as having any practical bearing on the matter in hand.

I will now mention, so far as known to me, the suggestions which have come before yourselves or others on this subject. Mr. Rundell, of Liverpool, so well known to many of us, read here, in 1870, a paper advocating a plan of his own, fully detailed in the proceedings of your society. His suggestion was, "that a round spot, of 9 inches in diameter, be conspicuously painted on every iron vessel on each side amidships, at the point through which a horizontal plane would pass, which would cut off the upper one-fourth of the space usually measured in ascertaining a vessel's registered tonnage (*i.e.* one-fourth of her whole internal capacity) when she is on her keel." I shall not enter more fully into his plan, as it was very freely discussed here at the time, and on the whole not approved of by the practical ship-builders present. Nor, so far I known, has Mr. Rundell's suggestions borne as yet any practical fruit.

Mr. Plimsoll, M.P. for Derby, in 1870, introduced a Bill into Parliament on this subject, with the best intentions; but I think anyone practically acquainted with the ship, whether it be as a shipbuilder, as a shipbroker, or as an underwriter, will perceive at a glance the impossibility of carrying out the proposals embodied in that Bill.

They are:—(1) That vessels not classed by Lloyd's Register or by the Liverpool Underwriters' Registry for iron vessels, should be classified, or rather certificated, by the Board of Trade. (2.) That vessels shall all be streaked over with yellow paint, to show the proper line of maximum immersion or load line. The authorities for fixing this streak are to be the builder, a surveyor appointed by the Board of Trade, and the surveyor to Lloyd's Register, or the surveyor to the Liverpool Underwriters' Association. And, again, any harbour master, officer of the Coast-guard or Customs, Receiver of Wreck or officer of the Board of Trade may detain any vessel which he thinks is overloaded.

He might as well have added to his list of officials the policeman on his beat or the parish beadle. Imagine the Cunard and Indian line, or the steamers in the Mediterranean or the Baltic trade (whose departure and arrival are timed almost as closely as that of a railway train) subjected to all these vexatious restrictions.

Mr. Edwin Chadwick, C.B., read a long and interesting paper at the Sheffield Meeting, in 1865, of the Association for the Promotion of Social Science. I have perused this paper with care, and am ready to admit that many of his statements as to the increased and increasing number of casualties on our own coast are such as might alarm the ignorant, giving, as he does, the statistics from the Wreck Register, for the completeness of which we are indebted to my esteemed friend, Mr. Jenkin. But what do you think is the result he comes too, after all his alarming statistics? Simply this, "that entire self-insurance is the great principle to be promoted." This is at least logical, which is more than I can say for the suggestions made in this room in 1870, during the discussion of Mr. Rundell's paper (already mentioned), when it was proposed that no owner should be allowed by law to insure more than three-fourths or two-thirds of the value of his ship. If the ship is to be under restriction as to insurance, why not the owner of cargo also? And for that matter, why not meddle with fire insurance and life insurance too. If every good thing that can be abused is to be the subject of legislation, where are we to stop?

I may add that the law in France attempts restrictions of this kind, which only result in the forbidden portions of insurance being that allowed for execution.

But if Mr. Chadwick's proposition, that entire self-insurance ought to be promoted, be logical, is it in any way practical? Would the cure not be worse than the disease? No doubt large and wealthy firms, or companies owning many vessels, can perfectly well do without insurance; but would it be well, or for the general advantage, that all ship-owning (or any other trade) should be confined to great and wealthy firms only? Would not this carry us back to the practice of earlier times, when there were but two classes of men, the very few and rich, and the many living by the labour of their hands, the former class, in such a case, tending yearly more and more towards the notion of a feudal lord superior; the latter becoming each generation nearer akin to the serf or the helot.

Before I leave this suggestion of Mr. Chadwick's, I desire to mention with gratitude that this paper of his led to the presentation of a memorial to the Prime Minister, praying for an authoritative digest of the case law of England—a thing most urgently needed (as I shall point out hereafter), but apparently as far from realisation now as it was then.

I suppose every one will allow that there are dishonest ship-builders, ship-brokers, and ship-chandlers; that ships are often badly built, improperly stowed, insufficiently manned and found. How then are these blots on our fair fame as honest men to be remedied, if we admit that legislative interference is impolitic?

My reply is, that commerce is really self-regulative. No one in the present day, I presume, would advocate the sumptuary laws of our ancestors, the restrictions on the export of bullion, or the peculiarities of the old wool trade, or any of the notions which used to prevail with regard to fostering industry in our country, and preventing the interference of foreigners with what we considered our own special productions. The truth is, that custom becomes law, and it is found that commerce practically creates regulations, which, in the course of time, have all the effect and power of legislative enactments; in fact, they become practical law, by being embodied in decisions of our courts of justice. I may bring forward, as an instance, what is technically termed the "running-down" clause, which, although restricted within certain limits by the Merchant Shipping Act, was invented and put in force by a compact between the shipowner and the underwriter. There are many other instances which might be brought forward of a similar description, but I take this as the one likely to be best known to most of those present. I believe shipowners will agree with me when I say that the restrictions, as laid down by Lloyd's Register and that of the Liverpool Association, are found in many cases to interfere materially with the real efficiency of vessels constructed by first-rate builders. If to this there were added government interference, I conceive that a fatal blow would be aimed at the prosperity and superiority of our ship-builders. I must not be understood by this in any way to object to Lloyd's Register, or that of the Liverpool Association. On the contrary, I think these afford one of the best arguments against legislative interference, for here we have a system grown up from the necessities of the case, owing its existence to private enterprise, and exercising a power which it would not be good that any government department should possess. The rules which govern the committee of Lloyd's Register and the Liverpool Register are open to modifications, as circumstances arise, but every one at all acquainted with government departments must realise the fact that if the shipping of the country had been built under the survey of the Board of Trade, or any department of government, there would have been no means of compelling them to alter their rules or regulations. In truth, if our shipping were built under government survey, I do verily believe it would soon become "conspicuous by its absence." I do not say that the registers alluded to are by any means perfect, but so long as ships and cargoes are insured, it is necessary for the use of underwriters to have a register, classifying vessels according to their materials, scantling, and workmanship. Such a register should, in my opinion, be drawn up by boards composed of underwriters exclusively, the register being required for their information, and not for that of owners. And the board must classify ships according to fixed rules; for although it is an evil that two ships, each complying with the rules, should have the same class where one is superior to the other, it would be a much greater evil to classify ships according to the opinion of surveyors, not only would the surveyors differ, but they would be subjected, if not to the offer of, at least to the imputation of having accepted bribes.

And if the rules of one such book become antiquated, a rival register can be started at once by those aggrieved. And if the regulation of the stowage of vessels has not yet attained the same point of completeness, it is at least in course of coming, under similar laws, in a very natural if Darwinian way—I mean by the "natural selection" of what is called the "Salvage Association," which circulates among its members (chiefly underwriters) all material facts with regard to every important vessel loading in the United Kingdom, and is gradually taking up also the state in which cargoes are discharged as well as loaded. This information is necessarily confidential, but the effects are soon felt, as a vessel overloaded cannot be insured at ordinary rates, and the owner who is not careful soon becomes known and avoided.

In short, my argument is, that by the non-interference of the legislature, matters like this become self-regulative.

As has been well said by a distinguished living philosopher—"So long as order is maintained, and the fulfilment of contracts is everywhere enforced; so long as there is secured to each citizen, and each combination of citizens, the full return agreed upon for work done or commodities produced; and so long as each may enjoy what he obtains by labour, without trenching on his neighbour's like ability to enjoy, a nation's functions will go on healthfully—more healthfully indeed than when regulated in any other way."* What has been well called by the same writer, "the negatively regulative enactment," is that which really arises in the manner in which I have endeavoured to show that private enterprise has brought about and kept up certain regulations with regard to the construction and stowage of ships. In short, we want no direct interference with the construction or loading of our ships; but we do want justice, prompt, sharp, decisive, and, above all things, cheap, so that if one man is wronged by another, he has his remedy in hand without any circumlocution or delay. As one means towards this end, the appointment of a public prosecutor seems to me to be very important. If a vessel leaves a port overladen, undermanned, badly equipped, (and I admit that such things frequently happen) the difficulties in the way of promptly bringing an action against the delinquents at the present moment are almost insurmountable. The sailor is on board, and bound by law, as well as by custom, stronger than law, not to peach; moreover, unless he combines with all the rest of the crew, he is naturally enough no-where in any attempt at remonstrance. The underwriter is generally more deeply interested in such questions than any other body of men. But what position does he occupy? He may feel—he may know for certain—that he is the victim of deliberate fraud; thus he can hardly ever bring a direct action against the wrong-doer; he must allow himself to appear as a defaulter, in order that the action may be brought against him, and then, again, if he does take this course and refuses to pay the loss, he is accused of impecuniosity, and suffers in *prestige*, which, in these days of competition, he can hardly afford to incur. Moreover, if he waits till an action is brought against him, the chances are that, long before the case comes to trial, the witnesses most necessary to him have disappeared, only partially to be recovered at a heavy outlay.

If these difficulties are overcome, and the case does come to trial, it does not consist in an appeal to certain general principles, laid down in any code or recognised system, but a contest to be decided by a reference on either side to a multitude of cases previously decided in courts of justice. The facts, as they are called, are then left to the decision of a jury of twelve unwilling and ill-paid men, selected quite indiscriminately, and who, moreover, must be unanimous as to facts which in such cases require an amount of technical knowledge which only an expert can possess. Puzzled and wearied, the result of their deliberations is either an irreconcilable difference of opinion, which renders a new trial necessary, or more generally they determine that one man is less able to bear the loss than a society of men, and they consequently give the verdict in favour of him whom they consider the weaker party.

The practical result of what I have said is, that what we want is not direct legislative interference, but such a reform in our law as will lead, in the first place, to its codification, so that each of us may know what the law really is; next, to its cheap and ready administration, so that if one man injures another his remedy lies at his own door, without incurring the risk of delay, expense, and disappointment. Codification, or a digest of the case law of England, as recommended through Mr. Chadwick by the Association for the Promotion of Social Science, I deem to be a matter of the utmost importance, but also one which would require much time, thought, and special knowledge in order to carry it out, and so cannot, perhaps, be looked for immediately; but the appointment of a public prosecutor seems a possibility not remote, and would, I am sure, tend towards the end I have in view, viz., the prompt bringing to justice of those who deliberately send a vessel to sea in a state that is not seaworthy, which, you will bear in mind, is a criminal act if it endangers life. Looking to the peculiarities which exist in the character of the sailor, and the exceptional state of society which must exist on board ship, I am quite content that the law should lay down the regulations it now does with regard to his treatment, although probably in his case, too, a prompt and ready means of suing his employer for damages would do away with the necessity for many of the present enactments in his behalf. I may add that, when a public prosecutor is appointed, I would gladly see the abolition of the jury in civil cases, or, at all events, the decision of the majority to be accepted, instead of an enforced unanimity.

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* Herbert Spencer, *Fortnightly*, Dec. 1871.

You will observe that my thesis is simply this, all interference of the executive ought to be avoided where private enterprise, or the natural laws of supply and demand, create regulations. Voluntary association is better than compulsion. The tendency to centralise so many enterprises in the hands of government, I confess, seems to me one of the worst features of these latter days. "God helps them who help themselves;" and sitting in the mud and howling for Hercules to come and raise us to some sort of governmental paradise will not tend to make us better men or a greater nation.

RULE FOR DETERMINING THE FREEBOARD FOR SAILING AND STEAM-SHIPS.

By Herr Gustav A. Mitzlaff (Elbirgen, Prussia).

Various rules for this purpose are in use with underwriters, but as all of them take only the dimensions (principally the depths) into account, without regard to the form of vessels, these rules give unreliable results, and are therefore injurious to shipping interests. In the following paper a rule is given which, it is believed, amends the fault referred to, and is easy of application.

A ship is overloaded if the enclosed part of her which remains above the load water-line is too small in proportion to the immersed bulk. The freeboard of vessels ought, therefore, principally to be regulated by proportioning that volume of the ship which lies above water, and represents her superfluous buoyancy, to her immersed part, which is the weight of ship and cargo in a state of equilibrium to the displaced water. To determine this proportion, mere theoretical investigations will not suffice, but practical experience—inferred from ships whose lines, draught of water, good behaviour at sea are known—may be made applicable for that purpose.

The part of superfluous buoyancy may be altered in size according to circumstances. For European voyages it may be smallest; it must enlarge for Transatlantic, and become still larger for long-course voyages. This is obvious, for on short voyages harbours of refuge, facilities for repairs and victualling, &c., are nearer at hand than on longer voyages. Ships of much rise of sheer require a greater height of freeboard amidships than those which are more straight. Vessels of great proportional length require more freeboard to make them ride safely in a rough sea; ships which carry a great number of passengers ought to have, on account of their precious cargoes, a still larger freeboard.

It is now necessary to decide on the best way in which the freeboard may be determined. The most reliable result would be obtained if the cubical contents of a ship, as enclosed by the deck, were calculated on outside measurement, and the part necessary for superfluous buoyancy (being a certain part of the whole) deducted therefrom. But as these proceedings would involve a new measurement for every vessel, this plan must be abandoned as too expensive and inconvenient. But in the tonnage measurement, as enacted by law in 1854, data are already given which may be made useful for the above-named purpose. The gross tonnage under deck gives the whole contents of the ship's hold, and it only remains to determine that part of the hold which has to be kept above her load water-line. The cubical contents of this part of the hold is to be calculated by the sectional areas (in number as prescribed by law) under application of Chapmann's formulæ for calculating contents of irregular bodies.

The ship's sides above load water-line are, in the middle part, about vertical, at the ends more or less inclining from the deck downwards. For convenience sake, let it be supposed that the sides are vertical throughout, which, for the purpose of calculating the freeboard, will be found admissible if the same course has been adopted with the standard vessels that have furnished the proportional part of superfluous buoyancy to the whole hold. Under this assumption, the areas of each of the sections are given in the product of uppermost breadth, as ascertained by tonnage measurement, by the corresponding height from load water-line to under side of deck plank.

Mr. Mitzlaff then proceeded to elucidate his method by an arithmetical example worked at full length. A small ship of 353 tons gross register tonnage under deck has the following measures as taken by officials:—Length for measurement, 118·5 feet. Distance between the five sections = 19·75 ft; uppermost breadths at these sections, commencing forward:—1st section = 24·35 ft.; 2nd section, 25·5 ft.; 3rd section, 25·45 ft.; 4th section, 25·0 ft.; 5th section, 23·1 ft. The depths of hold at each of these sections, in the same order: —At 1st section = 17 ft.; 2nd section, 16·55; 3rd section, 16·4; 4th section, 16·5; 5th section, 16·65 ft. Let x be the height of freeboard from load water-line to under side of deck-plank at lowest plane (in this case, at the 3rd section, which has the smallest depth). Then these heights, at the different sections, commencing forward, are:—1st section = $(x + 0{\cdot}6')$, ($0{\cdot}6$ being the difference between depth at 1st and 3rd sections, namely, $17 - 16{\cdot}4 = 0{\cdot}6'$); 2nd section $= (x + 0{\cdot}15')$; 3rd section $= (x + 0)$; 4th section $= (x + 0{\cdot}1')$; 5th section $= (x + 0{\cdot}25')$. Therefore the areas of these sections, expressed in square feet, are received in the products of the given breadths and heights:—1st section $= (x + 0{\cdot}6') \times 24{\cdot}35'$; 2nd section $= (x + 0{\cdot}15') \times 25{\cdot}5'$; 3rd section $= (x + 0) \times 25{\cdot}45$; 4th section $= (x + 0{\cdot}1') \times 2{\cdot}50'$; 5th section $= (x + 0{\cdot}25') \times 23{\cdot}1$. The contents of that part of hold which represents the superfluous buoyancy (B), expressed in cubic feet, applying Chapmann's rule, and keeping in mind that the areas at ends of vessels = 0, is given by—

$$0 \times 1 + (x + 0{\cdot}6) \times 24{\cdot}35 \times 4 + (x + 0{\cdot}15) \times 25{\cdot}5 \times 2$$
$$+ (x + 0 \times 25{\cdot}45 \times 4 + (x + 0{\cdot}1 + 25{\cdot}0 \times 2 + (x + 0{\cdot}25)$$
$$\underline{\times\ 23{\cdot}1 \times 4 + 0 \times 1.}\quad 19{\cdot}75 = B$$

Extracting x from this formula gives:—

$$x = \frac{B.\,3}{2 \times 19{\cdot}75} - \frac{(0{\cdot}6 \times 24{\cdot}35 \times 2 + 0{\cdot}15 \times 25{\cdot}5}{24{\cdot}35 \times 2 \qquad \times 25{\cdot}5}$$
$$\overline{= 0}$$
$$\frac{+\ 0 \times 25{\cdot}45 \times 2 + 0{\cdot}1 \times 25{\cdot}0 + 0{\cdot}25\ 23{\cdot}1 \times 2}{+\ 25{\cdot}45 \times 2 \qquad \times 25{\cdot}0 \quad + 23{\cdot}1 \times 2}$$

B, or that part of hold which is the superfluous buoyancy, has, as estimated from standard vessels, been found of sufficient size :—

(a). For European voyages $B = 0{\cdot}24 \times H$.
(b). For Transatlantic voyages, $B = 0{\cdot}273 \times H$.
(c). For long course voyages, $B = 0{\cdot}307 \times H$.
H being the contents of hold in cubic feet.

If in formula 1, in place of B, its value, expressed in part of H, be put, x is for European voyages :—

$$x = \frac{\frac{0{\cdot}24 \times H \times \frac{3}{2}}{19{\cdot}75} - (0{\cdot}6 \times 24{\cdot}35 \times 2 + 0{\cdot}15 \times 25{\cdot}5 +}{24{\cdot}35 \times 2 \qquad + 25{\cdot}5}$$

$$= 0$$

$$\frac{0 \times 25{\cdot}45 \times 2 + 0{\cdot}1 \times 25{\cdot}0 + 0{\cdot}25 \times 23{\cdot}1 \times 2)}{+ 25{\cdot}45 \times 2 \qquad + 25{\cdot}0 \qquad + 23{\cdot}1 \times 2} -$$

As in the example chosen, H = 353 tons = 35,300 cubic feet, and as $0{\cdot}24 \times \frac{3}{2} = 0{\cdot}36$:—

$$x = \frac{\frac{0{\cdot}36 \times 35300}{19{\cdot}75} - (0{\cdot}6 \times 24{\cdot}35 \times 2 + 0{\cdot}15 \times 25{\cdot}5 +}{24{\cdot}35 + 2 \qquad + 25{\cdot}5}$$

$$= 0$$

$$\frac{0 \times 25{\cdot}45 \times 2 + 0{\cdot}1 \times 25{\cdot}0 + 0{\cdot}25 \times 23{\cdot}1 \times 2)}{+ 25{\cdot}45 \times 2 \qquad + 25{\cdot}0 \qquad + 23{\cdot}1 \times 2} =$$

3·04 feet freeboard, for European voyages from load water-line to under-side of deck-plank at lowest place. As the deck of this vessel is three inches thick, the freeboard is 3 feet 3½ inches from load water-line to upper-side of deck-plank, at lowest place, for European voyages. Substituting the co-efficient for Trans-Atlantic voyages, $B = 0{\cdot}273 \times H$.

$H = 35300$ and $0{\cdot}273 \times \frac{3}{2} = 0{\cdot}41$, gives :—

$$x' = \frac{\frac{0{\cdot}41 \times 35300}{19{\cdot}75} - (0{\cdot}6 \times 24{\cdot}35 \times 2 + 0{\cdot}15 \times 25{\cdot}5 +}{24{\cdot}35 \times 2 \qquad + 25{\cdot}5}$$

$$= 0$$

$$\frac{0 \times 25{\cdot}45 \times 2 + 0{\cdot}1 \times 25{\cdot}0 + 0{\cdot}25 \times 23{\cdot}1 \times 2)}{+ 25{\cdot}49 \times 2 \qquad + 25{\cdot}0 \qquad + 23{\cdot}1 \times 2} =$$

3·49′ freeboard from under-side deck, or 3′ 9″ freeboard from upper-side deck-plank, at lowest place for Trans-Atlantic voyages.

For long-course voyages, substituting $0{\cdot}307 \times H$ for B, for H = 35.300, and 0·46 in place of $0\ 307\ \frac{3}{2}$:—

$$x'' = \frac{\frac{0{\cdot}46 \times 35300}{19{\cdot}75} - (0{\cdot}6 \times 24{\cdot}35 \times 2 + 0{\cdot}15 \times 25{\cdot}5 +}{24{\cdot}35 \times 2 \qquad + 25{\cdot}5}$$

$$= 0$$

$$\frac{0 \times 25{\cdot}45 \times 2 + 0{\cdot}1 \times 25{\cdot}0 + 0{\cdot}25 \times 23{\cdot}1 \times 2)}{+ 25{\cdot}45 \times 2 \qquad + 25\ 0 \qquad + 23{\cdot}1 \times 2} =$$

3·95′ freeboard from under-side, or 4′ 2½″ freeboard to upper side of deck-plank at lowest place for long-course voyages.

The freeboards for the three different voyages, 3′ 3½″, 3′ 9″, and 4′ 2½″, show a difference of 5½″ between them, that is about $\frac{1}{7}$ part of 3′ 3½″. If, therefore, the freeboard for European voyages is calculated, that for Trans-Atlantic voyages is found by an increase of $\frac{1}{7}$; and for long-course voyages by an increase of $\frac{2}{7}$ on the first calculated freeboard, thus simplifying the process.

The freeboard as above calculated, is applicable to vessels whose length does not exceed five times the greatest internal breadth; ships of five to six breadths to length must have their freeboard increased $\frac{1}{12}$; of six to eight breadths to length, $\frac{1}{8}$; and still longer vessels by $\frac{1}{4}$ part of the original. Ships which carry a great number of passengers ought to have their freeboard increased $\frac{1}{8}$ part besides. Making allowance for more or less freeboard, on account of season, will not appear judicious, as it is frequently impossible to determine commencement and duration of voyages beforehand, especially for sailing vessels. If the length of vessel be greater than in the above-given example, more sections come into the admeasurement for tonnage and in calculations of freeboard, which will easily be understood.

As in this rule for determining freeboard, only those measures are applied which are already taken for tonnage measurement, the officials who are entrusted with that work may as well, with but little labour, calculate the height of freeboard, and the result be noted down on the certificate of tonnage. As every vessel keeps this certificate on board, there would in future arise no differences as regards overloading or loading too little.

The English measurement law will shortly be adoped by Germany, and it is to be hoped that all other maritime nations will soon follow. It would be of great benefit to the shipping interests in general if, besides this international tonnage law, there were a generally adopted rule for determining the freeboard of vessels. By this many law-suits and other difficulties would be avoided. On trial of the given rule, it will be found that in principle it will answer the intended purpose sufficiently, although the co-efficients may, perhaps, want some slight alteration. In ships of the same size of deck and the same depths, the freeboard will become proportionably reduced the sharper the vessel, and it will increase as her bulk or capacity increases—just as it ought to do.

There remains one difficulty to be mentioned. In vessels with double bottoms, or of cellular build, the measurement gives, in comparison to displacement, too small a gross tonnage under deck, consequently too little height of freeboard. In the admeasurement of such vessels, precautions should be taken to amend this fault.

ON THE ROLLING OF SHIPS.

By W. J. Macquorn Rankine, C.E., L.L.D., F.R.S.S. L. & E.

In the "Transactions of the Institution of Naval Architects for 1861," vol. ii., Mr. Froude gave the approximated expression for the rolling oscillations of a ship amongst the waves when the resistance to rolling is neglected. He showed that the angle of inclination of the ship at any instant consists of two parts, which may be called respectively the forced part and the free part. The forced part keeps time with the motion of the waves, and bears a constant proportion to the slope of the wave at the same instant, depending on the proportion borne by the periodic time of the rolling of the ship in still water to the periodic time of the waves. The free part has the same periodic time with that of the ship's rolling in still water; and its amplitude or extent is either wholly or partly independent of that of the wave motion.

Mr. Froude further shows that if we assume that the ship is at first upright and stationary, and that a wave suddenly begins to act upon her, a portion of the free part of her rolling oscillation will depend on the slope and period of that wave. The particular case which he fully investigates is that in which the sudden commencement of action takes place either at the crest or at the trough of a wave: being the two positions in which the effect of the suddenness of the action is greatest.

The objects of the present paper are, first, to show a general expression for the effect of suddenness of action, and then to consider whether, or in what manner, the free part of the rolling oscillation is to be taken into account in connection with questions as to the safety of ships with a limited range of stability.

Let t denote time, reckoned from an instant when the ship is on the crest or in the trough of a wave;

T_m, the periodic time of the wave-motion;

T_s, the periodic time of a double roll of the ship in smooth water.*

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* When the following equations are treated as approximately applicable to a ship whose periodic time depends on the extent of roll, the symbol T_s is to be understood to denote the periodic time corresponding to the greatest inclination of the ship relatively to the wave-surface.

Let Θ be the steepest slope of the waves;

θ_m, their slope at the instant t;

θ_s, the inclination of the ship to the horizon at the same instant;

A, a, arbitrary constants.

The following, in the above notation, is the expression of the results arrived at by Mr. Froude:—Slope of the wave surface,

$$\theta_m = \Theta \sin \frac{2 \pi t}{T_w} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (1.)$$

Inclination of the ship to the horizon,

$$\theta_s, = \frac{- \theta_w \, T_m{}^2}{T_s{}^2 - T_m{}^2} + A \sin \frac{2 \pi (t + a)}{T_s} \quad . \; . \; . \quad (2.)$$

Inclination of the ship to the wave-surface,

$$\theta_m - \theta_s = \frac{\theta_m \, T_s{}^2}{T_s{}^2 - T_m{}^2} - A \sin \frac{2 \pi (t + a)}{T_s} \; . \quad (3.)$$

Greatest inclination of the ship to the wave-surface,

$$(\theta_m - \theta_s) \text{ max.} = \frac{\Theta \, T_s{}^2}{T_s{}^2 - T_m{}^2} + A \quad . \; . \; . \quad (4.)$$

In the right-hand members of the equations 2, 3, and 4, the first term expresses the forced part of the ship's rolling, which keeps time with the motion of the waves; the second term expresses the free part, which is performed in her own natural period, and whose semi-amplitude is expressed by A.

The arbitrary constants A, a, may have any values; but if we make the assumption already mentioned, that the free part of the rolling originates in a sudden commencement of the action of the waves upon a ship that is previously upright and stationary, we obtain the following result:—

Let t_o denote the instant of which the sudden commencement of the action takes place.

$$\text{Make } \theta_s = 0, \text{ and } \frac{d \, \theta_s}{d \, t} = 0,$$

to express the upright and stationary condition of the ship. Then from equation 2 the following value of the semi-amplitude of the free part of the oscillation is easily deduced:—

$$A = \frac{\Theta \, T_m{}^2}{T_s{}^2 - T_m{}^2} \sqrt{\left\{ \sin^2 \frac{2 \pi t_o}{T_m} + \frac{T_s{}^2}{T_m{}^2} \cos^2 \frac{2 \pi t_o}{T_m} \right\}} \quad (5.)$$

Hence it follows that if we assume the sudden commencement of action already mentioned, the greatest inclination of the ship to the wave-surface is increased beyond what it would be if the forced oscillation existed alone in the proportion expressed as follows:—

$$1 + \frac{A \, (T_s{}^2 - T_m{}^2)}{\Theta \, T_s{}^2} = 1 + \sqrt{\left\{ \frac{T_m{}^4}{T_s{}^4} \sin^2 \frac{2 \pi t_o}{T_m} + \frac{T_m{}^2}{T_s{}^2} \cos^2 \frac{2 \pi t_o}{T_m} \right\}} \; . \; . \quad (6.)$$

In the case considered by Mr. Froude, the sudden commencement of action is assumed to take place at the crest or at the trough of a wave; and then we have $t_o = 0$; and the ratio given in equation 6 becomes

$$1 + \frac{T_m}{T_s} \quad . \; . \; . \; . \; . \; . \; . \quad (7.)$$

If we next assume that the sudden commencement of action takes place at that part of the wave surface where the slope is steepest, we have $t_o = \frac{\pi}{2}$; and the ratio in question becomes

$$1 + \frac{T_m{}^2}{T_s{}^2} \quad . \; . \; . \; . \; . \; . \; . \quad (8.)$$

In all intermediate parts of the wave-surface the ratio has intermediate values.

The reciprocal of the ratio expressed in equation 6 is, of course, the proportion in which the wave-slope required in order to produce a given maximum inclination of the ship is diminished if we assume a sudden commencement of action.

It must be observed, however, that the assumed suddenness of action never can take place in practice; and I am disposed to consider that the free part of the ship's rolling is due almost wholly to such causes as the action of the wind, or that of small waves superimposed upon the great waves, or want of uniformity in the great waves themselves; and that the only practical way of providing against the effect of the free part of the rolling is to allow a margin in the limiting angle of stability whose proper amount can be determined by experience alone.*

THE ELEMENTS OF DESIGN AFFECTING THE SAILING QUALITIES OF SHIPS, WITH SPECIAL REFERENCE TO THE SHIPS OF OUR NAVY.

By James G. Wildish, Esq., Member.

Experience has proved that the best position, on the whole, for the centre of pressure of the wind on the sails of a ship is that which allows her to have a slight tendency to fly up into the wind, when sailing with the wind before the beam. When this tendency exists, a perpendicular, drawn through the centre of pressure of the wind, must always fall to leeward of the line of the resultant force of the water meeting the ship's bottom.

When sailing with the wind before the beam, the course taken by a ship is necessarily at an angle with the line of her keel, her motion being produced by a force which drives her bodily to leeward, as well as ahead. This angle, which is technically termed the angle of leeway, depends on the form below water, and the bracing of the yards, but does not appear to vary with the velocity of the ship, or the velocity and direction of the wind. The resultant force of the water meeting the bottom varies in direction with every angle of leeway, and, owing to the imperfect state of our knowledge respecting the laws of fluid resistance, it cannot be ascertained by calculation, either as to direction or intensity. Hence the best horizontal position for the centre of pressure of the wind, which requires to be in a certain position with regard to the resultant force of the water on the bottom, also becomes indeterminable.

In order to ensure the centre of pressure of the wind being in the best horizontal position for sailing, in a new design it is usual to imitate the arrangements of sail existing in ships whose good qualities have been proved at sea. For several years past this imitation has been effected by arranging the sail plain so that a point on it, known as the centre of effort, which is taken as an approximation to the centre of pressure of the wind on the sails, shall be a certain distance before the centre of gravity of the immersed longitudinal section, usually called the centre of lateral resistance. Before about the year 1850, the centre of effort was referred to the middle of the length of the load water-line, measured from the rabbet of the stem to the aft-side of the post, and sometimes to the centre of buoyancy, its position with regard to the centre of lateral resistance being very seldom, if ever considered. But Mr. Fincham, in his revised "Treatise on Masting," published in 1854, gives two rules, said to be founded on experience, for determining the right position for the centre of effort, which take into consideration both the centre of buoyancy and the middle of the load water-line, as well as the centre of the lateral resistance. These rules may be expressed as follows:—

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* For example, in unmasted ships of the 'Devastation' class, rolling amongst waves of 1,000 feet long and 32 feet high, the angle of vanishing stability (about 43°) induces a "marginal angle" of 22° (Report of the Committee on Designs for Ships of War, 1871).

$$C = \frac{L\,(\frac{3}{4}\,a + \frac{2}{3}\,b)}{10\,(a + b)}, \text{ for square-rigged ships, and}$$

$$= \frac{L}{10\,(a + b)}, \text{ for cutters and fore-and-aft rigged ships,}$$

where C = the distance of the centre of effort before the centre of lateral resistance: L = the length of the load water line between the limits already stated; a = the distance of lateral resistance abaft the middle of the water line; and b = the distance of the centre of buoyancy before the said middle. These rules, however, are widely departed from in our most successful sailing steam-ships.

According to some early writers, the centre of effort requires to be placed further forward, as the fineness of form below water is increased, and also as the fore-body is made finer than the after-body. Dr. Woolley, however, in a paper read at the first meeting of this institution, expresses an opposite opinion, the correctness of which is borne out by experience.

In the old sailing ships of our navy, the centre of effort was usually situated about one-fourteenth of the length of the ship before the centre of lateral resistance; in the fast wooden steam-frigates, built before the armour-clads, and in the armour-clads, it is usually from one-twentieth to one-twentyfourth before; and in the steam-frigate *Inconstant*, whose form, especially forward, is much finer than any of the ships already referred to, it is only one-twentyeighth before.

To secure handiness under sail, in addition to the centre of effort being properly placed with regard to the resultant force of the water meeting the ship's bottom, it is also necessary that the masts should occupy certain positions with regard to the length of the ship, and that the amount of sail spread on them should be duly proportioned. Here, again, we are obliged to be guided by the arrangements existing in ships of known qualities. Table marked A gives the relative positions of the masts, measured at their intersection with the load water-line, as well as the proportion of the total surface of sail carried by them, in several of the steam frigates of our navy which have answered well under sail, with certain other particulars, in order to make these figures useful.

In the old sailing-ships the fore-mast was situated considerably further forward, and the mizen-mast further aft, than is usual in our steamships, especially in those of recent construction. The placing of these masts nearer amidships in these ships has been occasioned chiefly by the fineness of their form at the extremities, and it has been found specially desirable in cases of extreme fineness forward, like the *Inconstant*, that the fore-mast should be kept well out of the bow. A disadvantage, however, is incurred by moving the mast aft, as by so doing, the sail on it is rendered less effective for manœuvring, particularly when required to pay the ship's head off in wearing. To remedy this as much as possible, and secure at the same time a good balance of sail for keeping steadily on a course, it seems desirable, in all fine-bowed ships, that there should be considerable set by the stern.

Let me now call your attention to the effect of the fore and-aft position of the centre of gravity of a ship upon her sailing qualities, with respect to which much doubt appears to exist. In considering this matter, it must of course be remembered that, when there is no pitching and scending motion, and the wind pressure on the sails does not alter the trim, the centres of buoyancy and gravity are situated in the same vertical transverse plane, and also that, by moving the centre of buoyancy forward or aft, an alteration in form below water, and consequently of the direction of the resultant force of the water acting upon it is incurred.

In the sailing-ships, the centre of buoyancy was usually somewhat before the middle of the length of the load water-line. Chapman, the well-known Swedish naval architect, considered that this point should be from one-fiftieth to one-hundredth of the length of the load water-line before the middle; and in the competitive designs by Messrs. Read, Chatfield, and Creuze, it was made one-seventy-fifth.

The position assigned to the centre of buoyancy in the sailing-ships seems to have partly depended upon the designer's ideas respecting the relative fulness of the fore and after bodies best suited for securing speed. Great importance, however, was attached to the fore-and-aft position of the centre of gravity, as it affects the pitching and scending motions, and no doubt the consideration had much to do with the position assigned to the centre of buoyancy.

No notice seems to have been taken in the sailing-ships of the effect of the fore-and-aft position of the centre of gravity upon their handiness under sail. But a consideration of this kind was scarcely necessary in their case, as their shortness, the great and overlapping sail-power at their extremities, and the superior effectiveness of their rudder in turning, owing to the absence of a screw aperture, rendered their performances in this respect all that could be desired.

In the steam-ships of our navy, however, propelled by the screw, the centre of gravity and buoyancy have generally been very differently placed with regard to the middle of the load-line to what they were in the sailing-ships, and in the best examples they are as much abaft this point as, in the sailing-ships, they were before.

This change in the position of the centres of gravity and buoyancy in the steam-ships does not appear to have operated against their speed under sail, nor has it injuriously affected their pitching and scending motions. But I believe their tacking capabilities have been much improved, especially in the case of single screw-ships, by thus moving their centre of gravity aft.

In order to see how this is, we will consider the forces acting on a ship when performing this evolution. Before doing so, I will take a case, which, though hypothetical, will make the point I wish to show clearly more easily understood.

Referring to the diagram marked No. 1, let A B represent a ship sailing close-hauled, the yards being braced and the wind impinging on the sails as indicated. Suppose her to be carrying such a balance of sail that she has no tendency to turn up into the wind, and, for the sake of simplicity, disregard the action of the wind on her hull and her inclination from the upright.

We know that, under these circumstances, the resultant force of the wind on the sails, which we may suppose to act through the centre of effort C, in a direction at right angles to the plane of the sails when stretched flat between the yards, is balanced by an equal and opposite force, due to the resistance of the water on the ship's bottom. Call this resistance R, and the angle it makes with the line of the keel θ. Resolving R at right angles to the line of keel, we get R sin. θ, which force, so long as the ship keeps steadily on her course, must also be balanced by the force of the wind, resolved in the same manner.

Now, imagine the action of the wind to suddenly cease. The mechanical work accumulated in the ship will cause her to continue to move forward, and consequently R sin. θ will continue to act, at the first instant with the same intensity and through the same point, C, but afterwards with reduced effect, as the ship loses way, and through a different point in the line of keel, as the angle at which the water strikes the bottom of the ship becomes changed. This unbalanced force will produce rotary motion in the direction in which it acts, which, though combined with a motion of translation, we may consider as taking place round an axis passing through the centre of gravity of the ship, in the same manner as if this point did not move.

The velocity with which the ship commences to turn under these circumstances will be proportioned to the moment of R sin. θ, about the centre of gravity, divided by the moment of inertia of the ship; and this, *cæteris* *paribus*, will vary as the distance between the point C and the centre of gravity. If C were in the same vertical line with the centre of gravity, and the wind were to drop, as supposed, it is evident that the ship would continue on her course, without changing the direction of her keel, till she came to rest. We see also that if C were before the centre of gravity, the ship's head would turn towards the wind, with a velocity at the commencement proportioned to the distance between these two points; and that if C were abaft the centre of gravity, her head would turn away from the wind, her tendency being to take up a position in which her keel is in a line with her course.

After the ship has commenced to turn towards the wind, as supposed, it is impossible to tell the point where R sin. θ crosses the line of keel; it may travel forward of the point C, during the earlier part of the evolution, and afterwards abaft it, as the water impinges more directly on the after body. But all the while it keeps the centre of gravity, the force R sin. θ assists in turning the ship, and when it gets abaft the centre of gravity, R sin. θ retards the turning motion.

Now let us consider the actual case of tacking. This evolution, as I understand it, is commenced by putting the helm down, or a lee, hauling the spanker boom amidships, and easing off the head-sheets. But after the ship, yielding to these altered conditions, turns through a few degrees, the sails are no longer of any avail in maintaining headway, nor do they appear to be of any further assistance in turning, till the ship gets sufficiently round on the opposite tack to enable them to draw. The only forces, therefore, available for carrying on the evolution, after the ship has turned through a few degrees, are the action of the water on the rudder and the lateral resistance of the water on the ship's bottom, of which I have just been speaking. With regard to the action of the water on the rudder, in the handiest single screw-ships it is found that after the tiller is put down and the ship has commenced to turn, there is little or no strain upon the tiller, showing that the rudder is doing little or no work in turning the ship; and it is also found that, when the action of the rudder is required to any extent, the ship is slow and doubtful in tacking.

I think this view of the matter justifies the conclusion that the centre of gravity of a ship is a point of importance as regards the question of handiness under sail. I believe the moving of this point aft, as carried out in our finest sailing steam-ships, has materially improved their tacking capabilities, especially in the case of the single screw-ships, which, owing to the water rushing through their aperture from the lee side, and disturbing the action on the rudder on the weather side, have to trust largely to other means than their rudder when turning under sail.

It should be noticed here that, in arranging a ship so that the centre of gravity and centre of effort, or, more correctly speaking, the resultant lateral pressure of the water on the bottom, shall be in a certain position with regard to each other, the moment the inertia of the ship and the effectiveness of the rudder become variable. But these variations are unimportant, and need not be considered. In the most successful of the wooden screw-frigates, built before the armour-clads, the centre of gravity was but a very little before the centre of gravity of the vertical longitudinal plane, without the rudder.

As an example bearing negative testimony to the view I have taken with regard to the effect of the fore-and-aft position of the centre of gravity of ships upon their handiness under sail, I may instance the *Rattler*, which, it may be remarked, was the first ship in our navy fitted with the screw-propeller. This ship was not designed to carry a screw, but was afterwards lengthened out at the stern, and so fitted. Her centre of gravity appears to have been unusually far forward, in fact, considerably before where the centre of effort ought to have been, and when her sailing qualities were tried they proved very inferior indeed. To remedy this, no less than six successive alterations were afterwards made, but they did not succeed, and, as I believe, simply because of the extreme forward position of her centre of gravity. I have ventured to give somewhat careful expression to my views respecting the effect of the fore-and-aft position of the centre of gravity of a ship upon her sailing qualities, because it is by no means uncommon now to altogether disregard the position of this point when considering the elements of design affecting a ship's sailing. I need scarcely add that, being unable to "hand, reef, or steer" myself, my ideas of this matter may be imperfect, and if they are so, I shall be most happy to receive correction.

But to continue, let me now refer to the height of the transverse metacentre. The height of this point in relation to the load water-line in our modern steam-ships differs greatly from what it was in the old sailing-ships. In the sailing line-of-battle ships and frigates designed by Sir W. Symonds, the load-draught position of this point ranged from 9½ to 8½ feet above the load waterline, and in the corvettes and brigs from 7 to 5½ feet above. In the old class of 74-gun ships, it was about five feet above the load-line, and in the *Canopus*, the celebrated line-of-battle ship taken from the French in 1798, it was 5·4 feet above. In our modern steam-ships, the load-draught metacentre is generally about two feet above the load waterline, the reduction in its height in these ships being caused chiefly by the increase in their proportionate displacement, and the change in their form of section required to enable them to carry their machinery as low down as possible.

It will not of course be understood here that I am attempting to define the transverse stability, which, as far as the metacentre is concerned, varies as the height of this point above the centre of gravity, and not according to its position with regard to the load line. It is well, however, to have an idea of the height above the load line, of the transverse metacentre, as it helps one in judging of a ship's exterior form below water.

Great difference also exists in the metacentric height in our modern steam-ships compared with the sailing ships. There are, I believe, only three instances on record in which this height in sailing-ships has been found by experiment. Two of these were brigs (the *Rover* and *Scylla*), and their metacentre height cannot be taken as representative of what is usual in ships of larger type. I find by calculation, however, that for the sailing line-of-battle ships and frigates to have even equalled in power to stand up under their sail, the modern ships of our navy, in which this quality is least prominent, their metacentric height must have been at least six feet, and the probability is that in the stiff ships it often exceeded eight feet. In our modern steam-ships the metacentric height is usually about three feet.

The transverse stability, however, of our modern steam-ships, compared with the sailing-ships, has not been reduced in the same proportion as their metacentric height. The power to resist inclination from the upright varies, of course, as the metacentric height multiplied by the displacement, and this latter being much greater in proportion in our modern steam-ships than in the sailing-ships, makes up, to a large extent, for the loss of stability which would otherwise result from the reduction in their metacentric height.

A word or two may not be out of place here as to the cause which has led to the metacentric height in our modern steam-ships being so much reduced. This appears to have been mainly brought about by the necessity for securing steadiness or immunity from quick and uneasy rolling when not under sail. It has been foreseen that naval battles between steam-ships must, as a rule, be fought with bare poles; and at such times, owing to the reduction in number and increase in power of the guns, steadiness of gun platform would be a most important desideratum. The great metacentric height in the sailing-ships was not so objectionable, as the steadying effect of their sail, to a very great extent, counteracted any tendency to quick and uneasy rolling. But the case is very different with steam-ships, which, on the most important occasions of naval warfare, would be deficient of this steadying power.

The experience with our armour-clads has taught us much in regard to this matter. The metacentric height in the *Warrior* was 4·6 feet when laden, but she proved to be too stiff; and in the *Achilles*, and other ships built afterwards, very great improvement was effected by reducing the metacentric height to about three feet. The *Prince Consort* is the stiffest armour-clad in our navy, and, as might be supposed, she rolls very deeply and quickly.

This reduction in the metacentric height in our modern steam-ships has to some extent limited their power of carrying sail; and until means are devised by which increased stiffness may be associated with the necessary steadiness when not under sail, it appears unadvisable to attempt to provide such ships with a larger spread of sail than is now usually carried. The extended use of bulge keels, however, may effect this object.

As some misunderstanding exists as to the vertical position of the centre of gravity of ships with regard to the load-line, it may be well to make brief reference to it. There is little doubt that, notwithstanding the heavy top-weights carried by the ships of our navy of modern build, their centre of gravity is lower in relation to the load-line than in the sailing-ships. I have already pointed out that the metacentric height in the larger classes of the sailing ships might exceed eight feet; but even supposing it were nine feet, the centre of gravity, in many cases I am aware of, would still be above the load-line. In our modern steam-ships, the centre of gravity is usually between one and two feet below the load-line, and the cause of its being so low is, that their heavy top-weights are more than balanced by the weights of machinery, &c., carried low down in the hold.

It may also be noticed that extreme accuracy in estimating the vertical position of the centre of gravity is much more necessary in our modern steam-ships than it was in the sailing ships, and this adds much to the difficulty of designing. This arises from the fact, already stated, of the sailing ships having great metacentric height and small displacement, compared with our modern steam-ships. An error of six inches in estimating the height of the centre of gravity of the case of the steam-ships would affect their stability as much as an error of a foot or 18 inches in the case of the sailing ships.

Passing, however, from considerations of this kind, let me in the next place refer you to the power of a ship to stand up under the side-pressure of her canvas. The recent loss of one of our large armour-clad ships has brought this question into melancholy notoriety, and the necessity for grasping the facts in connection with it has been shown in a manner which, though sad, has one redeeming feature of being effectual.

The fallacy fallen into by some persons of judging of the capabilities of low free-board ships to stand up under sail pressure by their metacentric height, has been placed beyond controversy; and the misleading character of comparisons made between the metacentric height of ships of high and low free-board, it is to be hoped, has been sufficiently demonstrated.

I do not presume to enter upon the difficult question as to the amount and range of stability necessary to enable a ship to stand up satisfactorily under her sail; or to discuss the matter as it affects high and low free-board ships, which latter has already been considered at former meetings of this institution. A few remarks, however, may not be out of place here, as to the various ways in which the power to stand up under sail in different ships may be compared.

In drawing comparisons of this kind, *i.e.*, between the high-sided ships in our navy, it has been usual for some time to obtain a measure of efficiency for each ship, by dividing the displacement in pounds, multiplied by the metacentric height in feet, by the moment of the sail in feet, about the centre of lateral resistance. The number so found of course represents the initial power of a ship to resist the inclining force of the wind on the sails, and, in most cases, has been found to range between 15 and 25, when the ship is at her load draught.

For comparisons at finite angles of inclination, recourse is had to what is known as the curve of stability. Though well-known to many present, let me remind you that the curve is prepared by calculating the horizontal distance between the centres of buoyancy and gravity at different angles of heel; setting these distances out as ordinates, at right angles to a straight line from points in it, graduated according to the angles at which the calculations are made, and passing a curve through the extremities of these ordinates. The area enclosed by this curve, the base line and any ordinate is proportional to the work done in heeling the ship over to the angle corresponding to the ordinate; and any ordinate, multiplied by the displacement, represents the righting moment, or the moment necessary to be applied to hold the ship at the inclination corresponding to the ordinate.

The curve of stability, however, does not afford a direct comparison between one ship and another as so the power of standing up under sail; but with the information it furnishes, we are able to prepare curves which do graphically represent the capabilities of ships in this respect. Diagram marked No. 2 shows two sets of such curves for the ships named thereon, together with their curves of stability. Those in black have their ordinates proportional to the righting moments, as calculated at the different angles of inclination, and they illustrate graphically the absolute power of the ships to carry sail; those in red have their ordinates proportional to the ratio of these moments to the corresponding moments of the wind pressure on the sails, and they illustrate graphically the power of the ships to stand up under the sail they actually carry. The curves of stability are shown in blue lines, and are furnished for purposes of comparison. In preparing the curves in which the pressure of the wind on the sails is involved, this pressure has been supposed to vary with the angle of heel, and, instead of assuming this variation to be in proportion to the sine squared, or the sine of the angle of incidence, I have preferred to use the data furnished by the experiments with regard to the oblique impulses of fluids made at the Academy of Paris. It should also be noticed that the effect of the wind on the hull, and the alteration in the angle of incidence of the wind on the sails, due to the rake of the masts, and the more or less transverse position of the yards, have been neglected.

Leaving these curves for a moment, it may be interesting to show the difference resulting in the estimated pressure of the wind on the sails, at various angles of heel, by assuming it to vary, first, as the $(\text{sine})^2$ of the angle of incidence; second, as the sine of that angle; and last, according to the experimental data just referred to. Diagram marked No. 3 shows three curves, the ordinates of which illustrate this difference; and it will be observed that, accepting the curve obtained from the experimental data as correct, the others are considerably in error. We see that the curve, the ordinates of which vary as the sine of the angle of incidence, differs materially throughout from that based upon the experiments; and also that the curve, the ordinates of which vary as the $(\text{sine})^2$ of that angle, though agreeing with the experimental curves for angles of incidence varying from 90 to 60 degrees, differs very greatly from it as these angles are further reduced.

With regard to these curves, it may be mentioned that the investigations of the various problems connected with sailing, made by the early philosophers, were based upon the assumption that the resistance of fluids varied as the $(\text{sine})^2$ of the angle of incidence; and it was chiefly owing to the results of these investigations, differing greatly from experience, that the experiments referred to were instituted. They did not clear up the difficulty satisfactorily, but they brought to light the main cause of the difference which had been found to exist between theory and experience; and it would appear that the curve I have deduced from them is much more reliable than those based upon the other assumptions. It should be noticed also, that since the moment of sail is divided into the moment of stability, in order to obtain the curves in red in No. 2 diagram, the ships are represented less favourably at large angles of inclination than would be the case if the pressure of the wind on the sails had been supposed to vary as the $(\text{sine})^2$ of the angle of incidence; and consequently, if there is any error involved by using the experimental data, it is in the direction of safety.

Referring again to the curves in No. 2 diagram, showing the absolute power of the ships to carry sail, supposing we know the steady heel, and the area of sail producing it, in any one case, to find approximately the area of sail which would produce the same angle of heel in either of the others under the same circumstances, we have the following:—Let a = the area of sail, and b_1 the ordinate representing the righting moment at the known angle of heel for one of the ships; and let b be the corresponding ordinate for either of the others, and ψ her area of sail. Then,

$$\psi = a\left(\frac{b_1}{b}\right)^{\frac{2}{3}}.$$

This formula would be exactly true if the centre of effort were similarly situated with regard to the centre of lateral resistance in the two ships.

Referring to the curves in red, showing the relative power of the ships to stand up under their sail, if we know the steady heel in any one case, we can find at once, from these curves, what it will be in all the others under the same circumstances. To do this, set up an ordinate corresponding to the angle of heel, and through the point where it intersects the curve for the ship whose heel is known draw a horizontal line; square down the points where this line intersects the curves for the other ships, and the required angles of inclination may be read off on the base line. Again, suppose we know the steady heel, we can also tell at once from these curves what angles the ships may be rolled over to, either by a sudden gust of wind, or by the heave of the sea, before they would be liable to be blown completely over by the steady pressure of the wind. To do this, set up an ordinate, as before, corresponding to the steady angle of heel, and through the points where this ordinate cuts the curves draw horizontal lines; the points where these lines again cut the corresponding curves, squared down on to the base line, will give the limiting angles of heel required. It should be further noticed with regard to the curves in red, that their ordinates only are comparable; their areas do not represent the work done in heeling the ship over to different angles, as in the case of the other curves, and they cannot be so compared.

In the last place, let me notice, very briefly, the manner of comparing the sailing qualities of ships, as to their driving power and speed. In forming an estimate of the driving power, the practice now is to compare the ratios of the area of sail to the area of midship section; and the ratios of the area of sail to the two-thirds power of the displacement. These comparisons are, of course, based upon the assumption that the wind pressure on the sails varies directly with their area; and that the resistance offered by the water to similar ships varies as the area of their midship section, and the two-thirds power of their displacement. But in judging of the speed under sail, the square roots of these ratios have to be compared, and it is also necessary to take into consideration the form below water, as well as the variation in the apparent velocity and direction of the wind at different speeds.

Suppose A, A^1, are two ships, their area of sail being represented by a, a^1, their area of midship section by m m^1, and their displacement by d, d^1. Then, if the apparent velocity and direction of the wind remain constant,

$$\text{for A, speed} = C\sqrt{\frac{a}{m}} = C_{,}\sqrt{\frac{a}{(d)^{\frac{2}{3}}}},$$

and similarly,

$$\text{for A}^1\text{, speed}^1 = C^1\sqrt{\frac{a^1}{m^1}} = C^1_{,}\sqrt{\frac{a^1}{(d^1)^{\frac{2}{3}}}},$$

the values of C $C_{,}$ C^1 $C^1_{,}$ depending upon the form below water. If the ships were similar, C would equal C^1, and $C_{,}$ $C^1_{,}$ and knowing their value in one case, we could estimate the speed in the other, in a similar manner to that adopted in estimating the speed under steam.

If we assume that a ship is able to vary her amount of sail, so as to make up for the variation in the absolute impulse of the wind on her sails resulting from the variation in her speed, we may fairly use these formulæ in estimating the speed of one ship from another of practically similar form, or in comparing the capabilities of such ships in this respect. But unless this assumption is made, the speed under sail becomes very difficult to estimate or compare, owing to the variation in the apparent force and direction of the wind, at different speeds, and the modification in the bracing of the yards which it makes necessary. The formulæ are, of course, most reliable when the ships are sailing with the wind abaft the beam, and there is no great variation in their speed.

SUGGESTIONS FOR IMPROVED DISPOSAL OF LIGHTS IN SHIPS.

By M. Cole, Esq.

The want of a better system of light for indicating the heading of a ship is obvious from the many and repeated collisions taking place at sea. It is almost sufficient to remark that not only are lights insufficient as to strength, but that if seen they do not give a true indication of a ship's position as to the terms "end on" and "nearly end on," for although upon the present disposition of lights, light may be obliterated, yet two ships are often found to be steering in each other's line of keel, which error arises from the magnitude and length of the screen, ship's sides not being of sufficient and exact definition to give a more minute return for ship's steerage.

I would therefore suggest split lights at the mast-head, white for starboard, red for port, with three-feet screen dividing the same, and taking with ship's entrance a fixture, this screen to be set over the cross-trees, which, with "roach" in top-sail, gives plenty of space for screen with reflectors thereon, and lights on each side, set at about fifteen inches from focus to focus. On this disposal of lights, at one point only of variation of compass is the one light shut off, and the smallest deviation of ship's head is arrived at by two ships meeting.

I here produce full-length design, so presenting such screen and lights; and it will be seen that by the deviation of one point of compass, such deviation is at once seen from the deck of ships meeting.

This design offers:—

1. Double light, and that at the mast-head, with reflectors on screen.
2. Concentrated observation.
3. More minute indication as to ship's steerage.
4. And, finally, what has been wanted since the creation of ships, a storm or blaze of two colours in lights on reflectors, at the mast-head of all ships, with hand-post in line with bowsprit end, to point out "ship's line of keel."

DESIGN FOR THE SAVING OF LIFE AND VALUABLES IN SHIPS.

By M. Cole, Esq.

Many contrivances have from time to time appeared for saving life in shipwreck at sea, but few have included the saving of ships' property or valuables. This design, offered in model two inches to the foot, representing buoy of six feet in diameter, and of tonnage, 2 tons, 15 cwt., 56 lbs., is divided into four compartments, with iron doors to each, ring-bolts round head of buoy for life-line, and foot or knee projection round half section, together with fast rope or line for holding on. The lower compartments are charged with ships' valuables, and ballasted, if necessary, with limber lead ballast; the top compartments are for provisions. Flag-staff and flag, self-acting if necessary, is given, besides revolving-cap, which may be shifted when flag-staff rises and flag unfurls. This buoy is set over iron cone, which stands a foot above buoy when shipped, and a plug over will make all secure, and a buoy cannot be unshipped except on ship foundering. This design is set in front of mizenmast, on a low cup or basement, and occupies comparatively no more of space on a ship's deck than a cricket ball would do in a man's drawing-room, and on ship foundering is always to be found on the surface of the water. It "holds its own" in the run of a sea-way, and so facilitates holding on. It may be seen at from two to four miles of distance, and from its rotundity cannot foul rigging on the rise, nor is it influenced by suction from cylinder passing through its centre. Two such buoys, of 20 feet in diameter, and of 200 tons of buoyancy, would have saved the *Captain's* crew; and if brought into use will yet save many a crew of our iron-clads that fail for want of vertical stability, or, in other words, bearing it to the surface, vertical and lateral.

The proceedings of the Institution will be continued this day (Friday) and to-morrow. The papers read will be given in next week's *Journal.*

THE SUEZ CANAL.—INCREASE OF TRANSIT-DUES.

The Council of the Suez Canal Company has just published a report, in the preamble of which it is stated that foreign opponents have become the best clients, the most earnest defenders of the company. Attempts are made in France itself to sow dissension amongst the earliest associates of the scheme. To meet this animosity by a statement of facts, the present report is presented to the Council at an earlier period than usual.

As regards the asserted offer of sale of the canal, the report states that certain governments had the idea of making arrangements amongst themselves to propose for the purchase; and that should such proposition be made it would be submitted to the proprietory of the canal.

The report goes on to say that the bed of the canal, from the head of the jetties of Port Saïd to the roads of Suez has now an average depth of 8½ mètres, and that the experience of two years shows that the cost of maintenance of the canal proper may be set down at 825.000 francs annually for every 500,000 cubic mètres. The total cost of the regular service, including employés, shops, and warehouses, has been reduced to 1,800,000 francs.

The transit and receipts are given as follows:—

	Vessels.		Tonnage.		Francs.
1870..............	486	..	435,911	..	5.159,327
1871..............	765	..	761,497	..	8,993,732
1872 (Jan. and Feb.)	200	..	214,506	..	2,517,504

Every day brings new elements of traffic; and nothing prevents a still more rapid growth but the insufficiency of the means of building steamers demanded by commerce.

All doubts respecting the transit of large vessels are declared to have been removed, and the following facts are quoted to show that such is the truth:—All the great English transports of 3,000 tons, and one of them having on board 1,421 men, passed without hindrance. And amongst commercial vessels may be named the *Nebraska*, of 2,988 tons. *Pei-ho*, of the Messageries Françaises, of 1890 tons, passed from one sea to the other in 13 hours 48 minutes of actual time, and the *Persia*, Italian packet, in 12 hours 49 minutes.

As to depth, the *Nebraska* made the transit with a draught of 7·21 mètres.

These facts, says the report, have removed all apprehension, and the largest commercial vessels can, without hesitation, pass to the seas of Asia by the canal. In support of this, a quotation is given from Messrs. Möller and Co's. circular, of the 3rd of January, in which it is said that, after a long struggle, steam has carried the day against sails, and the extraordinary success of the new route to the East by the Suez Canal has not only created a complete fleet for this important trade, but threatens to monopolise the entire traffic.

On the 20th of July last the total number of ships loading and on the way to or by the canal, amounted to 176 vessels; on the 10th March, in the present year, a similar account gives the total of 325 vessels. Ships which have passed the canal and are intended to return by it, being included in the above totals.

The land, which is the joint property of the Khedive and the company, is said to be rapidly increasing in value, and destined to become much more valuable; and while the society is careful not to injure its interests by too rapid sales, and therefore has refused many offers made, it favours the establishment of governmental agencies, navigation companies, consignees, merchants, and coal depôts, at Port Saïd and on the canal.

The financial portion of the report opens with the important announcement, that the council has only issued twelve out of the twenty millions of francs of the loan voted in July last, the remainder of the shares being in its own possession. The total receipt for the year 1871 amounted to 18,500,000 fr., and the actual expenses to less than 16,000,0000 fr., leaving a clear balance in favour of the company of 2,230,000 fr. on the 12 months.

The effect of the above result is that the payment of the coupons on the obligations, which was suspended, is to be resumed next month.

The remainder of the report is occupied with a long review of the tonnage question with respect to the canal dues. The terms of the original concession to the company fixed the transit charge at a maximum of ten francs per ton, and in 1861 the question of the tonneau-type, or method of taking the tonnage, was submitted to a commission, which gave it as its opinion that, pending an international arrangement for a uniform tonnage, it should be taken as it stood on the ship's papers in all cases; and the council acted on the recommendation. The papers of English ships were then the only ones which gave the gross tonnage and the register, which corresponds with the official tonnage of other nations; the latter, that is to say the registered tonnage, was then adopted, "conformably to the principles of equality of the flags of all nations." The council, however, as it plainly states, began to inquire if it could not obtain more money without departing from the spirit and the letter of its contracts, and without interfering with the growth of transit across the isthmus, and while Paris was besieged, an inquiry was being made into the matter, and, finally, in August last a commission was appointed to report upon the subject. This commission included three admirals and a retired naval officer, a naval constructor, a hydrographer, several inspectors general and engineers of ponts-et-chaussés and mines, and three or four officials. The commission took the advice of chambers of commerce and of other bodies, as well as of merchants and others.

One of the results of this inquiry was that the adoption of the system known as cubic measurement would increase the tonnage from 100 to 400, and close the canal against navigation. Another was that, in the words of the report, "From a comparison of the official English tonnage with that of other nations whose ships passed the canal in 1871, it results that an increase of at least 40 per cent. may be made in the transit dues." The commission argues that the company has the right to change the mode of calculation for three reasons, viz.—"That there is want of uniformity amongst nations; tha the various governments have successively modified their methods; and that the company has the right to establish a real tonnage type from the official tonnage of the nation which furnishes the largest number of vessels to the transit of the canal, and whose method has been adopted, in fact or in principle, by the chief maritime powers, France included."

The council of the society, acting on the advice of the commission, and considering, amongst other things, that "the gross tonnage of English vessels depends solely on the total capacity of the ship," and "that the British flag represents seven-tenths of the total navigation of the canal," has decided that, after the 1st of July, 1872, "The gross tonnage inscribed in the papers of vessels guaged according the English method now in use shall be taken as the basis of charge," and the tonnage of the vessels of other nations are to be reduced to the same standard, either by reference to the calculations of the International Commission of the Lower Danube, or by actual measurement by the society's officers after the English method.

In adopting as a basis for the transit dues the mode above indicated, the company does not renounce the right in the future of adopting any such new mode of measurement as may present the advantage of greater precision.

This decision of the council was arrived at on the 4th of the present month, and was adopted at the general meeting of the company, held in Paris on the 12th inst.

GENERAL NOTES.

Patent Pavement Lights.—In Hayward's patent light the reflecting face of each glass is placed at an angle so as to send the rays of light into the basement, in a direct line from the front, obviating the objection to the ordinary pavement light, that only part radiates inwards, as the rays are dispersed equally in all directions. The cast-iron frame of Hayward's light is composed of hexagonal recesses, into which the lenses are set, the surface of the glass being below the upper edges of the iron net-work.

Petroleum.—The production of the United States during 1871 was 5,755,057 barrels, or a daily average of 15,767 barrels. The stock on 1st January, 1872, was 568,858, against 585,868 barrels on 1st January, 1871. The average price for the year along the creek was 4 dollars 40 cents per barrel of 43 gallons, or an aggregate value of 25,358,699 dollars. The total export from the United States is 155,613,064 gallons, crude, refined, and naphtha, divided as follows:—

	Barrels.
From New York	2,852,008
„ Boston	68,547
„ Philadelphia	1,795,242
„ Baltimore	84,463
Total	4,800,260

The total expenditure of the wells in 1871 was 15,801,028 dollars, or an average cost of 2 dollars 66 cents per barrel. The area of a rectangle, which will embrace all the territory of the Pennsylvania oil region from which oil has yet been obtained, was about 2,000 square miles, but the whole number of acres that have yet produced oil does not exceed 6,500, equal to ten square miles, or the one-hundredth part of what is known as the oil region. Of the production of petroleum during the earlier years of the development of the country little or no record was kept, but it is estimated that the production previous to 1871 (about ten years) was about 33,500,000 barrels.

Lighting by Electricity.—The street lamps of Göttingen were lit simultaneously, for the first time, on Saturday, the 16th instant, by electricity.

Music in Cathedrals and Parish Churches.—The following is an extract from an essay, "The Education of Choristers in Cathedrals," by Sir Frederick A. G. Ouseley, Bart. (pp. 218, 219, "Essays on Cathedrals," John Murray, 1872):—"In the matter of music, as in many other things, the cathedrals should set an example to the parish churches, and it would not be amiss if prizes and exhibitions could be founded in connection with every choristers' school for musical proficiency and vocal talent, which all musical boys in the various middle or grammar schools in the diocese should be invited to come and compete for. In the event of their success, they would have the option of joining the cathedral choir and obtaining the concurrent advantage of free admission to the grammar school attached thereto. By some such machinery, the knowledge and practice of music, and especially of church music, might be widely spread, and a very extensive range of educational benefits conferred; and, reciprocally, the various middle schools and grammar schools of the diocese might co-operate advantageously with the cathedral choir, if they were furnished with endowments of prizes and exhibitions for which former cathedral choristers might be admitted to compete, when the breaking of their voices necessitated their departure from the choir. By some such co-operative system of musical and educational intercourse between the cathedrals and the various schools in the neighbourhood, the choral establishments of each diocese might acquire a wide-spread influence of a most beneficial kind, and a great impetus would be given to the cultivation of musical ability in the rising generation. As to the best system of choral training, it may not be out of place to observe that it should be of a somewhat varied and extensive kind. It ought to comprise—1st, the development of the voice, to the proper use of it; 2ndly, the habit of accurate performance at first sight; 3rdly, a knowledge of the rudiments of music, sufficient to qualify every chorister to pass creditably such an examination in that subject as is given in the local or non-gremial examinations at Oxford and Cambridge; 4thly, the requirement of a moderate proficiency on some musical instrument, preferably the pianoforte, the organ, or the violin. An hour (or at most an hour and a-half) every day ought to suffice for the above purposes, *if the most is made of the time.* If, however, a boy intends to follow music as his profession in after-life, of course much more time should be allotted to musical studies than in another case.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

March 27th.—*Passion Week.*—No Meeting.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon. ....Geographical, 8½.
Actuaries, 7.
Medical, 8.
London Institution, 4.
Social Science Association, 8. Dr. Haviland, "The Geographical Distribution of Typhoid and other Fevers in England and Wales illustrated by coloured maps."

Tues. ...Medical and Chicurgical, 8½.
Civil Engineers, 8. Discussion, "On the Economy of Fuel in the Blast Furnace for Smelting Iron."

Wed.....Royal Society of Literature, 8½.

Thurs...Philosophical Club, 6.

Sat.......Royal School of Mines. Swiney Lecture. Dr. Cobbold, "On Geology."

Journal of the Society of Arts.

No. 1,010. Vol. XX.

FRIDAY, MARCH 29, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

EXAMINATIONS, 1872.

The days fixed for the Final Examinations this year are April 16th, 17th, 18th, and 19th. The necessary forms for making the return of intending candidates have been issued to those Institutions which have already applied for them. Any Institutions having candidates for these examinations, and which have not yet applied for forms, should communicate with the Secretary of the Society of Arts immediately. Programmes of examinations can be had gratis on application.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

The Council invite members of the Society to forward to the Secretary, on or before the 29th of April, the names of such men of high distinction as they may think worthy of this honour.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscriptions paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society. (See notice on page 380.)

BARRY'S ETCHINGS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, are about to have a limited number of sets of the 29 plates etched by the late James Barry, printed. The impressions will be taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary not later than the 30th inst. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, will be £10 10s.

MOSCOW POLYTECHNIC EXHIBITION, 1872.

The Committee of the above Exhibition are desirous of forming, for reference in Moscow, a collection of catalogues or price lists of makers of machines and tools of all kinds, and of mathematical instruments. Parties willing to assist are requested to send at once to the Secretaries of the London Committee for the Moscow Exhibition, now sitting at the Society of Arts, Adelphi, London, two copies of each such catalogue or list (illustrated preferred), and the same will be forwarded to Moscow, free of expense.

Members of the Society are requested to give publicity to this notice, as it is very desirable to render the collection as complete as possible.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Season ticket holders will be invited to a reception that will be held by his Royal Highness the Duke of Edinburgh and her Majesty's Commissioners previous to the official opening of the Exhibition. The Albert Hall, the Conservatory of the Royal Horticultural Society, and the picture galleries of the Exhibition, will be thrown open, and military bands will play.

His Royal Highness the Duke of Edinburgh presided, on Tuesday, at the Royal Albert Hall, over a meeting of the General Purposes Committee appointed by her Majesty's Commissioners for the Exhibition of 1851 to carry out the current series of annual international exhibitions. There were present Mr. Bruce, Sir Francis Sandford, Mr. Bowring, Mr. Cole, Mr. Gibson, Mr. Thring, and General Scott (secretary).

ROYAL ALBERT HALL.

A general meeting of the corporation of the Albert Hall was held on Monday, in the East Lecture-theatre of the Hall, under the presidency of **His Royal Highness the Duke of Edinburgh**, who was supported by Lord Faversham, Lord Clarence Paget, Lord Sydney, and the members of the Provisional Committee.

In opening the proceedings, **His Royal Highness** spoke as follows:—My brother, the Prince of Wales, who is the President of the Provisional Committee of the Royal Albert Hall, being, to my regret, unavoidably absent, it is my duty and my pleasure, as a member of that committee, and as chairman of the Executive Committee, to lay before this meeting the draught of a new constitution for its government. It was provided in the Royal Charter that this should be laid before you within 12 months of its opening, which ceremony was performed by Her Majesty on the 29th of March last year. I have also to present a report which has been drawn up, embodying all that has been done in connection with the Hall since the commencement of the undertaking, together with a detailed account of the receipts and expenditure, as well as of the performances and prospects of the Hall, and it is our duty in so giving an account of our stewardship to resign our offices into the hands of the Corporation of Seatholders. The draught of the new constitution has been sent to every seatholder, to enable all to be acquainted with its details before the meeting. I shall, therefore, propose that the constitution be taken as read, and General Scott, the Secretary of the Committee, will now read the report previous to the discussion of the two documents by the meeting. In bringing forward this motion, however, I hope you will not think it out of place if I make a few remarks upon the commencement of this undertaking, and what led to it, as well as its past, present, and future. We all remember the Great Exhibition of 1851, which stood close to where we are now assembled. That Exhibition, the first of an International character, was mainly due to the untiring exertions of my lamented father, whose heart and soul were in the work of furthering art and science for the benefit of the whole human race, ably assisted by gentlemen of various professions and occupations. As we all know, this Exhibition had the greatest possible success; and many others of a similar character have followed it, not only in this country, but in others, with favourable results. The Commissioners for the Great Exhibition of 1851, at the close of the season, found themselves in the possession of a very large surplus, about £180,000, which by a Charter from the Queen was intrusted to those Commissioners, who thus became a permanent Commission. With a portion of this fund was purchased the estate of Kensington Gore, for the continued furtherance of science and art. The Exhibition of 1862 stood upon this estate, the Horticultural Gardens form the centre of it, and the present Annual Exhibitions are held in buildings, more or less permanent, standing upon it. When it was decided that the national memorial to my dear father should be erected upon the site of the Exhibition of 1851, a proposal was set on foot for establishing a hall for science and art to be called after his name, facing the memorial, forming an integral part of it, and intended to give, as it were, life to the whole, by the encouragement of objects to which he had been so much attached. The land, a portion of the Kensington Gore estate, upon which the hall has been erected, was granted by the Commissioners. This hall can therefore, to certain extent, be considered as a national undertaking, and, as far as it is concerned, the corporation may be considered to represent the nation. Of course, the individual seatholder is entitled to consider his interest as a pecuniary one; but the corporation, as a body, should take a large and expansive view of the institution, and maintain it in a manner worthy of the magnitude of the undertaking and the importance of its objects. Now, the principal objects of this meeting are to place the Hall on a sound basis—one of self-support, with a prospect of just sufficient gain to ensure maintenance and gradual improvements—and to decide upon its future mode of government. The results of the first season will decidedly show that it has thus far succeeded, while its usefulness and attractions are constantly increasing, and the Hall is more and more appreciated by the public. The Executive Committee have done all in their power to promote this improvement, and have commenced the formation of societies in connection with the hall. Engagements have been formed for about forty concerts between the present time and the end of the season, which will be two very interesting series. 1st, a series of penny concerts for the working classes; and, second, a series of eighteen concerts, in connection with which the Royal Albert Choral Society has been organised, comprising more than 1,000 picked voices, who will sing principally without accompaniment—a new feature in music in this country—and I think the society is likely to be very successful. A movement also to form a national training school for music is in active progress, as well as the formation of a society of amateur instrumentalists from all classes of society. Though this is merely a matter of recreation, it cannot fail to be highly beneficial in its results. For these societies the lecture theatres of the Hall will be available. When this Hall was built the amount of capital raised was barely sufficient for the erection and fitting up of the building; it is now proposed to sell 250 more sittings—in fact the sale has already commenced—to raise the capital to £225,000, in order to enable us to undertake things worthy of the institution. In the prospectus issued in 1866, it was proposed that the capital to be raised by the sale of seats should be £250,000, The last point I have to mention is what I should propose for the future management of the Hall. I think our experience shows us that it will be necessary to appoint an efficient manager, sufficiently paid, to carry out the general business and details of the management, and to be a thoroughly responsible officer. I should not propose that such an officer should be appointed before the next general meeting, but that for the ensuing season the management should rest with a council to be elected by yourselves, a proposed list of which we submit for your consideration. Having concluded my remarks, I move that General Scott read the report of the Provisional Committee.

General **Scott** then read the report of the Provisional Committee, and

Lord **Clarence Paget**, in seconding its adoption, said that the institution was now doing very useful work. He had had opportunities of witnessing the benefits that had accrued from the "People's Concerts" which were now in progress, and he felt satisfied that when these concerts became more known they would have their magnificent hall crowded from top to bottom. It was not necessary for him to state the great civilizing influences which this institution could not fail to exercise; but there was nothing more likely to induce popular refinement than an institution of the kind.

Upon the adoption of the report, his Royal Highness the **Chairman** moved the acceptance of a proposed form of constitution for the future government of the Hall, and, after some slight alterations, which were made at the suggestion of Dr. Mouat, Mr. R. Redgrave, and Mr. Warren De La Rue, the constitution was unanimously accepted.

Mr. **Bateman**, F.R.S., in proposing a vote of thanks to the Chairman, spoke of the very efficient manner in which his Royal Highness had conducted the proceedings; Lord **Sydney** seconded the motion, which was carried by acclamation; and, his **Royal Highness** having briefly replied, the proceedings terminated.

INSTITUTION OF NAVAL ARCHITECTS.

By permission of the Council, the meetings of this Institution were held in the Great Room of the Society, on Thursday, Friday, and Saturday, March 21st, 22nd, and 23rd. The following papers were read, the discussions following which will appear in the *Transactions* of the Institute:—

Thursday, March 21st.

ON TRIPOD MASTS, AND THE ARRANGEMENT OF RIGGING CONNECTED WITH THEM.

By **Admiral Paris, C.B.**, Associate.

As a sailor, I admit that I fear this unknown path on which we are entering, by constructing vessels deprived of sails and of the weight of a lofty mast acting as a balance-beam. The little that we know concerning the excessive rolling of our old ships when they had lost their masts, show that we should be exposed to hazards so grave, that we ought to endeavour to avoid them, especially, too, in order to retain a means of motion which enables us to economise our coal, nowadays so difficult to find room for in an iron-clad ship. I have, therefore, no other object in view, in what I now bring forward, than to derive the utmost possible advantage from the employment of iron tripods, to get rid of the fears that have caused them to be discarded, and to preserve to the sailor a resource which the authorities will some day perhaps repent having deprived him of. I have attempted to arrive at this end by making the shrouds and running-ropes pass down the inside of the masts, so as to get rid of the rope ladders, which were shown in the models at the Exhibition of 1867; and lastly, I have profited by the form of the proposed ships to devise places for stowing the yards and top-gallant masts, with the view of leaving only the tripod standing, and that stripped of every encumbrance, instead of keeping all the rigging standing. I do this merely by reducing the height, by sending down the top-gallant masts, and placing the yards parallel to the keel. It appeared to me that in this manner we might avoid all chance of the rigging fouling the screw, or of the turrets being buried under the wreck of the masts. At the same time, I believe it is essential that we should endeavour to go further.

For this reason I have adopted vertical masts, with a diameter of 1 metre, as in the old three-decked vessels, with 0·75 metres at the head, where the ropes are less numerous. The mean diameter is 0·87 metres; and in order to avoid the mast being heavier than is usual, I have taken advantage of the holes necessary to admit light and air into the interior to diminish the amount of metal, so that the mast does not exceed in weight one of 0·70 metres diameter at the base, as originally proposed. With the ordinary arrangements, and without making the ropes pass inside the masts, a very simple calculation shows that by piercing holes 0.022 inches in diameter in places where the rivets of the vertical angle-irons do not come, and by spacing these holes one decimetre from centre to centre, as shown on the diagrams, an equality of weight may be established between these masts and those ordinarily used, and without the plating being weakened, because in each horizontal strake the air-holes do not take away more metal than those required for the rivets of the covering straps. Thus the proposed piercing of holes would not weaken a mast of unaltered diameter, and consequently the proposed masts would be stronger still, since their angle-irons would be further from the centre. Moreover, if the passage inside were not found sufficiently large, we might increase the diameter of the mast, and of the holes in the same proportion; and if one carried out this idea to an extreme, one would get Japanese masts, that is to say, masts without shrouds, always preserving the same weight by means of the increase in diameter. The 48 tons, therefore, allowed for the 197 cubic metres of plates in the original system of masting would not be exceeded.

In order not to obstruct the turret fire, it was important not to have the masts in advance of the turrets, and I have easily effected this by placing the turrets one metre farther apart than is shown on the original plan, and by placing the tripods in reverse to one another, as Captain Coles had done, and as will be seen by the diagrams. In this manner the centre of effort is kept in a suitable position, and the fire from the turrets is as unrestricted as in a monitor or in the *Devastation*, especially when firing end on. Moreover, this arrangement of the tripods allows the spar-decks to be supported without having recourse to a number of stanchions, which, although more slender, obstruct the aim at least as much as the four large oblique columns of the legs. I consider, therefore, that in this respect the retention of the masts offers no incumbrance.

If one wished to get rid of all the running ropes on clearing for action, it would merely be necessary with this plan to increase the diameter of the vertical masts, to cut openings in them at suitable heights for getting in and out, to strengthen them by means of angle-irons; and, lastly, to place in the interior of the masts rings of iron, by which the men may ascend, as miners do by the ladders inside shafts. Certainly with this plan we should no longer be able to see any combined manœuvres by the whole crew; the eye would no longer be able to follow those 500 ants climbing to the masthead with marvellous speed, in order to spread themselves out along the yards, and afterwards slacken sail like one man. This will be a matter of regret to the sailor; but for years past he has had many similar ones to put up with; and, in future, manœuvres with the sails will have to be executed in the same sullen sort of manner as the remainder of his service in those iron-covered forts, which have made his ship a species of venomous being, as ugly as it is formidable.

But it has been remarked to me that it would be preferable to keep the running ropes passed within the masts, so that one would only have to let them go with a knot at the end in order to make them disappear, and to seize the upper extremity in order to rearrange them in their places when it would be required to reset the sails.

In order to complete the proposed plan it would be necessary to arrange for the exit of the ropes from the masts, so that they might act upon the yards and sails. This is effected by means of iron blocks with two sheaves of different diameters, placed one over the other.

These blocks turn on two spindles, like those just described, and their sheaves pass through a slit in the mast. They will also allow of angles of 32°, so that the ropes may follow the movement of the yards, as when it was a question of lifts, burtons, and brails. Being placed at the mast-head they would be less crowded than they are below, and the openings for their passage would consequently not require thicker plating, particularly as the 8 angle-irons would not be interrupted.

But it would not be sufficient to get rid of the running rigging as well; it is essential also to be able to conceal the yards, and not allow them to remain aloft, where they would of course require several ropes. For this I have taken advantage of the form of the ship to stow the yards outside of and below the deck, as may be seen in the diagram, in which the rigging is shown prepared for action.

Things being thus arranged, and the ship being under sail, the rigging would be made ready for action by furling and sending down the sails, and then by striking the top-gallant masts in the usual manner. As each rope lost its lead the top men would make a knot at the end of it, and the men below would haul it in and coil it on the lower deck, as I have endeavoured to indicate by means of a midship section at the left of the diagram, showing the general arrangement. The topsail-tye would be long enough to lower the topsail yard right down, as in the case of the top-gallant masts; and the lower yard, halyard, or main gears will admit of the lower yard being lowered on the other side, braced parallel to the keel, and allowed to slide down one of the tripods.

I believe that in twenty or five-and-twenty minutes everything would be below, and the ship would have her masts stripped and only her signal-halyards leading aloft, as shown on the second diagram. The gaffs of the fore-and-aft sails would have their peaks dropped and lashed alongside the masts, and the turrets would have their fire as unrestricted as in a monitor, and without being much more exposed than the latter to the falling of the upper portions of the masts. If on a cruise one was desirous of retaining the three fore-and-aft sails and jib, one would still have 957 cubic metres of canvas, and with canvas one can save coal by keeping the course with the smallest amount of sail, and, moreover, such sail that in an instant it could be lashed close to the mast, if one did not desire to make further use of it. Lastly, the anchors would be stowed inclined inwards by means of a revolving cat-head, suggested by Admiral La Brousse; and if it were desired to keep them lower, the waterways might be so arranged as to make room for one of the flukes. As to the boats, they would be lowered below the level of the deck, and would rest on iron crutches fixed on the low deck of the outer vessel, and their davits would remain in place, save the most forward one, which would be struck on account of its being close to the turret. The quarter-boats might have falling davits, lowered by means of a rack and pinion.

If, in order to attack forts, it was desired to get rid of the masts altogether the part above the spar-deck could be easily separated from the rest, and the ship would be in the same condition as a true *Monitor*, or as the *Devastation*, with the sole difference that the ordinary supports of the spar-deck would be replaced by the four tripod legs. The upper portions of the masts being fastened to the lower by shrouds, this separation would be as easily performed as the putting together afterwards, by the resources of the ship itself, and the only embarrassment would be to remove these great iron tubes. Such an operation would be difficult away from an arsenal or a friendly port.

The system of rigging that I propose may be adapted to a spread of canvas very different from that shown, which has been chosen only as being best suited to the probable number of the crew likely to be apportioned to a ship of only four guns. The lower yards are not made so long as usual, in proportion to the topsail-yards, in order to secure a considerable reduction in the weight to be moved. Lastly, this plan is applicable to every kind of ironclad ship—since, with the guns in a battery, the yards find a natural position on the deserted deck, and do not interrupt the line of fire, while being quite secure against falling overboard.

It remains to say a word concerning the spar-deck. The position of the masts between the turrets allows of their being used as supports for this deck, which is fastened to them by large angle-irons running from each of the lower masts to the funnel casing and on the edges by other longitudinal angle-irons rivetted to the legs as well as by other angle-irons running athwartships. By making these portions sufficiently strong, the remainder can be formed of light angle-irons crossing one another chequer-wise, to support the hatch covers or grating for walking over. The funnel casing would serve as the principal support to the deck against lateral motion, and being situated between the two turrets it would not interfere with the fire. It would contain a number of large openings, closed at will by doors, with a view of assisting the masts in the ventilation of the interior of the vessel.

Friday, March 22nd.

ON THE CORROSION AND FOULING OF IRON SHIPPING.

By Robert Mallet, Esq., F.R.S.

The following is an abstract of the principal points in Mr. Mallett's paper:—

The paper began with general considerations—a tolerably complete *resumé* of the circumstances under which iron, in the three states in which it is used structurally, namely, wrought-iron, cast-iron, and steel, are produced, and in relation to how far the material itself can be produced to a certain extent homogeneous, so that taking a unit of surface—of a plate for example—it can be ascertained how far it shall corrode uniformly under given conditions, or whether certain parts corrode more rapidly than others.

Mr. Mallett then went on to show that, from the necessity of the case, in the processes of manufacture of all three of these materials, it is not possible that any piece of cast-iron, wrought-iron, or even steel, shall be produced absolutely homogeneous. The agents which act upon iron in these various states, namely, our fresh waters, our salt waters, and our weather or atmosphere, are then referred to. The tables which he gives show the extent to which corrosion takes place in fresh river water, in ocean water, and in sea water, fouled, and when exposed to the weather, by sewage. He passes, then, from the question of the want of homogeneity in the iron of which ships are made, and of the relations of the external natural agents, to the iron supposed to be in its pure condition, and also in those in which we actually find it in manufacture, in which it is never pure iron at all, but iron combined with certain other things—carbon principally—and proceeds more particularly to the conditions under which the materials of iron ships are exposed to corrosion. He then shows the effects of differences of temperature —of extraneous agents, such as cargo, &c.—on the different parts of the interior; for example, the necessary conditions of the coal bunkers in promoting corrosion of those parts, and how far the corrosion is influenced on the outside by the depth of immersion of the several parts of the hull, and by their position in the hull of the ship, as affected by her passing through the water, and a variety of other conditions. Amongst those necessarily alluded to were a great many conditions which are constantly in practical occurrence constructively. He endeavoured to place that matter in a tolerably clear light—a clearer light, it seemed to him, than that in which it generally is viewed even by those practically concerned in iron shipbuilding. He then turns to another class of circumstances, affecting not only the rate but the localisation of corrosion in ships—the electro-chemical action of the contact of dissimilar metals, such as copper, lead, bronze, brass, or muntz metal, by which, more or less powerful galvanic circuits are formed with the iron of the ship, which, being electro-positive in sea-water to all those metals, is thus powerfully but locally corroded. He then refers to the fact that iron shipbuilders seem to be generally under the notion that tin has no electro-negative effect. Then he also alludes to the conditions under which the bunkers affect the other parts of the ship, the floor of the engine-room, and so forth, being the parts that are most powerfully affected. The tables appended to the paper give some of the various experiments. The actual way in which ships do corrode is more or less by "pitting"—as was shown by specimens exhibited, in one of which corrosion has eaten away a hole quite through the metal, while the remainder is not very greatly corroded. The subject of protective coverings was then dealt with, and the chemistry of oils, paints, and varnishes slightly reviewed. Then passing from the subject of coating, considered as mere preservatives, he came to the question of coatings considered as preventives of the other difficulty with regard to iron ships, namely fouling. With regard to this portion of the paper, he showed that corrosion is the necessary condition previous to fouling. As appendix to the paper is an abstract, with a very short digest of the mass of patents which have been taken out for "anti-fouling compositions." Mr. Mallet remarks that metal sheathing over some insulating coating seems to him, after a large review of the whole subject, to present advantages which no other proposed scheme against fouling as yet has offered. And as to the modes of practically carrying this out, he would only express the negative opinion that the plans—such as those of Jouvin and Daft, &c.—which abjure the use of planking, and endeavour to secure the sheathing metal directly (with felt or the like thin material only between), to the iron skin, are really impracticable.

PLAN FOR REGISTERING REPORTS OF SURVEYS OF IRON AND STEEL STEAM AND SAILING VESSELS AND OTHER FLOATING BODIES; ALSO FOR THE SHELLS OF MARINE AND LAND BOILERS, RESERVOIRS, TANKS, MASTS, &c.

By William Taylor, Esq.

The object of this plan is to lay open to view the whole of the interior and exterior surfaces of the hulls of iron and steel steam and sailing-vessels, and other floating bodies, shells of marine and land boilers, reservoirs, tanks, masts, &c., and at the same time register all defects, and the gradual or rapid deterioration of all and every single plate thereof, from the date each hull of vessel, shell of boiler, reservoir, tank, mast, &c., was new, until the same shall be entirely worn out. This plan will then show which of the plates have deteriorated gradually and which have deteriorated rapidly. It will also show which of the plates may have deteriorated first slowly, and afterwards rapidly; or first rapidly, and afterwards slowly. In fact, it will show every change and degree of deterioration from first to last, and may lead to discovering the cause why one plate deteriorates more quickly than another when both are apparently exposed to the same deteriorating influences.

1st. This plan of registering consists in expanding the whole of the sheathing plates of the hull of vessel, &c., giving their length, breadth, and thickness when new, and with a distinguishing number marked on every plate, so that if an accident should occur abroad, and the vessel requires repairs in the hull, the exact plate or plates and their position in the vessel could be easily recognised, and the extent of damage made known at home by telegram, and reference to the plan.

2nd. The keel, stem, and stern-post, also the position and distinguishing number of every frame and bulkhead in the vessel are shown.

3rd. Also, the gradual or rapid deterioration of every plate, both on the inside and outside surfaces, from one survey to another, as long as the vessel, &c., may last; and also whether the deterioration has been gradual or rapid, or whether the deterioration has been alternately gradual and rapid; in fact every stage and degree of deterioration, and both the years in which it has gone on slowly, and those in which it has gone on rapidly.

4th. Also, the repairs and renewal of plates.

5th. All holes, with their exact position in the several plates, that may be drilled for the purpose of ascertaining the thickness of such plates, such thickness being registered on the plan.

6th. The light and load water-lines, also the line of cementing, with its extent and thickness.

A form or table is which all the thinnest and worst plates are set down, also the condition of cementing, &c.

This plan of reporting surveys would be exceedingly useful to the principal officers in her Majesty's dockyards, to the Admiralty, and the Board of Trade, and to the Lords of the Admiralty, &c., who would then have the true state of all the iron and steel vessels, boilers, &c., in the service before them, and would thus be able to give instructions to the officers at the several dockyards as to which parts of the hull of the vessel, &c., required particular attention when a vessel was docked for survey and repairs.

This plan of keeping reports of surveys would be found of very great assistance to Lloyd's Committee of Registry of British and Foreign Shipping, when about to class or re-class any vessel; and to their surveyors, as they could take a copy of previous surveys with them, which would show all the worst parts of the vessel they were about to examine.

It would also be of great service to public companies, owners, and captains of vessels, and others, when about to make purchases.

This plan of keeping reports of surveys would be of incalculable service to underwriters and merchants, as they would see plainly before them the exact condition of the ship they were about to insure, and merchants would see the state of the vessel by which they were about to send their goods from the form or table previously referred to, which could be hung up in their offices.

One drawing only is required during the whole period the vessel may last. Owners should arrange with the builders for one when contracting to build.

By adopting this system the date of each survey is nearly all the writing required. Other advantages could be stated.

ON THE MIS-USE OF CEMENT ON IRON TRANSPORT SHIPS, WITH SUGGESTIONS FOR MAKING HALF-WORN-OUT IRON SHIPS PERFECTLY SEA-WORTHY AT A SMALL COST.

By William Poole King, Esq., Associate.

There can be no doubt that the half-worn-out plates of iron ships may be much strengthened by the application of the cements in ordinary use, composed of silicate of lime and alumina. The plates are found covered with scales of oxide of iron, and when the cement is applied in a wet state, an imperfect chemical union is formed, consisting of silicate of iron, lime, and alumina, which hardens into an artificial stone of some strength; the plates are firmly backed up, and the ship is much strengthened throughout her structure; as long as there is little cargo in the ship, she makes but little water, and seemingly is in perfect order for the longest sea-voyages.

This, however, is delusive, for when the ship is loaded, say 20 feet deep, and her plates are a little strained by the motion of the ship, she begins to leak; for although the scales of iron, strengthened by the artificial stone, may easily resist the pressure of water where it is only 2 or 3 feet deep, with a pressure of 1 pound or 1½ pounds on the square inch, yet they generally yield to a pressure of 10 pounds on the square inch, or 1,400 pounds on the square foot in 20 feet of water. At that depth a little water oozes through some small orifice on the outside of the plate, and collects behind a strengthened scale; it gradually accumulates, and, as surely as in a Bramah press, acts with a 10 pound per inch pressure on the scale, and forces it from its place; an inward current of water is then established, which is sure to enlarge the leak. Sometimes the scales are of sufficient strength to resist this pressure, but the risk is great. It is instructive to remember that the scale of cement was found to be gone off from the lowest part of the bottom of the *Megæra* near the keel, and several shales of iron and plaster were detached in the bottom of that unfortunate ship.

By affixing cement upon the inside plates of an iron ship, a most deceptive trap is laid. In dock, under survey, the ship appears abundantly strong, and resists the strenuous and honest strokes of a wood mallet; borings may be taken which seem compact—the ship may not even leak till a small hole occurs deep in the outward surface from working in rough water; when the ship labours, the trap falls, and lucky are the sailors if they escape.

In cementing vessels it would be well to fill in solid between the frames, and flush with the lining or ceiling about the bottoms of coal bunkers, leaving a course for water in the centre of each bay by inserting a piece of iron piping; the bottom parts of the vessel, forward and aft, should be filled in to nearly the top of the floor plates, and such other parts as it is difficult to gain access to.

Should it be desirable to preserve an iron ship for future use, whose frame-work is of adequate strength, but where the state of the plates is precarious—this may be accomplished by lifting all platforms, and everything that covers over the inside of the plates in the hold; a sheathing then can be fixed all over the plates outside from keel to deck, of say 4 inches thick, of pitch pine above and American elm under the deep water, secured by means of metal screws, 3 inches long, turned from the inside of the plates into the wood. Where the plates happen still to be of sufficient strength, the application of an iron washer with a hole through its middle for the screw, would be found enough; but where the plate is weak, a butt plate secured between the frames may be advantageously employed. I should recommend a screw, cast in Prince's metal, ½ inch in utmost diameter, with six turns in 3 inches. This screw will support 1,200 pounds without drawing, and cost 2d. The stem, keel, and such like parts, can be sheathed, and fastened by means of metal screws and nuts, countersunk in the wood, and covered with stoppers of gutta-percha and sand; the outside of the wood sheathing thus cut off from all electric communication from the iron plates and frames can be coppered, and thus the transport will sail better by far than before, but the copper should be kept atleast 3 inches distant from all ironwork such as the screw propeller. If this wood sheathing be caulked with oakum, made from new tar rope (not oakum picked in gaols from old rope taken from the marine store dealer), the ship may be safely sent out for a five-years' cruise, without fear of her leaking, and if the attachment of the screws be inspected and made good, the sheathing will remain good for fifteen years, with merely re-caulking, the ship thus sailing at small cost.

ON A NEW SYSTEM OF LONGITUDINAL SHIP-BUILDING.

By J. E. Scott, Esq.

Several papers have been read before this Institute and other scientific societies, having for their object the comparison of the different modes of ship-building. It is not my intention to touch upon all those different systems, but confine myself to that arrangement most commonly adopted, viz., the transverse system, as compared with my longitudinal arrangement.

There have been various plans for longitudinal construction, and a great number of vessels have been built from them; this was some years ago, but of late the transverse system has been almost entirely built from, the plan of building longitudinal ships being so much more expensive, and requiring a much longer time in construction; and as ships had not the excessive proportion of length they have now, longitudinal strength was more easily obtained than it is now possible with the transverse system.

In describing the different parts of my arrangement, I hope to be able to make clear its superiority to you, the members of this Institute.

The great economical results attained by vessels of small section in proportion to length, has induced almost every shipowner to have as long ships as possible, until there are vessels now building of eleven beams to length. The only drawback to this increase is the great additional weight required to bring up the longitudinal strength. Within the last few years there have been a great many changes in the different classification books, all tending to diminish the section for preventing transverse bending, and increase the section for resisting longitudinal bending; and even with all those improvements, I find that we have still 30 per cent. more section against transverse than against longitudinal bending. This is what I propose, by my longitudinal arrangement, to reverse. In carrying it out, I have the outside plating in longitudinal strakes, exactly as at present; but instead of having the frames transverse, I have them longitudinally, following at the stem and stern post, where those frames terminate the line of the seams of the skin plates continuously through the bulkheads, until it becomes necessary, by the diminished girth forward and aft, to gore or run two into one, and at the stem and stern post, where those frames terminate, they are connected to the corresponding frames on the opposite side of the vessel by hook-plates, thus completely connecting both sides of the vessel. These longitudinal frames, as shown in large scale section, may be formed of the usual frame and reversed angle-bars, or of Z iron, or ⊐ channel section. The spacing of those frames to be as at present, from 18 to 24 inches apart, according to the size of the vessel. From the centre line to the turn of the bilges, where we have the floor plates in transverse framed ships, I increase the longitudinal frames to the same lines as the present floors, each longitudinal forming a girder, with an angle-iron on each edge. All the longitudinal frames and girders, throughout the entire framing of the ship, will be square off the skin plates they are connected to, so that no angle-bar will require to be bevelled in any way.

Inside the longitudinal frames there are fixed to them, at spaces corresponding to every third beam, transverse, vertical tie-frames of angle-irons rivetted back to back, of the same scantlings as the present keelsons, extending from the upper deck stringer-plates, and passing continuously through the lower decks, and overlapped across the centre line, and connected to the longitudinal frames by double reverse angles. The flat of floor is additionally strengthened transversely by means of plates let down between, and connected to the longitudinal girders, and rivetted to the angle-irons of the tie-frames. In broad, flat-bottomed ships, it will be necessary to have an extra tie-frame carried up to the turn of the bilges, with plates fitted between and rivetted to the longitudinal and tie-frames, so as to give the necessary transverse strength.

The beams are fitted at present across the ship at right angles to the centre line, and connected to the ship's side by double angle-iron on each knee; those beams which occur at the tie-frames have deep knees passing between, and extending from the outside of the tie-frame to the skin plates. In construction, those beames are raised with the tie-frames to preserve the form.

The bulkheads are fitted in the ordinary manner, being let in over the longitudinals and made water-tight round them. The reverse bar may be either cut and kneed, as in the case of ordinary keelsons, or allowed to pass through. This makes up the general arrangements of iron ships.

In moulding vessels with longitudinal frames, we will have the lines and bevils for each tie frame, also the fore and aft curve of the longitudinal frames, the breadth and curve of each plate in the outside skin; all this can be easily laid down from the body plan.

In construction, I commence by setting the centre longitudinal girder in position on the keel blocks, and then raise upon it the transverse tie frames, with their beams, securing them in the ordinary manner by ribands.

The first longitudinal frame on each side may then be bolted to the tie frame, and the first strake of plating to them, and shored or blocked off, after which the remaining longitudinal frames and strakes of plating may be added in the same manner consecutively. In order to advance the deck work, the strake in way of each tier of beams, with the longitudinal frames, should be raised as soon as the tie frames are in position; the beams which come between the tie frames may then be attached to those strakes, and the stringer-plates fitted.

In order to have a comparison between the effective cross-sections of an ordinary transverse framed and longitudinal framed ship on my arrangement, I have taken a vessel of 312 feet long by 34 feet beam, and 29 feet moulded to spar deck, with 3,390 tons displacement or 20 feet 6 inches draught, or 19 feet 6 inches from top of keel; gross tonnage, 2,000 tons; to class 100 A at Lloyd's; index numbers, Lloyd's rules, 81 and 25,194.

The scantlings of the longitudinal frames correspond with those of the present vertical frames, and those of the tie frames to scantlings given for keelsons; all deck-stringers, beams, and skin-plates are the same in either case.

TRANSVERSE FRAMED IRON SHIPS.

	Sq. in.
Keel	27·50
Keelson angles	67·20
Centre keelson plates	20·97
Side keelson plates	28·73
Garboard stakes	58·32
Bottom plating	236·64
Side plating to lower deck	112·84
Side stringer	34·28
Lower deck stringers and tie-plates	53·39
Lower deck stringers and angles	17·98
Wood of lower deck = 1224 ÷ 16, equivalent in iron	76·50
Side plating, lower to main deck	104·23
Main deck stringer plates, ties, and diagonals	128·24
Main deck stringer plates and angles	24·80
Wood of main deck H 1224 ÷ 16 =	76·50
Plating main to spar deck	53·82
Spar deck stringer, ties, and diagonal plates	83·91
Spar deck stringer, angles	8·00
Spar deck wood, 1224 ÷ 16 =	76·50
Greatest total area of section =	1,335·94
Deduct for rivets connecting skin plates to frames	108·00
Least total area	1,227·94

LONGITUDINAL FRAMED IRON SHIPS.

	Sq. in.
Keel	27·50
Garboard strakes	58·32
Botton plating	236·64
Girder plates	139·50
Girder angles	119·19
Side plating to lower deck	112·84
Side longitudinal frames to lower deck	66·22
Lower deck stringer and tie-plates	53·39
Lower deck stringer and angles	8·99
Lower deck wood, 1224 ÷ 16 =	76·50
Side plating, lower to main deck	104·23
Longitudinal frames, main to lower deck	39·72
Main deck stringer, ties, and diagonal plates	128·21
Main deck stringer and angles	24·80
Main deck wood, 1224 ÷ 16 =	76·50
Plating from main to spar deck	53·82
Longituninal frames from main to spar deck	39·72
Spar deck stringers, ties, and diagonal plates	83·91
Spar deck stringers and angles	8·00
Spar deck wood	74·50
Greatest total area of section	1,579·41
Deduct for rivets connecting skin plates to longitudinal frames	66·00
Least total area	1,513·41

TRANSVERSE FRAMED IRON SHIPS.

	Areas.	Distance from Spar deck.	Products.
	sq. in.	feet.	
Spar deck	168·41	0·0	00·00
Sides from main to spar deck	53·82	3 9	210·89
Main deck	229·51	7·4	1698·37
Sides from main to lower deck	104·23	11·2	1177·37
Lower deck	147·87	14·9	2203·26
Sides to bilges to lower deck	147·12	19·5	2868·84
Bottom	484·98	28·3	13724·93
	1335·94	....	)21883·66

Neutral axis below Spar deck = 16·38 ft.

	Areas.	Distance from Neutral axis.	Products.
	sq. in.	feet.	
Spar deck	168·41	16·38^2	45544·80
Sides from main to spar deck	53·82	12 5^2	8409·37
Do. do. do.	53·82	7·0^2 ÷ 12	219·58
Main deck	229·51	9·0^2	18590 31
Sides from main to lower deck	104·23	5·2^2	2818·37
Do. do. do.	104·23	7·5^2 ÷ 12	487·79
Lower deck	147·87	1·5^2	332·70
Sides to bilges to lower deck	147 12	3 2^2	1506·50
Do. do. do.	147·12	10·02^2 ÷ 12	1225·50
Bottom	484 98	12·0^2	69837·12

Spar deck from Neutral axis = 16·38)148972·54

Moment of resistance .... 9094·54

Longitudinal Framed Iron Ships.

	Areas.	Distance from Spar deck.	Products.
	sq. in.		
Spar deck	168·41	0·0	00·00
Sides from main to spar deck	93·45	3·9	364·45
Main deck	229·51	7·4	1698·37
Sides from main to lower deck	143·95	11 2	1612·24
Lower deck	183 88	14·9	2739·81
Sides to bilges from lower deck	179 06	19·5	3491·67
Bottom	581·15	28·3	16446·54
	1579·41	………	)26351·08

Neutral axis below Spar deck = 16·60 ft.

	Areas.	Distance from Neutral axis.	Products.
	sq. in.		
Spar deck	168·41	$16{\cdot}6^2$	46407·06
Sides from main to spar deck	93·45	$12\ 7^2$	15072 55
Do. do. do.	93·45	$7{\cdot}0^2 \div 12$	381·27
Main deck	229·51	$9{\cdot}2^2$	19425·72
Sides from main to lower deck	143·95	$5\ 4^2$	4197·58
Do. do. do.	143·95	$7{\cdot}5^2 \div 12$	673·68
Lower deck	183·88	$1\ 7^2$	531·41
Sides to bilges from lower deck	179·06	$3\ 0^2$	1611·54
Do. do. do.	179 06	$10{\cdot}0^2 \div 12 =$	1471·56
Bottom	581·15	$11{\cdot}8^2$	80919·32

Spar deck from Neutral axis = 16·6)170691·69

Moment of resistance .... 10282·63

Transverse Framed Iron Ships. Resistance to Hogging.

Displacement × Length ÷ 20 = 52,884 ft. tons = greatest bending moment.

9094·34 = Moment of resistance.

Greatest tension longitudinally 5·81 tons on the square inch.

0·73 Difference of distances from neutral axis.

Greatest thrust longitudinally 4·24 tons on the square inch.

Resistance to Horizontal Bending.

	Areas. sq. in.	Multipliers. feet.	Products.
Sides	305·17	17·0 = ½ breadth	5187·89
Bottom and decks ...	1030·77	17·0 = do. ÷ 4 =	4380 77

Resistance to bending ... ... = 9568 66

Greatest bending moment ÷ do. do. ... ... = 5·52 tons per sq. in.

Longitudinal Framed Iron Ships. Resistance to Hogging.

Displacement × Length ÷ 20 = 52,884 ft. tons = Greatest bending moment.

1028·63 moment of resistance.

Greatest tension longitudinally 5·14 tons on the square inch.

0·71 Difference of distances from neutral axis.

Greatest thrust longitudinally 3·65 tons on the square inch.

Resistance to Horizontal Bending.

	Areas. sq. in.	Multipliers. feet.	Products
Sides	416·46	17 = ½ breadth	7079·82
Bottom and sides.. ...	1162·95	17 do. ÷ 4 =	4942·53

Resistance to bending ... ... = 12022·35

Greatest bending moment ÷ do. do. ... ... = 4·39 tons per sq. in.

By reference to some tables, Mr. Scott showed that the cross-section of transverse framed vessels is to longitudinally framed vessels as 12 to 15, and that the resistance to longitudinal bending is as 9 to 10; and that the resistance to horizontal bending is as 9 to 12. This is with the same total weight of vessel, and is equal to about 15 per cent. more strength longitudinally, in longitudinally framed ships, which would enable any of our present vessels to come through any strain that they might be subjected to.

For a particular service suppose the transverse framed vessel taken out in tables to have sufficient longitudinal strength, then take the difference between areas of sections given for transverse and longitudinal ships = 285·74 square inches, and this divided by 960 inches = the total girth amidships = ·29 inches thickness, = 11·6 lbs. weight per foot and this × length and by mean girth of vessel = 105 tons less weight required for a longitudinal vessel with my arrangement; and as the total is 900 tons, this reduction in weight is over 11½ per cent.

The advantages to be gained in construction and material are very great. The deprecatory effect caused by heating our present frame bars to the extent necessary for setting and bevelling, is well known; they become so short in the grain after being heated to such a degree, that they in many cases will not stand hoisting into their places, or even the rivetting of the several parts together; this will be completely overcome by my arrangement. We will require neither the heating, bevelling, nor setting of floors, as the frames will be all square off the outside skin, and following the line of those plates, they being raised sufficiently fore and aft to take out the sag or vertical set, leaving each frame in a straight plain from end to end. Then as to the fore and aft curvature amidships, it is evident that a blow from a hammer will put this to rights; even at the ends, where the curvature increases to a maximum of 1 in 20 in the fullest ships, the beam pressing machine could put this round on with ease, as it is only twice the round given in deck beams.

Now all the skin plates can be multipliers of the same number from end to end of the vessel except the fore and after plates in each strake, which will be regulated by the length from the last butt to the stern post. This regularity is caused by there being no transverse frames to regulate the length of each plate, so that with this construction, all the longitudinal frames, girder plates, and frame holes of skin plates, can be punched from the same template, or punched with a machine such as that used in bridge and boiler construction, with self-regulating details, thus obviating false punching, and the necessity of a separate template for each plate.

As skin plates are of different breadths, it may be considered difficult to obtain this advantage, but as the butts do not over-lap one another, they can be punched in the usual manner.

The advantages to be gained in this part of the structure is the saving of time, as all the plates and frames can be marked and punched at once, instead of having one part marked off another as at present.

In riveting the frames, it will be an easy matter to have them brought under a common riveting machine, which at present is all but impossible, from the awkward shape and weight to be carried from the machine to the ship, so that the usual mode of riveting large frames at present is across their own keels, for convenience in hoisting. Even this inconvenience and the expense of riveting may be altogether overcome by the use of **Z** iron or **]** channel iron. To obtain this advantage in the present mode of transverse construction is impossible; neither of these sections can be used, as they have to take many sharp curves and be bevelled in many different ways.

To bring and keep longitudinally-framed vessels in shape has always been a serious difficulty. Prior to this, temporary moulds have been used. This is at once costly and insecure, therefore objectionable, but will be overcome in my arrangement by the transverse tie-frames of double angle-iron, back to back, which will be in permanent position at the beginning of construction. I may here mention that these are the only frame bars requiring to be heated and bevilled, and they amount to only $\frac{1}{6}$ of the ordinary transverse frames. Here, also, you will observe a decided advantage in the reduction of furnace work, as the present frames cost twice the amount per ton weight of iron of any other part of the structure.

In securing the deck beams to the outside plating, the loss of the transverse frames at this point will be made up by double angle-irons on the beam knees, as the connection does not in any great measure depend on the knee, but to a large extent on the stringer plates and bar. The difficulty and great expense of connecting deck stringers to the outside plating on deck, where the frames pass through the stringers, will be removed by the bars being continuous fore and aft, and not cut into short pieces between the frames, as at present. This connection is very necessary, to prevent straining at the decks.

By having the bulkheads in direct contact with the skin, as in transverse framed ships, it becomes a very rigid part of the structure, and, instead of strengthening, tends to weaken, on account of the skin plates being pierced so close in order to make the connection secure, the rigidity being only diffused by the keelsons and stringers ; but by having the double angle-iron frames inside the lodgitudinal frames, we disperse the rigidity fore and aft of the bulkhead over a large area, and, instead of weakening the skin at one point, it gives strength to all around by having the longitudinal frames passing continuous through the bulkhead, and making it water-tight round them by fitting plates between the longitudinal frames, and connecting them to the skin and bulkhead frames by angle-irons. There is, therefore, no necessity for having the skin doubled, as at present, at this point to assist in keeping the bulkhead from working, as there is no direct strain on the skin plate. The only use of plates between the longitudinal frames is to cut off the connection between one hold and another.

It is very requisite at the ends of vessels to have one side thoroughly connected with the other, especially so in screw steamships, where the vibration caused by the propellor being suddenly thrown in and out of the water is very severe ; the best workmanship and materials are often found insufficient to cope with this for any length of time. Now, with transverse frames this part of the structure is in no way strengthened, for not only are they almost always reduced in the inner flange to admit of the stern-pipe being got into its proper place, but are altogether in the wrong position to hold out against this strain. To meet the vertical strain on this point, we have the whole length of the stern-post above and below the shaft connected to the plating, thus diffusing it thoroughly in this direction ; but to meet the horizontal we have only the cross section of the stern post, skin plates, and water-tight iron deck. As the transverse vertical frames are completely disjointed in a horizontal direction by the impossibility of introducing keelsons at this point in such a contracted space, we cannot allow anything for them. It is clear, I think, that this horizontal strain is met in a very insufficient manner ; but with longitudinal framing we shall be able to completely overcome this inequality in rigidity by having a series of iron deck, as it were (as shown in plate) above and below the shaft, thus completely connecting the skin plates from side to side, and adding to the horizontal resistance. There will also be greater facility for rivetting the skin, as those horizontal plates can be fitted after the skin plates are in position, and rivetted. At the fore end of the vessel there are numerous advantages to be gained by having the sides of the vessel so thoroughly connected horizontally, and giving support to the stern, which, at present, is only supported by the skin plates and stringers.

Water ballast tanks so greatly promote economy in shifting from port to port that they are every day becoming of more importance. They are with difficulty constructed in a satisfactory manner with transverse frames, because of the frames having to be cut on each side or allowed to pass through the side-plate of the tank at such close intervals, the difficulty being to make it water-tight round each frame.

In the first construction we sacrifice the frame, in the other we weaken the side of the tank in order to preserve the frame. With transverse frames this is imperative, but if we have the frame running in the same line as the side of the tank, then we obviate all this unnecessary and unsatisfactory work. Water ballast tanks can be constructed in longitudinally framed ships with the greatest ease, and assurance of being tight when completed, by a very simple arrangement, as shown on plate. The side-plate of the tank is attached to one of the longitudinal frames, making a plain caulking seam fore and aft with the outside plating, which has no interruptions whatever, and all plain work from end to end, instead of the many interruptions and small detached pieces that are necessary in transverse framed ships : this is the part that makes those tanks so expensive and troublesome to construct. We shall be able to entirely dispense with those heavy knee-plates that connect the frames to the side-plate of the tank.

The transverse tie frames pass through the side-plate of the tank, but as they are clear of the side of the ship there is every facility for making the tank-plate tight round them. To have the wash from one side to the other stopped is one of the most particular points in the construction of those tanks : if the water is allowed to wash from side to side, the pressure brought to bear on the side-plate is so great that it is impossible to keep them tight : this is entirely prevented in longitudinal framed ships. If it is necessary to end the tank before reaching the ends of the vessel, it can be made perfect by having a bulkhead fitted across, in the same manner as the others.

The small number of composite ships now building shows a serious defect somewhere ; either they must be weak for the quantity of material per ton, or, when strong enough, they are too costly. By studying our present composite ships, it is apparent that they have too little longitudinal strength as compared with an iron ship. We have in composite ships the transverse frames, floors, beams, and keelsons, all of much the same scantlings as in iron ships, and on those frames are bolted the longitudinal strakes of planking. In my arrangement for composite ships I have the external outside planking worked diagonally, which may be either of one or two thicknesses, according to the size of the vessel. The longitudinal frames, transverse tie-frames, and deck beams, are all fitted in the same manner as described for iron ships on this principle.

As the longitudinal frames require to be united at their outer edges as well as at their inner edges, I have narrow flat-plates from keel to gunwales, crossing the longitudinal frames at each of the transverse tie-frames. Those plates are connected to the plates between the longitudinal frames in flat of bottom by angle-iron on their lower edges. At the centre line a strake of plating is applied, running fore and aft, sufficiently broad to embrace the garboard strakes and the butts of the diagonal planking. The keel, stem, and sternpost are also bolted to this plate, as at present. At each bilge there is a strake of plating fitted, embracing two of the longitudinal frames, and extending over three-fifths of the ship's length amidship ; and in the line of each tier of beams it is necessary to have similar strakes for connecting the beam-knees and stringer-plates to the frames.

In construction all the longitudinal frames will be secured to the tie-frames and outside tie-plates, and also the longitudinal strakes of plating in their proper positions, before putting on the diagonal outside plating, as each diagonal strake crosses all the longitudinal frames.

The advantages gained in frame setting, punching, and riveting, in iron-clad ships with my arrangement, are likewise obtained in composite ships.

The whole structure will be much more rigid than with the present transverse frames, by the outside planking passing diagonally across the frames, resisting at the same time transverse and longitudinal bending, also giving great stiffness at the bilges, which at present are only supported by the transverse frames and bilge keelsons.

To show more distinctly the advantages to be gained as to strength, by the frames being longitudinally, I have taken out the section of a vessel 200 feet long by 34 feet broad, and 22 feet moulded; tonnage under-deck 898 tons; displacement 2,050 tons, on 19 feet 6 inches draught of water, or 18 feet from the top of the keel; to class 100 A at Lloyd's.

In making up those sections I have taken the same scantlings for longitudinal frames as required by rules for transverse frames and for my transverse tie-frames I have taken the scantlings given in rule for keelsons.

Composite Transverse-Framed Ships.

Keel wood, 342 ÷ 16	21·37
„ plate	24·30
Bilge strake	27·28
Planking of bottom wood = 2160 ÷ 16	135·00
Keelson angles	54·00
„ plates	52·60
Planking from bottom to lower deck, wood 1584 ÷ 16	99·00
Diagonal plates on frames between lower deck and bottom	6·82
Keelson angles	18·00
Wood of lower deck, 1224 ÷ 16	76·50
Stringer and tie plates of lower deck	42·16
„ angles	9·00
Planking from main to lower deck, 924 ÷ 16	57·75
Iron sheer strake	20·46
Diagonal plates or frames	6·82
Wood of main deck = 1584 ÷ 16	99·00
Main deck stringers, ties, and diagonal plates	65·72
„ „ angles	9·00
Total area	824·78
Deduct for rivet connecting plates to frames	18·00
Least total area	806·78

Composite Longitudinal-framed Ships.

Keel, wood, 349 ÷ 16	21·37
„ plate	24·30
Bilge strakes	27·28
Wood planking of bottom = 2160 ÷ 16	135·00
Longitudinal web plates	152·00
„ „ angles	178·76
Wood planking from bottom to lower deck, 1584 ÷ 16 =	99·00
Iron lower deck shear strake	10·50
Longitudinal frames from bottom to lower deck	87·00
Wood of lower deck 1224 ÷ 16	76·50
Lower deck stringer and tie plates	42·16
„ angles	9·00
Planking from lower to main deck, 929 ÷ 16	57·75
Iron sheer strake	20·46
Longitudinal frames between main and lower deck	43·50
Wood of main deck, 1584 ÷ 16	99·00
Main deck stringers, ties, and diagonal plates	65·72
„ „ angles	18·00
Total area	1,167·30
Deduct for rivets connecting plates to frames	15·00
Least total area	1,152·30

Composite Transverse Framed Ships.

	Areas.	Distance from Main Deck.	Products.
	sq. in.		
Main deck	173 72	0·0	000·00
Sides from main to lower deck	85·03	3·75	318·86
Lower deck	127·66	7 50	957·45
Sides to bilges from lower deck	123·82	12·50	1547·75
Bottom	314·55	22·22	6991·02
	824·78	………	)9814 88

Neutral axis below main deck = 11 90 ft.

	Areas.	Distance from Neutral Axis.	Products.
	sq. in.		
Main deck	173 72	$11{\cdot}9^2$	24600·49
Sides from main to lower deck	85 03	$8{\cdot}1^2$	5441·92
Do. do. do.	85·03	$7{\cdot}5^2 \div 12 =$	398·57
Lower deck	127·66	$4{\cdot}35^2$	2415·32
Sides to bilges from lower deck	123·82	$11{\cdot}00^2 \div 12 =$	1248·51
Do. do. do.	123·82	$0{\cdot}70^2$	60·67
Bottom	314·55	$9{\cdot}30^2$	27205·42
			61370·90

Main deck from neutral axis = 11·90 ft.

Moment of resistance ………… 5157·73

Composite Longitudinal Framed Ships.

	Areas.	Distance from Main Deck.	Products.
	sq. in.		
Main deck	182·72	0	000·0
Sides from main to lower deck	121 71	3 75	456·41
Lower deck	127·66	7·50	957·45
Sides to bilges from lower deck	196·50	12·50	2456 25
Bottom	538·71	21·50	11582·26
	1167·30	………	)15452·37

Neutral axis below main deck = 13·23 ft.

	Areas.	Distance from Neutral Axis	Products.
	sq. in.		
Main deck	182 72	$13{\cdot}23^2$	31981·48
Sides from main to lower deck	121·71	$9\ 50^2$	10984·32
Do. do. do.	121·71	$7{\cdot}50^2 \div 12$	569·60
Lower deck	127 66	$6{\cdot}00^2$	4595·76
Sides to bilges from lower deck	196·50	$11{\cdot}00^2 \div 12$	1980·72
Do. do. do.	196·50	$1{\cdot}00^2$	196·50
Bottom	538·71	$7{\cdot}70^2$	31940·11
			82248·49

Main deck from neutral axis … 13·23 ft.

Moment of resistance …………… 6216·81

Composite Transverse Framed Ships.—Resistance to Hogging.

Displacement × Length ÷ 20 = 25,000 ft. tons = greatest bending moment.

5157·73 = moment of resistance.

Greatest tension longitudinally 4·84 tons per square inch.

·78 difference of distances from neutral axis.

Greatest thrust longitudinally 3·77 tons on the square inch.

Resistance to Horizontal Bending.

	sq. in.		Products.
Sides… … … …	208·85	17 ft. = ½ breadth =	3550·45
Bottom and decks…	615·93	17 ft. = „ ÷ 3 =	3489·85
		Resistance to bending …	7040·30
Greatest bending moment ÷		do. do. =	3·55 tons per sq. in.

Composite Longitudinal Framed Ships.—Resistance to Hogging.

Displacement × Length ÷ 20 = 25,000 ft. tons = greatest bending moment.
6216·81 = moment of resistance.
Greatest tension longitudinally 4·02 tons per square inch.
·58 differences of distances from neutral axis.
Greatest thrust longitudinally 2·33 tons on the square inch.

Resistance to Horizontal Bending.

	sq. in.		Products.
Sides...	318·21	17 ft. = ½ breadth	5409·57
Bottom and decks...	849·09	17 ft. = ,, ÷ 3 =	4810·94
		Resistance to bending ...	10220·51
Greatest bending moment ÷		do. do. =	2·44 tons per sq. in.

The difference, as shown in those tables, between the cross-sections of composite transverse and composite longitudinal ships is very great. They are as 8 to 11, and the resistance to longitudinal bending is as 5 to 6, and that of horizontal bending as 7 to 10.

ON YACHT DESIGNING AND BUILDING.

By Henry Liggins, Esq., Associate.

It may truly be said that yachting is the national pastime of this country, particularly among the class of our wealthy countrymen who can afford to indulge their taste. The Queen, the Prince of Wales, the Duke of Edinburgh, and Prince Arthur encourage the sport, and two of our thirty-five yacht clubs have for their commodores the Duke of Edinburgh and Prince Arthur, and for years past the Prince of Wales has in his own small yacht attended the matches of the Royal Thames Yacht Club, to which I have the honour to belong, and which is the oldest and largest yacht club in the world.

The number of yachts registered in this country is about two thousand five hundred, their tonnage about 60,000 tons, and the number of seamen employed to navigate them about six thousand. I am obliged to say "about" such numbers, because no accurate or reliable list exists, as I think should be the case, from which exact data can be obtained.

The money value or cost of production of this large fleet may fairly be set down as £1,500,000 at £25 per ton, although few vessels of the present day are ready for sea and finally fitted for use much under £30 per ton.

I hope I have given some good reasons why the subject should receive more consideration from naval architects generally, and from this Institution in particular, than it has hitherto done; and I may further remark that yacht designing is essentially the school in which the designer has the opportunity of displaying his talent, and of proving his success in the annual contests that take place in all the great ports of our country, and even across the mighty Atlantic; while our superiority in this particular has yet to be proved in the great centres of yacht building and sailing in the United States.

The only work written on the subject in this country that possesses any value is the book brought out in the year 1856, by the late Mr. P. R. Marett—now, I regret to say, out of print, but much sought after—who gave very concisely all that was known of general interest down to that time, and then lamented the "great want of scientific principle in the construction of yachts, and that few yachts built answer the expectations of builder or owner." He attributed this "to the imperfect knowledge of the theory of naval architecture which the generality of yacht builders possess," and he further remarked that, "although the builders are undoubtedly men of great experience, still the very nature of their employment prevents that study of the scientific part of their business which can alone produce a competent naval architect." Mr. Marett was of opinion that the art of scientific designing was more in the way of the experienced yacht sailor than of the mechanical builder, and illustrated his opinion by the fact that the fastest yachts of that day, viz., "the *Mosquito* cutter, the *Alarm*, and *America* schooners, were not designed by regular yacht builders, who were then unable to compete with the scientific naval architect and scientific yachtsman who did design them, but were driven back to follow in their wake, and adopt any model that attained a temporary superiority."

These remarks of Mr. Marett, which were perfectly true in 1856, are in a higher degree applicable to the present day, both in this country and in the United States, where in the last few years yacht sailing has received enormous development.

I state this fact from my own knowledge and personal observation, and as an illustration may mention, that in the month of August, 1868, the New York Yacht Club schooner *Sappho*, the largest racing yacht in either country, came over here and challenged the leading yachts of each rig to a match round the Isle of Wight, on the 25th August, 1868, with a time allowance for difference of tonnage that was considered all in her favour; she was reported to be the newest yacht, and the fastest in New York in all weathers, and was looked upon as the best specimen of an American fore-and-aft schooner afloat, a kind of vessel in which up to that time the Americans were unrivalled.

The English yachts that accepted her challenge were the unrivalled cutters *Oimara* and *Condor*, to this day at the head of the list, and the schooners *Aline* and *Cambria*, second to none at the present time. It was admitted by the American owner and his captain, that nothing could be more fair than the manner in which the match was sailed in a nice steady fresh sailing breeze, the strength of which will be understood when I state that the winning vessel was 8¼ hours making the round. The start took place from off Cowes at 10 a.m., sailed to the eastward with a nice full sail breeze from N.W., and the match was finished off Cowes as follows:—

		H.	M.	S.
1	*Cambria*	6	17	30
2	*Aline*.................	6	19	36
3	*Oimara*	6	22	55
4	*Condor*	6	25	40
5	*Sappho*	7	55	0

Now this is a case in which a fast new American yacht was beaten by a faster new English yacht in an 8¼ hours' race, by one hour 37½ minutes.

This fine vessel changed owners, and came amongst us again after being greatly improved in New York, and I am proud to say, that at the time of her defeat, a member of our council, Mr. John White, of Cowes, expressed an opinion as to her deficiencies, which were in some respects adopted by her new owner, but it was not until after Mr. White had her in his hands that she became the perfect vessel that she now is, and I believe her at this moment to be the fastest yacht in the world.

So much for alterations in an American yacht, but everybody knows that the *Oimara* cutter never won her matches as originally designed; she was over-masted and had to be reduced, and then proved a great success. At the earnest entreaty of her builder she was altered back, some years after, to her original dimensions, and was a dangerous failure, and at great further cost was, last summer, altered again, by reducing her mast five feet in length, and is now again the fastest cutter in the world.

The *Cambria*, too, since launching, has constantly received alterations in hull, spars, sails, and ballast, and is, in my opinion, at this time, the fastest schooner in England. I may mention another very fast and successful racing schooner, the *Egeria*, that has taken years to bring up to her present state of perfection and speed.

I have recorded these facts to show that, up to the present time, the designs of yachts are made by gentlemen, who carry out the constructive work magnificently well, but who so completely guide themselves by the rule of thumb, and not by scientific knowledge, that it is really all a chance how the vessels turn out; but this unsatisfactory state of things is so disappointing and expensive to owners, that none but very rich men can venture to order a racing yacht; so that the present unsatisfactory arrangement of combining the skill of the designer and the work of the builder in one person tends greatly to check orders, and the development of a trade that might be made with more success, and certainly of greater importance to the nation at large, as a field for the improvement of the science of naval architecture generally.

With a view to remedy these anomalies to some extent, and to prevent the repetition of former blunders and proved failures, the New York Yacht Club have a rule as follows, that—

"The model of every yacht entered for a regatta shall be deposited with, and become the property of the club, and retained in its possession, and no other than a United States naval constructor shall be permitted to copy it, except he shall have obtained written authority from the owner or builder of the yacht."

I know that in this country, however general the desire may be to receive all the information and knowledge possible, there is a feeling among yacht-builders and their owners that their designs should be kept as secret as possible, and that a successful yacht should have her good points known only to those who are immediately concerned in them; but after what I know of such matters, and the success in information I have been able to get at some time or other, and the remark made last year by our friend Mr. Merrifield, that "he could find more than one man who, if he had an opportunity of walking round a yacht lying on the ground on her legs, and had also access to the Customs measurement, will be able to reproduce the lines of that yacht with quite sufficient exactness to be a practical copy of her, the sailing, he thinks, depending very much more on the way in which the weights and sails are put into her, than upon those minute differences in her lines which he would fail to catch. It must be remembered that the trained eye of a man thoroughly accustomed to taking off lines from ships and drawing them, can copy a vessel at sight with far greater minuteness than is commonly supposed possible, and probably with far greater minuteness than the water would find out any difference in."

Then Mr. John White at that same time was good enough to express similar views, and added that, "as far as I am concerned with regard to any yachts built by myself and my son, I shall be very ready to furnish the Royal School of Naval Architecture with the designs and lines of those yachts, in order that they may calculate their elements."

I do not agree that any advantage is the result of the secrecy that is unfortunately so general among our yacht designers; on the contrary, I know it leads to much waste of time and money, consequent upon the repetition of old and tried before condemned theories, to the extreme disappointment of owners who have to pay for these useless attempts at improvements, which certainly would not have been the case if there was some central authority or museum of models and drawings which designers could, under certain restrictions, have access to.

Now I think the time has opportunely arrived when a new and, as I contend, improved state of things may be inaugurated.

I observe that, at South Kensington, a large, new, and costly building is fast drawing towards completion, which I understand is to be devoted to the use of the Royal School of Naval Architecture, and a Museum to contain the inestimable valuable naval models belonging to the Admiralty and various private contributors; and I think a very little interest and activity displayed in some quarters might enable it to be enriched by drawing and block models (not necessarily costly and pretty) of the leading yachts of the country, which have during the last half-century made their reputation generally known for speed, sea-going qualities, and general excellence of design.

I think that as the gain would be great to all parties, and the science which we all love, that it is a matter we may earnestly hope may be considered as worthy the careful consideration of the Council of this Institution; and I venture to suggest that if they would bring the subject to the notice of the Admiralty, I have reason to think their advance would be favourably received. And perhaps, with a view to a national good, their lordships might be induced to require that whenever a new yacht applies for the necessary Admiralty warrant, they should accompany it by requiring the builder to deposit with them a certified correct drawing and model, to be placed by them in the National Museum, under the guardianship of their own curator, or the authorities of the Royal School of Naval Architecture, or of this Institution.

I am glad to know that the value of this Institution, and if I may be allowed to use the expression, its right arm—the Royal School of Naval Architecture—is duly appreciated, and is producing excellent fruit; and I hope this paper may act as a stimulus to the students by my pointing out to them a new field of study, and one that would lead to emolument, wealth, and national good.

ON RAKING STERN POSTS IN YACHTS.

By Dixon Kemp, Esq., Associate.

It is well-known that the practice of raking the sternposts of yachts owed its existence to the now obsolete club tonnage rules, which took the length of a vessel along the keel, and it is somewhat surprising that the practice was not abandoned when the rule became altered to length on deck. In fact, one would think that, under the new rule, the same inducement existed for putting the sternpost upright that caused it to be excessively raked under the old rule, viz., that of cheating tonnage. The truth is, however, that some of our yacht builders, who are notable for building fast-racing vessels, adhere steadfastly to the rake, and, no doubt, can defend the system to their own satisfaction. The principal argument urged in favour of the rake is, that it enables the vessel to stay quicker, owing to the reduction it makes in the area of the immersed longitudinal section. It is also argued that an increased area of rudder is obtained by the greater length of sternposts, and that deck-room is gained by the rake; and that the rudder remains at ease when the vessel is at anchor.

In reply to the first argument, it may be at once stated that the desirable reduction of the immersed longitudinal section can be obtained by other means. If the mere object of raking the sternpost is to reduce the lateral resistance of a vessel aft, it is obvious that this can be done as well by narrowing the immersed longitudinal section as by shortening it. Perhaps my meaning will be more clearly understood by the annexed diagram, where the dark lines show the usual rake (35°) given to a sternpost, and the dotted lines the upright post, with decreased depth corresponding in area to the increase longitudinally. (The advantage here gained by the reduced length "taken on deck from the fore-side of stern to after-side of sternpost" is very considerable.) In some yachts as much as 45° of rake is given to the sternpost, and in such vessels the "drag" has to be increased accordingly, so as to keep the centre of lateral resistance sufficiently aft to permit of the carrying of a large mainsail. There is no denying that the shorter a vessel is on the keel the quicker she will turn; but the question is, whether the quickness gained in bringing a vessel head to wind by a raking sternpost is not more than counterbalanced by disadvantages.

The increased deck-room gained is a matter of very small moment, and not worth considering at all; and we can very well dismiss in the same way the other argument used in favour of the rake—that the rudder, for the reason that it hangs away from the vessel, remains at ease when at anchor.

Apart from the question of tonnage, the strongest argument against the rake is the hard helm it makes a vessel carry when she is making any considerable speed. A notable example in this way is the schooner-yacht *Livonia*, which has, I believe, about 30° of rake. I have seen this vessel, when going twelve knots an hour with checked sheets, or eight by the wind close-hauled, require four men, with two double tackles on the tiller, to move the helm a-weather, the tiller being about ten feet long; and I have seen American yachts (all of which have upright stern-posts), with tillers not more than half the length, have them easily put up by one hand without any tackle whatever. No doubt the *Livonia's* is an extreme case, as she is a vessel that, owing to an extremely powerful immersed water-line aft, takes a great deal of weather-helm; but separated from this defect—shortly to be remedied, I hear—she suffers more or less from a hard helm, as all yachts do that have excessive rake to their stern-posts. This "hardiness" is traceable to the fact that each time the rudder has to be moved a body of water is lifted, which, besides causing inconvenience to the steersman, has a serious defect on the vessel herself in a seaway. Mr. Edwin Bett, in his "Notes on Yacht Building," one of the cleverest treatises ever written on yachts, says:—"When the slanting rudder is put over to one side, it has a tendency to dive or drag the ship's stern down, and this lifts the bows; the remainder of the force which it is capable of exercising is directed to turning the ship round. If the stern-post is placed at an angle of 45° to the perpendicular, and the rudder put over to an angle of 90° to the keel, then exactly half its power is devoted to lifting and half to turning; and as the inclination of the stern-post decreases and approaches the perpendicular, so the lifting power of the rudder is decreased and the turning power increased until the perpendicular is reached, and then all the force of the rudder goes to turn the vessel. The effect of depressing the stern and lifting the bows, when altering the direction of the ship's course is not, as may be imagined, to render her easier to turn; for neither the whole displacement, the lateral resistance, nor the length of the water-lines are in any way reduced, but that she will turn on her keel instead of on her centre. The after-part of the ship being somewhat depressed, it remains comparatively stationary, whilst her head comes round. It follows then that a greater part of the slanting rudder's force being devoted not to turning the ship, but to making her turn on a particular pivot, that its efficacy is reduced according to the angle to the vertical at which it hangs; and it must therefore either be larger than the upright one, or it must be put over to a greater angle to produce an equal effect; all of which amounts to so much more stoppage of the ship's way."

Now Mr. Brett has here very clearly pointed out the disadvantages of the rake, and his statement of the case embodies the cause of a vessel with a very raking stern-post steering hard.

Another argument that can be revived against the rake is the danger of the rudder being damaged by a sea hitting it. The probability is, that if a rudder, hanging to an upright stern-post, were hit by a sea when the vessel's stern were raised, it would receive the shock without harm, and yield to the blow, even though it were over at an angle of 30 or more degrees; but in the case of a rake, the weight of water would come on the plane of the rudder, which, resisting the force by not immediately swinging on the gudgeons, would be likely to receive very serious damage; and if a vessel were badly scending, that is lifting her bows and depressing her stern, the consequences might be even more serious, and inflict some injury on the steersman.

So much the fashion has raking the stern-post now become, that we frequently hear of vessels having their rakes altered from about 20° to 40°, and at the same time a portion of the fore-foot is rounded away, to keep the centre of lateral resistance as nearly as possible in its normal position. But very frequently the fore-foot is not rounded away, or cannot be taken off sufficiently, and then the effect is that the centre of lateral resistance is thrown forward, and the centre of effort of the sails remaining the same, strong weather helm is carried, and every one, I presume, knows what a bad thing too much weather helm is. Whilst on this subject it may not be out of place to remark that very frequently our builders do not pay sufficient attention to the positions of the centre of effort of the sails and centre of lateral resistance of the vessel. The latter centre, when the vessel is under way, and especially in a seaway, is continually shifting; and on a wind in smooth water, is always more or less thrown forward by reason of the wave that accumulates under the lee-bow. To regulate this deviation of the centre of lateral resistance from its normal position, the obvious plan would be to have the centre of effort of the sails forward of the vertical, in which the true centre of lateral resistance is; but I only know of one yacht-builder who has given this point attention, and he, I believe, always does place the centre of effort forward to the extent of four to nine inches, according to the size and peculiarities of the vessel, and an easy weather-helm and no gripe is the consequence.

American vessels always, for the reason I have just indicated, carry less weather-helm than an English yacht does; but then, again, American yachts are not subject to other abnormal influences which English yachts frequently are. One never sees an American yacht, when on a wind, lifting her quarters out of water and forging her head down, and the reason is that American builders pay greater attention to the immersed or inclined water-line fore and aft. If the vessel be too full aft above the load-line, she naturally, when inclined, lifts her quarters, and the result is to decrease the lateral resistance aft and increase it forward. The steersman is perplexed, and has to put his rudder right across the keel to keep his vessel out of the wind; and ultimately, finding this damaging remedy ineffectual, checks his main-sheet, and then the sail is, perhaps, not at such a good angle. I am now, however, wandering from the immediate scope of this paper, and with a few more remarks will bring it to a close.

There is no doubt, as I said before, that the shorter a vessel is on the keel the quicker she will turn, and the seconds gained this way may be of advantage when sailing in a ditch; but the question is whether altogether better results might not be obtained by rounding the keel a little more and having a vertical stern-post. A fairer amount of lateral resistance—an essential for weatherliness—would be obtained with considerably less draught, and this I consider a matter of the utmost importance. I was witness that both the *Cambria* and *Livonia* were quicker in staying than the American yachts they contended against, but they were both out-winded, and the few seconds they gained in tacking would not alone save them from defeat.

I have approached this subject with a great deal of diffidence and without any intention of dictating to a class of men of so great experience as our yacht builders; at the same time I think it is a matter well deserving their consideration, and I trust that they and this meeting will receive my imperfect remarks in the spirit they were intended.

ON CHANNEL COMMUNICATION BETWEEN ENGLAND AND THE CONTINENT.

By Henry Liggins, Esq., Associate.

There is no subject of great importance in this country and, I believe, also on the continent of Europe, in connection with travel, that has received so much notice and anxious consideration, and which is more ardently desired to be improved, than the present universally admitted unsatisfactory and imperfect mode by which the trifling distance that separates us from our neighbours is accomplished. It is not too much to say that the arrangements of the railways on both sides of the Channel, and the steamboats, are as unsatisfactory to the traveller, and also for merchandise, as it is possible for the most indifferent persons to have devised; I also think they are, when compared with what has been done in other countries, the United States and Canada more particularly, for the simplification and comfort as well as the expedition of travel, a disgrace to our genius as a practical people.

These are somewhat harsh remarks, but I hope, to some extent, may be justified from the fact that those who are concerned in, and are expected by the public to effect improvements, have for many years been led astray from their work, by being worried by gigantic plans for improvements of the harbours on both sides, by plans for tunnels, for bridges, and also plans for such novel and costly vessels, that I think that no nautical man of any Channel experience who may have been consulted on their applicability, could be expected to adopt any of the plans that have yet appeared for tunnels, bridges, ships, harbours, or balloons.

I think, now that happily peace prevails all over the world, and between us and our neighbours in particular, that the time has arrived when we should unite the talent of different countries interested in this undertaking, and agree to adopt some well-devised expedient for remedying the acknowledged defects as they now exist. I think my experience of travel in different countries, over a considerable number of years, has been sufficiently extensive and observant to justify my venturing the following suggestion for their accomplishment. They have no novelty whatever to make them attractive, but possess the greater advantage of being practicable and efficient, as well as capable of rapid execution, at a cost that is a mere bagatelle to most of the schemes which, up to this time, have naturally, from their frightful cost and risk, prevented their adoption, and deterred financiers from entertaining, because it has never yet been shown to the satisfaction of those who have to find the money, that those schemes, if they would give the public what they require —which I for one, and as one of the public, very much doubt—could be made to pay. I do think that this is the first element that should be settled, and until it is, I predict that the public will have to wait and grumble.

Now I have no desire, by using a nautical phrase, "To take the wind out of another's sails, " if I do so by remarking that the only grumblers about the present system are the half-dead sea-sick travellers, and not the inert dead goods and merchandise, whose owners have not yet bestirred themselves to make even a modest growl, considering no doubt that the goods can take care of themselves, and that passengers will never willingly consent to become part of a goods train in a dark unhealthy tunnel for an hour, or in a steamer lumbered up with railway carriages for an hour and a quarter, which railway carriages would gladly be deserted by their occupants, who would be only too ready to stretch their legs after their ride from London, Paris, or Brussels; and if they were not glad to do so, it would, I am sure, be because they were sea-sick, in which case I leave others to imagine what would be my discomfort as a non-sea-sick voyageur, on resuming my land journey to see around me and probably on my vacant seat the evidence of my fellow-traveller's suffering.

I have studied the various plans for tunnels, and quite believe in the skill of our engineers being able to accomplish them, but at a cost that I feel certain never can be made a financial success, and, even if completed, there is in the minds of so numerous a body of travellers such a horror of tunnels in general, which would not be lessened by the knowledge that a stormy sea was over-head, that I feel convinced opposition steamers would draw off a large portion of the traffic, either by way of the Straits of Dover, from the Thames, or by Newhaven and Dieppe, which latter route, by the bye, might be made, with some improvements in the harbours, and by much larger and faster boats, the quickest as it is now shortest, and one of the cheapest routes to Paris. (I am quite aware of the reason why the Dieppe boats are now six hours doing the run from Newhaven, although if it was worth their while to use the speed they possess, they could accomplish the run in four or five hours, but the state of the tides require that a faster class of vessel should do the distance in three hours.)

I have been in too many of the most severe gales in the Channel, where alone experience on such matters can be gained, to believe for a moment that any system of bridge that has yet been brought out can be risked. Our engineers can, at a ruinous cost, construct a bridge that will be safe; but no seaman yet born, not even a Dover pilot, would undertake, under the varying circumstances of weather that too frequently prevails on our coast, to keep vessels clear of such an obstruction; and I do not think, even if the bridge was raised up in mid-air so as to allow ships to freely pass under, that the nations of the world would ever permit the obstruction which the piers would offer, when on many occasions no amount of warning lights would be of any avail, and numerous shipwrecks and floating dead bodies would soon testify to the folly of the scheme.

I now come to the plans that have appeared for monster steamers, 400 or 500 feet long, to carry trains, for these monsters are not, and never will be, required for the passenger traffic. It is perfectly true, and there can be no two opinions, that it would be an enormous saving of time, risk of injury to goods, and convenience, if goods could be got across in the trucks in which they were packed at Manchester and taken straight through to Paris, even Constantinople or India, without break of conveyance; but I hope I have already shown that, in the matter now under consideration we should act wisely in confining our inquiries alone to passenger transit; and I am quite clear that no such steamers could ever be made to pay, because competition with other routes, such as those in daily use by the General Steam Navigation Company, established in 1824, would prevent the charge of any extra sum on goods to meet the enormous outlay for these costly vessels.

I have had considerable experience at sea in the largest ocean steamers, and am as certain as I am of anything, that those monster ships, if not impracticable, are unsuited to the seas of our Channel and the harbours that exist or that may be made on either side. But they would be dangerous at sea with their enormous load of trains, and every practical sailor knows perfectly well that their motion will at all times, even on the finest day produce sea-sickness. I may here remark that one of the greatest and most successful geniuses in our country, Mr. Henry Bessemer, will find that his new ship will render her passengers as liable to sea-sickness as any ordinary vessel, for his skill has failed to neutralise the effect of the upward heave and the downward depression, which, I believe, has more influence on the brain, mind, and other refractory organs, than the pitching and rolling motion.

I cannot hold out any hope that sea-sickness will ever be cured by the civil engineer, the naval architect, or the physician. Our aim must, therefore, be directed to lessening its miseries and shortening its duration; and in this respect I am satisfied we have the remedy at hand.

I must say a few words upon the proposed new harbours that any monster steamers will demand, and am satisfied that there is no occasion whatever for any such lavish outlay, which, like the ships, never can pay any interest on the enormous sums their construction will require. Besides, while tunnel, ships, and harbours for them are being made, many years will be required—I think wasted—and the present generation will have lost all interest in the matter, and are, therefore, not likely to advance capital for the benefit of posterity.

Now, what is the difficulty that has for so many years occupied so much thought, and to travellers occasioned so much misery?

The answer is very simple. Twenty-one miles of water divide us from our friends on the other side, who desire to see us as often as possible land on their shores in health and good spirits; and we still continue to sing with heart and voice, "Britons never shall be slaves!" while we allow this twenty-one miles of Neptune's domain to tyrannise over us.

I am quite alive to the necessity for improvement in the only two harbours that I think need be considered in any new plan—viz., Dover and Boulogne. (I exclude Calais, twenty-one miles from Dover, because it involves an extra land journey of twenty miles, or one hour in time to Boulogne and Paris.) I think, too, that Folkstone possesses no advantage to justify its continued use.

Boulogne is twenty-five miles from Dover, and Boulogne is about twenty-seven miles from Folkstone. So that I propose a route four miles longer than the shortest that can be used—say fifteen minutes more—but saving one hour in the land journey. Another reason for adhering to these two ports is, that in themselves they are very large and attractive towns, carrying on a considerable trade, the destination of a large number of passengers, and also as stopping-places by many for rest during a lengthy journey. Besides, they already possess so much good accommodation that a moderate extra outlay and a few months' work would make them nearly perfection.

The trains from London, England, and Scotland run along the Admiralty pier at Dover, a magnificent work; and any vessel suited for our purpose can lie alongside of it at all times on whichever may, according to the direction of the wind and sea, be its lee side. Without in any way interfering with it or its uses, much smoother water could be procured, and a really fine roadstead be made, if a second arm were run out at any convenient spot to the eastward, having an entrance of from 500 to 1,000 feet wide. But this improvement is no necessary part of the suggestions I offer for the present. Little more is required now at the Admiralty pier at Dover than the erection of a commodious shed, under which the trains should run with their passengers, with suitable and improved landing-stages, covered in from the rain and snow. Steam cranes are now in general use, and cost less to work than the present large staff of porters that are required to convey the baggage from train to boat and from boat to train. To my mind nothing can be more barbarous than the custom that prevails in this country and abroad of handling every package of luggage singly, whether large or small, in all the changes that a long journey renders inevitable. How easy it would be for a railway company to save money for their proprietors by placing upon a truck, say two large boxes, in the aggregate the size of an ordinary luggage van; as the baggage arrives at their station in London, say for Paris, place all the baggage, large and small, in them instead of in the fixed box as at present. At Dover, while, and in less time than the passengers are stepping on board, the steam crane would in a few moments transfer these large boxes, perhaps each containing fifty articles of baggage, from the train-truck to the hold of the steamer, thereby saving much time, some anxiety to the traveller, and preventing all damage and injury from exposure to bad [illegible]

There being plenty of water at Dover, these indicate all the improvements that I consider to be necessary to make that port useful and convenient; and an outlay of £1,000 is sufficient to give the public what I think they have a reasonable right to expect.

At Boulogne we are not quite so fortunate in the depth of water, and I fear this is *the* weak part of all the proposed plans; however, we have to consider how this difficulty can be surmounted.

I have no doubt that the French government and the authorities of Boulogne will be prepared to consider any reasonable scheme for the improvement of the harbour and deepening its water, even to the extent perhaps of protecting its rather dangerous entrance by a further extension of its piers; but I do not think it reasonable of us, who do all the sea-trade—and let us hope that our delay in improving it may not cause us to lose it altogether—to ask them to expend hundreds of thousands, or perhaps millions, upon their harbour, which is now good enough for their own requirements.

The present harbour is sufficient for the vessels I shall presently indicate and describe, if used by them at a proper time of tide.

The Northern of France line of railway is now in use for goods only, on the new quay on the west side of the harbour, and might be used to-morrow for the passenger traffic; but I have heard within the last month that, desiring to keep the passenger and goods traffic quite distinct, the railway authorities are about to lay down a line of rails to and on the east quay, where for many years passengers have embarked and landed. This should be supplemented by shed covering for the train, covered landing stage, and steam cranes; a similar outlay to that at Dover, viz., £1,000, in addition to this half-mile extension of railway, is all that is needed to give perfection on that side of the water.

I now come to the vessels, and in doing so may be excused for paying a tribute of praise to our old friends, the *Lord Warden*, the *Victoria*, the *Maid of Kent*, and others. I am satisfied that these vessels and their able commanders, to whose skill and care we owe so much from their absolute freedom from serious accident in these stormy seas, are, in their way, nearly perfect; but fine as the vessels are, and safe, they never were suited to convey passengers; and I do think, limited as their accommodation is, it could not have been worse arranged than it is for decent people.

I have no desire to draw comparisons between our usual passenger steamers and the magnificent steamers running on Long Island Sound, near New York, where, at some parts, the sea is quite as rough as between Dover and Boulogne; but I think there is no reason why we should not learn a lesson from them in the beautiful trim in which they are kept, and the perfect accommodation on board. The fares charged are much less than we are used to, for if we adopted the scale I have paid there, a first-class ride from London to Paris would not cost more than 20s.

Our best coast passenger steamers are the Holyhead and Dublin, or rather Kingstown mail boats, but they were not placed on the station until the subject had been agitated in the newspapers, and their owners dinned and entreated to give the public the accommodation they desired.

Now, these vessels are, in almost every respect, suited to our Channel requirements, with one exception, and that a fatal one—viz., they draw too much water to enter Boulogne at all times of tide, particularly when that depth is reduced by boisterous weather, and the rise and fall of stormy seas at the entrance.

I then search for other fine specimens of suitable passenger boats, and unhesitatingly select the one that is undoubtedly the finest river passenger boat in the world—the *Iona*. You, many of you, know her high character on the Clyde, where I have seen her with 4,000 passengers on board—of course, far too many for comfort; but she is very large and roomy in every part, and has a speed of 21 miles an hour; a portion of her work between Glasgow and Ardrishaig is frequently in very rough water, and the Scotch, who are truly fond of steamboating, are justly proud of her.

The principal dimensions of the boats now in use, and of others I have named, are as follows:—

	Holyhead Boat. *Connaught.*	*Iona.*	Belgian Mail. 5 boats.	London, Chatham, and Dover. *Foam.*	South Eastern Railway. *Victoria.*
Length	348	255·5	227	237	220
Breadth	35	25·6	24	34	25
,, over paddle boxes ...	...	44	46	56	43·9
Depth in hold	20·3	9	14·6	13	10·6
Draft of water	...	4·6	7·6	7	7
Gross tonnage	2,039	$393\frac{34}{100}$	568	...	...
Registered tonnage...............	...	$112\frac{86}{100}$	...	...	...
Horse-power (nominal).........	720	180	220	260	...
,, (indicated)	...	800	1,600	...	...
Speed (trial)	...	21	...	...	...
,, (working)	21	19	17	..	...
No. of passengers licensed for	...	1,400	...	...	...

Now, I am not about to trouble this institution with any detailed plans for new ships, but I desire to indicate that, in my humble judgment, all that is required are fine, large, roomy, fastships, to do the distance, 25 miles, in $1\frac{1}{4}$ hours, in most weathers; say about the length and breadth of the *Iona*, fitted somewhat in the same manner as regards decks and cabins, but with as much greater draft of water as may be allowed for Boulogne harbour, and with more free-board, higher bulwarks; and, in fact, many arrangements that the different nature of her work would clearly show to be necessary. The best of the present boats might be kept as a spare vessel, to be used only in very severe weather, when perhaps, not a dozen passengers would care to cross.

There is no difficulty in preparing plans for such vessels, and I take it for granted that the ordinary paddle-wheels must be used; and if they are made to disconnect, as Mr. Scott Russell has so ably described here on previous occasions, so much the better.

That the new boats must draw little water is a misfortune. The Holyhead boats draw 14 or 15 feet, and I fear the utmost limit we can venture upon for Boulogne is 10 feet.

The sea disadvantages of light draft may, to some extent, be got over by good beam; but this must not be carried too far, or it would, in bad weather, increase the rolling. This rolling may be considerably checked while out in the Channel deep-water, if the vessels were fitted with bilge-keels, or with two iron-drop keels, or with centre boards—(invented in England 210 years ago, and much used in shallow vessels at this day in the United States).

Such vessels, with the deck area and cabin accommodation of the Holyhead boats, or the *Iona*, with the internal upholsterer's work adapted to this service, is all that is needed to satisfy the requirements of the trade, the wants of the travelling public, and our own national honour.

I may here remark that the bed-places, sofas, and almost every part of the cabin fittings of most of our passenger vessels are fearfully deficient for the comfort of those using them, and are planned by men who have had no experience of the exacting requirements of sea-service.

I fear, for the present, that the depth of water at Boulogne must require the service to continue to be as now, a tidal service, but I know of no reason why one large, new, fast boat should not do the work that is now done, to and from Folkestone, by two boats. For instance, the steamer could be timed to leave Dover on her daily work so as to reach Boulogne half an hour before high-water; a stay there of one hour would enable her to land her passengers, clean up and take in another set of passengers, and leave the port about half an hour after high-water, on her return to Dover. This short stay could, at many states of the tide, be extended another hour, giving plenty of time to deliver and receive such light freight as these boats might carry, and which should be stowed in boxes, to be dealt with in the same manner as the passengers' luggage, by the steam crane, so as to interfere as little as possible with the local vessels in Boulogne harbour; these boats might be made sharp at both ends, so as not to require to swing or turned round until after they had left the harbour.

If a night as well as a day service was decided upon, I think three such boats would be quite ample to do the work easily.

To obtain the money for these costly vessels, I would venture to suggest that the South Eastern Railway, the London, Chatham, and Dover, and the Great Northern of France, should unite their friendly forces, and urge upon the governments of England and France to give them the mail contracts, so that they might reap the pecuniary benefit of these contracts in utilising some of their present boats.

I take for granted the fixed hours for the mails must settle small boats to Calais for that service.

The daily average number of passengers crossing by the Straits of Dover, during the year, is, I believe, under 1,000 a day; and I think the abandonment of some of the services, concentrating them into one service, in large fast boats, would soon cover this cost by more than doubling that number.

I feel sanguine that if these suggestions are carried out, and moderate fares charged, the comfort of the vessels, and the short time occupied in crossing, would very quickly divert all the passengers from the numerous other routes, to the gain of the proprietors of the railways and steamers, and add to the honour and *prestige* of this great country.

ON INTERNATIONAL COMMUNICATION BETWEEN ENGLAND AND EUROPE BY SPECIAL HARBOURS AND TRAIN STEAMERS.

By John Scott Russell, Esq., F.R.S.

I am happy to be able to say to this meeting that the long-missing link in the chain of international communication by railway between England and the Continent has been found. This missing link, which the reader of the preceding paper, Mr. Liggins, so much deplores the want of, is not any particular mode of ship-transport, but a deep-water harbour on the French side. This deep-water harbour has been found out. It has been approved by all the French engineering authorities to whom it has been submitted. It has passed the ordeal which we call passing through the Committee of the Lords and Commons. It is now on the point of becoming the law of the land and the sea; and I am now permitted, with great pleasure, by my colleagues on the French side of the water, to announce to you that the heavy labours in which they have been engaged for the last three years to get this matter authorised and carried into effect, have now been successful. M. Dupuy de Lôme, the late constructor of the French Navy, desires me to say to you that he intended to have come here this evening, in fulfilment of a long promise and hope of his, to join in our proceedings; and he would have joined with me in reading one-half of this paper to you, and I would have read the other, for he and I have been colleagues during these three years in our endeavours to find a deep-water harbour on the other side of the Channel. He regrets that he cannot now come. but he promises you and me that he will make his appearance at our meeting next year. I beg you to understand that the missing link which I am about to present to you this evening is a harbour matured by himself, by another marine engineer who has joined with us, by a whole group of French marine engineers, and by your very humble servant who represents so much of English professional duty as is involved in the invention and construction of this harbour. I ought to add also, that this matter has advanced so far that the parties who have to carry it into effect have been appointed. The contractors have made their estimates, and a contract has been made, and I am able to inform you that the deep-water harbour on the other side will be ready for you in two years at the most, and in much less time if it is thought worth while to expend the money for that acceleration of time. So that we are now no longer talking of hopeless projects, but of that which is immediately within our power. I will first describe the difficulties which have so long prevented this want of a French deep-water harbour from being supplied. I will next explain the principle on which this deep-water harbour has become possible, after being universally considered impossible for so many years. Finally, I will explain how the new system is to be worked. Allow me shortly to explain to you the inextricable difficulty of old Calais harbour, and the inextricable difficulty of all harbours of that sort. Calais harbour, as most of you know perhaps, was merely a little inland stream, deepened enough to hold water for boats at high water, and even deepened enough to hold water for some boats at low water. Now, allow me to tell you the story of the old Calais Harbour, and why it has been impossible to make it good for anything for our purpose. Imagine an inland stream turning down through a line of coast. We will call this the line of coast, and this the inland stream. [*Illustrating it.*] When they wanted to deepen the inland stream to hold vessels, what the did was to dam up the water, and scour the channel out. They dammed up the water, they opened the sluice, and they scoured the channel out. And what did this stream of water do, do you think? It scoured the channel out, and all the stuff it scoured out of the channel it put up in a pretty heap in front. That is what the water did; but it took ten years to do this in an intolerable manner, and during that ten years there was something like a deepish channel. After ten years the channel was scoured away to this bank. Well, the engineers, looking not too far ahead, but being, as we would call them, moderate practical men, said, "Oh, we will soon get over that difficulty." They said, "Let us run out a long row of piles:" and they did so. They put a pier, and at the end a lighthouse, thinking that that was the end of the whole difficulty. They then said, "Let us put another mark here, and let us take a larger reservoir of water inside; we will confine it, and then we shall have a bigger rush, and see if it will not sweep this impediment away." They dammed up the water, they then let it out, and it swept away the impediment, and they said, "Look! See what a harbour we have made for Calais." This went on day by day, and then gradually shallowing week by week a little further out, until at last they found they had taken all the stuff away from where they had first placed it, and deposited it a little further out. That was ten years more work. Then they said, "Oh! Now we know how to cure that very easily;" and then they began to do the same thing over again. The lighthouse was shifted out, the piers were continued, and the embankment was carried out further. Gentlemen, that is the history of the fifty years of my personal intimate acquaintance with the harbour of Calais, and I need not say that I looked upon each of these experiments with the deepest interest. Now, perhaps you would not be surprised (to use a modern phrase) to find that when M. Dupuy De Lôme, and some of the French engineers and myself were appointed to consider this serious question, we did seriously, in the first intance, entertain the question whether we should or should not do this over again a little more, and we agreed that we should not. What we did determine to do I will now tell you. It occurred to us that, as this plan of trying to bring deep water inland did not seem to answer, we would try an altogether new plan, and see if we could not take the land a great way out into the deep sea. That was our idea. So we said to ourselves, "Suppose we make an island out in deep water, with nothing but deep water all round it; and suppose we then cut out of the inside of this island a comfortable little harbour, leaving just all round as much thickness of island as we want, and inside of the island as much room as we want?" Might not that be a decent plan? Well, we thought of making this island. Of course, there were difficulties in the way. Making an island is not yet what you call an established trade; and what we should make the island of, and what shape we should make it, and how we should get it there, and how we thould make a harbour of it when we got it there, was very troublesome work to us; and I candidly confes, to you that it spoilt our sleep for a great many nights. At length, the difficulty, by dint of investigations gradually cleared away, and at last we settled that we would make an island, and we settled that we would make a harbour in the middle of the island, and we settled that we would make a little railway viaduct out into the middle of the island, so that instead of bringing the water into the land, we would take the land out into the water. But at our first starting this island was an awfully big one, and awfully expensive to put there. Now I will explain to you the reason why this has to be built upon a totally different principle from any other harbour which you are acquainted with. You know the principle of a modern harbour. A modern harbour generally consists of two great piers, enclosing a large area. The harbour at Holyhead is such a harbour; it has two large piers enclosing a large area; the harbour at Portland has two great piers enclosing a large area; and the harbour at Kingstown has two great piers enclosing a large area. In order to make such a harbour conveniently accessible to railway vessels what are you obliged to do? You are obliged to make the opening of their harbour very wide. You are obliged to make the opening of the harbour face out into the sea through the channel through which vessels are most likely to be driven into it; and you make the opening inevitably so wide and so facing the sea, that enormous waves come into it. And how do you obtain shelter, and make it a harbour? In this way: You make the internal area of the harbour so large that the waves shall spread so wide as to become small by the surface over which they are spread—just as if you take a little pat of butter and spread it over a very big piece of toast, it becomes very thin. That is the principle of a modern harbour, and no other. And mind the consequence. There are waves that are obstinate, and will not spread. I remember being in the harbour of Kingstown, in Ireland, one day. In the harbour I saw three ships wrecked. And why wrecked? Because the wind happening to blow right into the harbour, the waves drove right into the harbour, and the vessels were driven on a lee-shore in the harbour and wrecked. I do not know whether you remember the poor *Great Eastern* standing in considerable danger of being wrecked in Holyhead harbour and carrying away her anchors. That would never do for us. So we had to find out something else. We have arrived, then, at this—first, that we should make our island in the water, and, secondly, that we should get the harbour in it. We came, then, to a determination which seems to me to read us several practical lessons. We were talking yesterday of a ship of war, and whether we should make a ship of war to do everything or only something. Now we ask ourselves, shall we make our harbour good for everything, or only good for the particular thing we want? We decided that we should disregard sailing vessels altogether, and we put this question to ourselves: What is a steam harbour, as distinguished from a sailing harbour, and what is necessary in the mouth of a harbour to let a steamer come in comfortably, and not a sailing vessel? Applying our minds to that question, we found that everything became altered. We found that we could abandon all those principles, and adopt an entirely new principle, and that is the principle which, if you will allow me, I will shortly explain to you. Now the principle. We determined that instead of turning the mouth of the harbour to the waves, we should turn the back of the harbour to the waves, and put the mouth on the sheltered side—and that is all: that is the secret, and there is nothing more to tell you. That is the harbour. Now look how that at once relieves us of the difficulty. When we have turned our back on the waves, and when the mouth is on the sheltered or back side of the harbour, then it is quite plain that we no longer need a large harbour to diminish the waves, because the waves no not come in. Therefore we can make the harbour as small as will accommodate our ships. We can only settle what breadth of opening our ships can comfortably steam into and what room in the inside is necessary for the evolutions which they have to perform, and then we have done all that is requisite. Of course, the character of such a harbour depends very much upon local circumstances. If you will allow me, I will now describe to you the local circumstances in which we had to do this, and how we did it. I ask you just to look for one moment at what is a very common kind of harbour—I think, if I remember rightly, Plymouth is of the sort that I allude to. At all events, I will assume for the moment that Plymouth has a very large inland bay (I forget the exact form of it, but there are many similar bays), and that there is something like a large breakwater (I do not remember the form of it) in front of a bay, that it leaves a comparatively small opening at the two sides by which vessels can comfortably enter. I do not know whether you have noticed, but I have, that the snuggest place in that harbour was here [illustrating it]. I said to myself, if the snuggest place in that harbour is there, why should we not make the whole harbour a snug place like that? So it occurred to me that to make this sort of shape would increase very much the snug part of the harbour, and that we could enlarge this place as much as we liked, and make a snug harbour in the snuggest place, where the waves could never reach it. Of course the poor sailing vessels, sailing in here, would probably not be able to make that on either side. Some might, and some might not; but the steamers would wish nothing better than to turn into this snug harbour, because they would be quite ready to start out again whenever opportunity required. That is the principle. Now I will come to Calais, and the application of the principle. The harbour of Calais presents a long drift of sand and a great sandy shore, covering chalk, gradually tending down from high water to low water; and when I tell you that it is about a kilometre, or 5-8ths of a mile, from the shore to the low-water line, and that the high and low water difference is something like 18 or 20 feet, you will see what a very gentle incline the whole of the sandy shore of Calais is. I will explain what I am about to say by a diagram. Call this the kilometre of distance; call this the shore; this the low-water line, and a point so much further out the place of deep water. For our purpose we call deep water from 20 to 23 or 24 feet. For our purpose we had to study for a long time the waves breaking on the shore, to find which way they broke; we had to study what were the prevalent winds, and which way the heavy seas came, because, for our purpose, it was necessary, if it were possible, to guard against alll contingencies which were likely to happen. Perhaps it might not have been possible. You will remember that I am not giving you a *panacea* for all harbours, but only giving you something which suits Calais harbour. After long study, and consulting naval men and captains in the vicinity—for they were all called upon to give their evidence, because this sort of thing had half the world for it and half the world against it—the conclusion at which we arrived I will now endeavour to illustrate to you. Here is the entrance to Calais harbour at low water; there are the ordinary sand-banks in front of it, as I explained to you; and outside, and clear of all these things, we found the deep water we were in search of. It so happens that steamers coming to Calais steam in this direction, and come in here. What we thought was, that we should put a harbour out here, and instead of turning in this way, the steamer would only turn in that way [describing it by the diagram]. Then we ascertained that the prevalent winds and sea all came from this direction, and so we determined to make our great harbour of this shape, and that the steamers should turn in this way into our harbour, and that they should go out again in the opposite direction. After a great deal of trouble, we found out what was the angle which would be perfectly protected against seas, and what was the angle which would be perfectly convenient for going in and out, and at that angle we put the entrance to our island harbour. Now I will give you the dimensions. We found that 1,000 feet in diameter, or 1,000 yards or metres round, was a size that would allow three of our large ships to do their duty there at one and the same time; that that size would allow comfortable entrance and comfortable exit, and that for our steam navigation, or steam station, we wanted nothing bigger. We then went into all the calculations as to the cost of it, and got our contractors to estimate how much they would build it for; and when I tell you that the whole harbour can be built for very much less than a million, you will see that there is something in this mode of working very much more moderate in expense than things of this kind generally are. We found that something like a million would not only make the harbour, but the ships. Now, I have given you, in general terms, what I will show you in a fuller manner. This is the actual plan of the harbour as it was approved of by the government before the war, and as it was about to be constructed before the war; but at that time the great majority of the people were against it, and people did not want to use it for any other purpose but our own. Unluckily, in the year which followed the war, people came to be in love with this harbour, and they would not let us make it for ourselves only, but they compelled us to make it for them also. So we have been obliged to open up our harbour, and make it considerably larger than was at first contemplated, with room in it where sailing vessels making for the entrance, and not being able to get in might take shelter. I have not been able to give you a diagram of the thing as it is exactly settled, because there are first a few little differences of opinion as to a little more this way, and a little more that way, which are in the act of being settled; but I have given you the principle, and from the mode in which I started you will see quite well that whether I open this harbour up a little more, or close it up a little more, makes no difference. Now one word more about waves, because there may be a great blunder made if you fancy the arrangement I have shown you is as good for a precipitous coast as for this long slow sloping one which I have described to you. Were this a precipitous rocky coast we should not have at all the advantages of this arrangement which we have here. With a rocky coast you would have great waves striking and being reflected. This harbour is locally protected on the west side by the form of the coast, and the waves only break upon it in this standard direction which I have shown, and the waves are so utterly broken upon this coast—so utterly broken to pieces—that there is not what you have upon a rocky or precipitous coast, a reflected wave. The consequence is that we have only to protect ourselves against those. The task therefore is, by that circumstance rendered easy, and the harbour appropriate to the situation. Time is getting on, and I am trying to give as fast as I can the whole story, so that I think I will leave that there. This line which you see upon the diagram, if the extension of the Northern Railway by a viaduct on screw piles, hollow, concrete piles, and matters of that kind, on to this island. The island is a quay of concrete and of iron. This quay has all around it lines of railway. These lines of railway begin at a certain level, and go gradually down to the level of high water. At this quay the boat which has to embark a load at high water embarks it—

or the contrary. At this quay a boat which has to embark a load, or the contrary, at mid-water, embarks it. At this quay the boat which takes in or gives out a train at low water, embarks it or the contrary. Now, these three quays are nothing new, but mere repetitions of former things in existence. All this manipulation we have been talking of in the inside is nothing new, but is only a repetition of what is known and practised in a similar manner in other places where trains are shipped on board ships to go across the sea. The point which is new, and which enables us to meet the difficulty, is the deep-water harbour of Calais. Now, I will explain to you how this system is to be worked. Let me say to you that there are no difficulties whatever on our side at Dover. The preceding speaker, Mr. Liggins, has justly praised Dover harbour. We have 40 feet of deep water at low water in Dover harbour, and, permit me to say that, with the least trouble in the world taken by the Admiralty, in a way that I and the Admiralty engineers quite understand; (and, I have no doubt when the French government come and say, "We have done this; will you be good enough to do the same thing at Dover," they will do it), the same thing could be done at Dover. They have only to make a slight arrangement of quays to receive our ships, and the shipments will go down to the sea by trains, and the trains will go down along the present government harbour, and so on to our ships, just as they do on the opposite side at Calais. In like manner as at other places, there are a set of harbour commissioners at Dover, who are now improving their harbours, and they assured me there was no difficulty in making a place in their harbour which would receive all our vessels in deep water at low tide, and which would enable them to ship, or not to ship, the trains, just as they pleased. Therefore, there are no difficulties in Dover harbour which a modest expenditure will not overcome. All the difficulties were these, and now, therefore, I will consider the matter at an end. The manner in which we propose to utilize this harbour is a matter open to argument. I will argue it as shortly as I can. A certain length of ship is necessary to go fast—we had better take that length of ship; a certain breadth of ship is necessary for a certain degree of stability—we had better take that breadth of ship; a certain draught of ship in the water is necessary for a good sea-going boat—we had better take that draught of water. Therefore, we are going to take a good sea-going length for speed, a good breadth for stability, and a good depth for sea-going qualities, and we are not going to make a bad ship on any account, or to please anybody. There are people who like bad ships—ships which draw no water at all, and which skim on the surface. But I am not one of those. I like a ship to have all the dimensions which are good for her in a seaworthy proportion. Now I will tell you where I know some very good ships; and if you say they are bad, I shall be glad to be instructed. I remember giving evidence before a Royal Commission, when it was said by a great many people that the communication between England and Ireland was so perfect, the boats so beautiful, with such accommodation, and such magnificent and exquisite proportions, that although they took an awfully long time to get across, especially in bad weather, yet nothing better could be done. Some time after that what did you find had come into existence? The Dublin and Holyhead boats. And I ask you whether those boats are not a triumph of mercantile and passage-carrying steam packets? Now I say we will take nothing less for ours than boats like the Dublin and Holyhead boats, because we think they are of the right proportions to be seaworthy, and go with sufficient rapidity. "Oh!" said somebody, "that is capital; but the Dublin and Holyhead boats do not take trains, and now they they are going to have boats that do not and cannot take trains." We will go a step further with that. The Holyhead boats do not, I am sorry to admit, take trains; but I do not think you know why they do not. Nobody knows why they do not. I was attacked when I was over in Paris by a commission which said that certainly there must have been some excellent reason why the Dublin and Holyhead boats did not take trains, and that there must be some unanswerable argument against it, which there was. It was that we had an Irish gauge—a very Irish gauge—a gauge so utterly un-English that not a railway carriage, and not a locomotive engine if they were to carry artillery, or anything else for the protection of the United Kingdom—not one of all those things which we could send over into Ireland for our protection in case of war could by possibility travel on an Irish railway if it got there, and the reason of that is—no reason, except that one is an Irish railway and the other is an English railway. Now my time is up, and I am only just going to say this to you: We will not take a boat bigger than that which is necessary to make it a good, fast, sea-boat. Those Holyhead and Dublin boats are quite big enough for us, and in the Dublin and Holyhead boats it would be the easiest thing in the world for us, as we know how to do it, to put a couple of trains on board each of them filled with passengers, to do that without any stoppage whatever, and to have a better sea-boat when the two trains were in the boat than when they were out of it. And permit me to say that it is a great error to suppose that we, or any one else, dream of doing this for the exclusive benefit of passengers. My friend and predecessor was quite right in saying that the boats we dream of building, and the harbours we dream of making, could never be paid for by passengers. He is quite right, therefore the whole of our arrangements have been made as to the money-making part of it, for carrying over the enormous trains of coals and iron, and every kind of British manufacture, which we know will cover that line as soon as they can go right through from the coal-pit to the burning-market, from the mine to the furnace, and from the iron manufactory to the iron ship building place in France, without any shipment or any derangement. That is the real secret. The truth is that the luggage part will pay magnificently, and that the passengers will enjoy the luxury which they will derive from also having the benefit of carrying goods. Therefore we propose to have one of these boats going from each side every two hours, and sometimes they will be filled with two passenger trains, and sometimes filled with one passenger train and a goods train, and we will always fill them as full as they can hold either of one or the other, or we will not send them across. That is the plan which has now been adopted by the authorities in France, and which is now on the point of execution. You will be angry with me perhaps that I did not tell you all this long, long ago, as it has been so long in progress; but in the course of my life I have always felt it more pleasant to tell of something done, instead of something proposed to be done, and in this instance there has only been a little bit of premature information given to you, because M. Dupuy de Lôme and I felt that it would be unkind any longer not to take you into our confidence.

ON SOME RESULTS OF MODERN PRACTICE IN OCEAN STEAM NAVIGATION.

By Herr J. N. Moerath, Chief Engineer Austrian Navy.

With reference to the present controversy among marine engineers as to the comparative merits of the trunk principle, with cylinders of equal diameter and light weights, and of Woolf's compound high and low pressure cylinder principle with heavier weights—both employing surface condensation and super-heated steam, it is of great importance that the Institution of Naval Architects should decide which of the two systems is preferable for ships of war. At the Paris Exhibition of 1867 there were exhibited in the English section the engines of H.M.'s corvette *Sappho*, with simple surface condensers, while France exhibited the engines of the

Friedland, constructed on Woolf's compound principle, but without surface condensers, in order to avoid galvanic action in the boilers. At the Naples Naval Exhibition of 1871, it was interesting to observe the manner in which improved surface condensers were combined with Woolf's compound high and low pressure cylinders. The Compagnie des Forges et Chantiers de la Mediterranée exhibited an important improvement in surface condensers, which was the more interesting on account of Woolf's surface condensers having been so often alternately adopted and abandoned. This improvement was accompanied by a statement of practical results, among which were that only ·83 of a kilogramme of coal were consumed per horse-power per hour, with a speed of ship of 12·86 knots. The improvement in question consists in as far as possible preventing the water of the boiler coming into contact with brass.

For instance, instead of "metal" tubes, iron ones, tinned outside, are employed in the boiler, and in the condenser copper tubes, tinned both inside and out. All the copper surfaces in contact with water are tinned over in the same manner. Those parts of the engine which come into contact with the condensed water are constructed as far as possible of cast-iron. In this manner the water is prevented from touching brass, which, being an alloy of zinc and copper, produces galvanic action when brought into contact with the greasy and consequently acidulated water of the condenser.

In my capacity as reporter to the Austrian government on the subject of navigation and the saving of life at sea, in the official report of the Paris Exhibition of 1867, I have already publicly commented on this subject. I then stated that the surface-condenser for ships of war could not be generally applied until a remedy was found for preventing the galvanic action referred to, which tends to destroy both the boiler-plates, and afterwards the brass tubes of the boiler and condenser. M. de Lacour, in his book, "Étude sur les Machines à Vapeur Marines et leur Perfectionnement," estimates that with surface condensation the quantity of greasy matter amounts to 4½ per cent. of the boiler water, and states that some time since, the boilers of the steamer *Thesis*, running between Liverpool and Glasgow, were destroyed by galvanic action produced by surface condensation. This view is confirmed by the necessity which recently arose of changing the boiler of the iron-clad ship *Bellerophon*, at Woolwich, and also by the damage sustained by the engines of the *Briton*, at Sheerness, in December last. The cause of the destruction of the *Bellerophon* boilers, and the bursting of several condenser tubes, assuredly was not owing to bad management or want of attention on the part of the engineers, as some reports stated, but merely to the destructive galvanic action on the plates of the boiler, and on the untinned condenser tubes.

For these reasons I am desirous that the Institute of Naval Architects shall take this improvement into consideration, with the view of promoting further experiments with high and low pressure cylinders for ships of war employing super-heated steam, and fitted with these improved surface-condensers, by the use of which no brass is allowed to come into contact with the water of the boiler and condenser.

In order to work the boilers at high pressure, without any risk of their becoming weakened by this galvanic action, I would suggest that experiments should be made on a mode of cleaning the greasy boiler and condenser water by means of a solution of crystal soda (pure soda not being injurious) pumped into the boiler along with the feed-water, the resulting soapy matter being expelled on arriving in port.

ON ECONOMY OF FUEL IN STEAM-SHIPS.

By T. S. Prideaux, Esq.

The question of the economic production of steam-power naturally resolves itself into two perfectly distinct branches, viz., first, how to evaporate the greatest weight of water with a given weight of combustible, hinging on the structural arrangements and management of the furnace and boiler; and, secondly, how to obtain the maximum mechanical effect from the steam raised, dependent upon the construction and management of the engine—the first branch being chiefly concerned with chemistry and physics, the second with physics and mechanics.

To evaporate the greatest weight of water from the fuel employed, involves two considerations—

1st. The generating from that fuel the utmost amount of heat it is capable of rendering, to be accomplished by effecting perfect combustion in the surface.

2nd. The transference of the largest practicable proportion of this heat to the water in the boiler—to be attained by the judicious arrangement of its heating surface. The first is a question beset with complication, the second one of comparative simplicity.

After carefully investigating the subject, the conclusion at which I have arrived is that we cannot assign to carbon a smaller heating power than 9000° centigrade, which is equivalent to the capacity for evaporating 15 times its own weight of water from 100° Fahrenheit. The average duty obtained in marine boilers at present, must, I apprehend, be set down at not more than 7½ lbs. of water, evaporated by 1 lb. of coal, or, in other words, we only obtain half the duty which theory assigns to the fuel.

The heat obtained from coal is evolved by the chemical union of the hydrogen and carbon of the coal with the oxygen of the atmosphere, forming with the former substance water, and with the latter carbonic acid; and just in proportion to the completeness with which we transform all the hydrogen of the combustible into water, and all its carbon into carbonic acid, without admitting any superfluous air, will be the temperature produced, and (other conditions being equal) the amount of water evaporated.

But here I must not omit to draw your attention to the important fact that, if through the defective regulation of the air supply of the furnace, you cause half this gas to pass off up the chimney unburnt, the heat wasted is more than 17½ per cent., because the gas has robbed the furnace of the heat employed in its own volatilisation, or transformation from the solid into the gaseous form. Seven and-a-half per cent. is by no means an over-estimate of the heat subtracted from the duty of the carbon by this process, and hence we arrive at the result that, in the case of a furnace so managed as to dissipate half the carburetted hydrogen unburnt, the waste fuel through this channel alone reaches 28 per cent. That this amount of waste actually does in practice often take place from this cause is unquestionable, since I have, in numerous instances, witnessed this per-centage of saving effected by simply altering the conditions governing the air-supply of the furnace during the first five minutes after coaling—the period at which, under the ordinary system of furnace management, or rather mismanagement, this great waste of unconsumed gas takes place. In short, I have rarely seen an instance where experiment did not prove that with bituminous, or north country coal, a saving of not less than two-thirds of this amount, or from 17 to 18 per cent., was obtainable by these means, so that I feel justified in saying that in furnaces so construced at present—*i.e.*, with no provision for adapting the air-supply to the changing conditions and consequent varying requirements of the fuel, this waste of a large proportion of the gaseous constituents of the coal must be regarded as the normal state of things, and inseparable from the rude, defective, and unintelligent system of furnace management pursued.

Although, as a general rule, the combustion of the carbon of the fuel is effected without the large proportion of waste attendant upon that of its gaseous constituents, yet occasionally—in such a case, for instance, as one of which we have recently heard, where, in the Southern Pacific, the flames proceeding from the top of the funnel of one of her Majesty's ships at night, were accidentally mistaken for an eruption from a volcano in one of the peaks of the Andes—a great waste of carbon occurs. Such a state of things as this, however, can only co-exist with most defective furnace arrangements, involving a really frightful sacrifice of fuel.

I will endeavour to describe the conditions under which alone I conceive such an occurrence as described to be possible. The flame emitted does not extend from the furnace through the flues to the funnel-head, as many suppose, but is produced by carbonic oxide gas, generated in the furnace through deficiency of the air-supply, passing off at such a high temperature as to preserve the temperature necessary for ignition after mixing with the 2½ volumes of atmospheric air required to furnish the oxygen needful for its transformation into carbonic acid. Now, since an atom of carbon in combining with 1 atom of oxygen only yields one-third of its heating power—the remaining two-thirds being set free upon its combining with the second equivalent of oxygen and beoming carbonic acid—it follows that two-thirds of the heating power of all the carbon passing off as carbonic oxide is wasted.

Unless there be something more than ordinarily faulty, either in the construction of the furnace, or the mode of firing pursued, the coating of the tubes with soot may be regarded as the necessary precedent to the exhibition of flame at the funnel head, as, in fact, begetting the conditions under which it occurs. A deposition of soot on the interior of the tubes simultaneously diminishes the draft, and, in a still greater ratio, the steam generated. Heavier firing is resorted to to keep up the steam, with the effect of aggravating the previously-existing evils. Flame makes its appearance at the top of the funnel, and a vicious circle of evil consequences is produced, which eventually re-act upon and aggravate each other.

The waste of a large proportion of the coal gas, or carburetted hydrogen, contained in the fuel during, say, the first third, or first five minutes of the coaling interval (as ordinarily takes place under the present system of furnace management) by no means pre-supposes such conditions in the arrangements and working of the furnace as would subsequently lead to the dissipation of carbon as carbonic oxide. The fatal sign of flame at the funnel-head, however, announcing, as it does, a thick layer of ignited carbon on the bars, and an insufficient air supply, may be accepted as indicative of conditions being present in the furnace which must have been productive of a more than average waste of carburetted hydrogen at an earlier period.

How are we to realise in practice this all-important and indispensable condition to economic furnace management, the due adjustment of the air supply—that is, the supply of such a quantity as a *whole*, and so distributed as to *period*, as to convert all the hydrogen of the fuel into water, and all the carbon into carbonic acid, with the admixture of the smallest possible quantity of surplus air? However difficult the task may be, it is nevertheless most certain that, by how much we deviate from the correct quantity, either more or less, by so much do we fall short of "generating from the combustible the utmost amount of heat it is capable of furnishing;" for the laws of chemical affinity are unchangeable and ubiquitous. In short, this danger of erring on either side may be said to be the Scylla and Charybdis to which voyagers in search of perfect economy in furnace management are exposed, and safety is only to be attained by studying the landmarks and bearings so carefully as to be able to steer with confidence a middle course.

The supply of air which enters a furnace depends upon the rates existing between the *pull* exerted by its chimney or stack, and the *obstruction* caused by the layer of fuel on the grate-bars and a more or less confined ashpit. The force of the pull or suction exerted by the stack is the difference in weight between the column of heated gas it contains and a similar column of air at the temperature of the atmosphere. The higher the temperature and the taller the stack the greater the force of the draft, and *vice versa*.

The great practical difficulty which stands in the way of obtaining the regular flow of the right quantity of air into the furnace is the fact that the demand is not a constant but a varying quantity. Were the same conditions always present in the interior of the furnace—that is to say, the same thickness of fuel in the grate-bars, and the various layers of this fuel at similar stages of combustion. so as to cause the supply of air demanded by the wants of the fuel to be uniform, then the average rarefaction or draft in the stack being once attained, a steady supply would enter the furnace, proportionate to the thickness and closeness of the layer of fuel, the area of the grate-bar openings, and the free ingress of air to the ashpit, which, once adjusted, the equable and economic working of the furnace would be secured. Unfortunately, however, for the cause of economy of fuel, the reverse is the case. Not only are the requirements of the furnace not uniform, but they fluctuate within very wide limits, whilst the evil results in waste of fuel which ensue are aggravated by the fact that the furnace's unaided power of supplying itself varies in an inverse ratio to its requirements, being least when these are greatest.

Assume a coaling interval of fifteen minutes, and that towards its end, the carburetted hydrogen having passed off, a layer of ignited carbon alone is left on the bars, through which the current of air has gradually worn for itself a series of channels or perforations, until their united area is more than sufficient to admit the right quantity of air under existing amount of draft. Let us examine the condition of the same furnace a few minutes later, after the act of coaling has taken place, and we shall find a blacker layer of fuel on the bars, the channels for the passage of air which previously existed in the thinner layer obliterated, and the temperature of the furnace greatly lowered by the abstraction of heat consequent upon the introduction of the charge of cold fuel and volatilisation of its gas going forward. The diminished temperature in the stack comparatively destroying the draft at the period when the resistance offered by the fuel to the passage of air is greatest, whilst the demand of the furnace is at its highest point, in consequence of the large quantity of oxygen required for the ignition of the carburetted hydrogen gas now in course of rapid evolution.

As the necessary sequel to these conditions, the gas generated passes off unburnt—worse than simply wasted because it has abstracted a portion of heat from the ignited carbon in undergoing transformation into the gaseous form. We here get an explanation of the fact that more heat is practically obtained in some kinds of furnaces from coke, or in other words deprived of $\frac{1}{3}$ part by weight, of that portion of its combustible matter which is richest in heating material than from coal in its pure state. From the same cause also, viz.—defective furnace management, the commercial value of coal is often in an inverse ratio to the quality of its bituminous constituents and real heat-giving power, were proper means employed to make this practically available.

In short, under the present system of furnace management the function of the furnace as an agent for raising steam may be said to be almost entirely suspended after each coaling interval, and only gradually regained, the furnace virtually assuming the office of a retort for the manufacture of gas, but with this difference in the result, that the gas which in the latter case is carefully preserved as a valuable commodity is here despatched unconsumed up the chimney, carrying off at the same time the heat stolen from the carbon in effecting its volatilisation.

Can a doubt be entertained of the wisdom and desirability of burning this gas instead of wasting it, of filling the furnace with flame instead of smoke, of causing the generation of steam to proceed with additional rapidity immediately after coaling instead of being all but suspended? Now, all that is required to evoke this transformation is to supply the gas with 10 times its own measure of atmospheric air, and, except in a few exceptional cases of badly-constructed furnaces, it will require no further solicitation to burst into flame.

ON ECONOMY OF FUEL AND PREVENTION OF SMOKE.

By Captain J. Gordon McDakin, late 42nd Highlanders.

The heating surface being in proportion to the result required, there is still in all furnaces, and particularly in those of marine engines, a loss amounting to at least 25 per cent., arising from imperfect combustion. Indeed it has recently been stated, on the authority of a Royal Commission, that our best Cornish engines only utilize one-eighth of the coals burnt, and the majority of engines not more than one-thirteenth.

In order that I may explain the object that I have in view, and the principle of my system, by which I seek to prevent this loss, it is necessary to consider the nature of those effects which we find in operation in the furnaces of our engines.

When coal is burnt in the open or in the ordinary house grate, the principal products of combustion are carbonic acid and water; a certain portion of finely-divided carbon escapes combustion and constitutes the soot or visible smoke of a coal fire. When the decomposition of coal is effected in retorts or vessels from which the air is excluded, the products are much more numerous and complicated. A large amount of volatile matter is expelled, partly in the form of hydro-carbon gases, and partly in the form of hydro-carbons in the state of vapour, solid coke remaining in the retort.

Now different parts of the furnace frequently represent the conditions of the open fire and retort, also constantly varying in place and temperature. In the laboratory if we want a smokeless gas flame we adopt some contrivance similar to the Bunsen's burner, in which a mixture of air and gas takes place (as in some varieties) through wire gauze, the particulars of air and gas being thoroughly distributed through the entire volume; the molecules of each gas coming into individual contact, a condition that is essential, and the result is a smokeless flame, in which glass tubes and white porcelain capsules may be heated without becoming blackened.

This would not be the case with the ordinary gas-jet burning in the open; the supply of air in this is abundant, but it is not commingled with the flame, only coming into contact with the outer shell, producing a flame that deposits a thick soot on any other object placed in it, pointing out the absolute necessity of maintaining the conditions of combustion that we possess in the Bunsen's burner.

It would be simply ridiculous to attempt to make gunpowder by the haphazard throwing together of saltpetre, sulphur, and charcoal. The proportions of the gun and projectile might be the best, but what result should we have from an explosive so prepared? It is doubtful whether it would ever burn. Is there not a close analogy between this and the well-constructed boiler and furnace, and the condition of the combustible material represented in the latter by the imperfect mixture of air and flame?

Not only may vast quantities of unconsumed carbon pass off in a dense smoke, but also volumes of invisible and inflammable gases escape ignition, as they would from the retort of a gas factory, and at a low temperature the furnace may actually be distilling hydro-carbon oils, as in one specially built for that purpose.

It is this visible loss in smoke, and visible loss in unconsumed gases and vapours, which it is our object to save by the proper admixture of the atmospheric oxygen.

Various contrivances have been proposed for this purpose, and adopted with more or less success. Improvements at the bottom of the furnace, as in the ventilating fire bars, which make a better distribution of the air, at the lower part of the fuel. In others the air has been admitted at the fire-door, and at the back of the bridge; but the volume of air has generally been greater than necessary, chilling the gases below the point of ignition, the stream of cold air only coming into surface contact with the heated gases, as some ocean currents of hot and cold water are said to flow side by side without mingling with each other.

It is, therefore, the thorough admixture of the heated gases with air, as in the Bunsen's burner, which is the essential feature of the system which is the subject of this paper.

The object in view I seek to attain as follows:—

In each tube of an ordinary tubular boiler is inserted another of much smaller diameter, perforated at its end nearest the fire in such a manner as to cause an induced draught when required, by a current of air flowing through the said tube, or being forced through by a blower or steam jet, this being under perfect control by opening or closing a valve. Each of the boiler tubes is in this manner filled by a smokeless flame of great intensity—the deposit of soot and dust is reduced to a minimum, there not being any smoke except on first lighting the fires. No obstruction is offered to cleansing the tubes, and the inner ones can be separately unscrewed, or removed in sets, when it is required to prick out the perforations or to renew the ends.

The expense is small, the air pipes costing not more than a few pence per foot, and no alteration for their introduction being required except of a most trifling nature.

The same system is applicable to locomotives and other engines.

ON THE INCREASING SPIRAL IN HEAVY RIFLED ORDNANCE.

By Commander W. Dawson, R.N.

Rotation is usually imparted to elongated projectiles by means of ribs, studs, or other projections, which, in their exit from the gun, traverse suitable parallel grooves or slots, cut to receive them in the bore, at an angle with the axis of the piece proportioned to the desired rapidity of spin. When the angle which the slots make with the axis of the gun is the same throughout, uniform spirals are the result; but when the angle becomes greater towards the muzzle, the grooves form curves known as increasing spirals. If the bore be conceived as laid open like a flat surface, the uniform spirals will appear as straight lines, the "uniformly increasing spirals" as parabolas. Each point in those parabolas makes a different angle with the axis of the gun, and would impart, if possible, a different amount of rotation to every part of the projectile. As, however, a rigid iron cylindrical body cannot have every point in its length rotated at different speeds, one "driving" point, or ring of "driving" points, is selected in rear of the centre of gravity, on which the whole effort of rotation is concentrated. A second ring of "guiding" points before the centre of gravity, being made to fit the grooves very loosely, tend to check any extraordinary deviation from the prescribed route. By a strange hallucination, even in the uniform spiral "Woolwich" guns, the effort of rotation is concentrated on two soft non-centering points in each groove, instead of being diffused over a long iron centering bearing extending along the whole cylindrical body of the projectile. Of the nineteen rifled guns now in the naval service thirteen have uniform spirals, which complete one turn in 20, 30, 35, 36½, 37, 38, and 40 calibres; four have their grooves cut as "uniformly increasing spirals," beginning as parallel straight lines at their origin, progressing as parabolas, and ending at the muzzle with one turn in 35, 40 or 45 diameters; whilst two guns have a compromise between the two forms of spiral, the grooves beginning as curves of one turn in 100 calibres, and ending at the muzzle with one turn in 40 or 50 diameters. This diversity of twist aptly illustrates the guess-work which obtains as to the proper angle of spiral, and as to the consequent rapidity of spin necessary to ensure stability of flight. Experiments were made in 1864-5, to determine the influence of various degrees of twist with uniform spirals upon the initial velocities, from six 6·3-inch, 7-ton, "shunt" guns, but no notice is recorded of the corresponding stabilities of flight. From these it was ascertained "that the velocity increases as the amount of twist decreases, up to a certain point, viz.: one turn in 50 (? 40) calibres, where the velocity is greatest, it then commences to diminish. The loss of velocity in the higher twists is probably due to increased friction in the passage of the projectile through the bore. The diminution of velocity in the case of the low twist is most likely owing to the projectile not being retarded sufficiently to admit of the complete combustion of the charge." The initial velocities were:—

Spiral of Gun.	Charge.	Shot.	Calculated mean initial velocity.	Charge.	Shell.	Calculated mean initial velocity.
calibre.	lbs.	lbs.	feet.	lbs.	lbs.	feet.
1 turn in 20......	...	...	...	...	...	...
1 ,, 30......	16·926	84·625	1520	10·499	83·4	1124·5
1 ,, 40......	,,	,,	1535	,,	,,	1124·5
1 ,, 50......	,,	,,	1533	,,	,,	1137·2
1 ,, 60......	,,	,,	1514	,,	,,	1126·3
1 ,, 80......	...	...	...	...	...	...
1 ,, 20......	14·625	71·9	1526·6	...	...	...
1 ,, 30......	,,	72	1540·0	8·395	83·4	997·3
1 ,, 40......	,,	71·6	1553·4	,,	,,	995·6
1 ,, 50......	,,	72	1562	,,	,,	992·1
1 ,, 60......	,,	71·7	1550	,,	,,	988·9
1 ,, 80......	,,	71·8	1521	...	...	...

To know what effect the angle of uniform spiral has on stability of flight, the chief object for which rifling is adopted, we must turn to Sir Joseph Whitworth, who has worked out experimentally the relation between the length of the projectile, expressed in diameters, and the rapidity of twist, as it affects the polygonal iron-bearing centering system. This was tried with a 1-foot gun of about 1½ inch calibre, firing 25 ounce charges at 3 inches elevation. It was found that one turn in 34·35 calibres gave perfect spin to shot three diameters in length; that one turn in 15·26 calibres spun shot six diameters long perfectly: and that one turn in 7·13 calibres sent shot of seven diameters perfectly true, and point first. These results have been verified as regards several angles of spiral in larger calibres, so that Sir Joseph Whitworth now recommends one turn in 18 calibres for heavy guns, which is capable of giving perfect rotation to projectiles five diameters long; whilst the French or "Woolwich" non-centering short-bearing system gives, with one turn in 35 calibres, only a wabbling, waltzing, movement to shell of 2½ to 3 calibres.

No experiments exist as to the influence of various degrees of final muzzle twist upon the initial velocity, nor upon the stability of flight, in the case of spirals the angles of which increase rapidly at the muzzle. The amount of spin is, in these cases, determined by the well-known formula familiarly called "the rule of thumb."

The professed object of introducing, in 1865, increasing spirals for the stronger and heavier wrought-iron coil guns, was the supposition—1st, that the projectiles would slip away more rapidly from their seats next the powder chambers than when uniform spirals were employed; 2nd, that these assumed quicker commencing velocities would considerably reduce the maximum powder pressures in the chambers; and 3rd, that this supposed great relief to the chambers would prolong the lives of guns.

Now, here are three distinct guesses, each one of which is opposed to experience:—

1st. In the heavy gun competition of 1863-5, where all the conditions, except the rifling projections and grooves, were identical, Scott's uniform spiral 7-inch gun projected its iron bearing flanged-centering 110 pounds shot from its muzzle 59 feet faster, inflicting a muzzle blow 133 foot tons heavier than the similar French, or, as it is now mis-called, "Woolwich" gun, with increasing spiral and studs, the report stating that "the French system has decidedly the lowest velocities." Again, 1865, two 7-inch guns were rifled with the same final angle of twist, on the French or "Woolwich" system; one with uniform and the other with increasing spiral, and the latter gave 21·2 feet less initial velocity, and 56 foot tons lighter muzzle blow. The Professor of Artillery at Woolwich mentions, in his "Modern Artillery," the case of an 8-inch gun which gave, with uniform spiral, 35 feet more initial velocity, and 116 foot tons heavier muzzle blow than its increasing spiral competitor. Against these facts we have guesses, but not a single experimental datum.

2nd. The Committee on explosives have recently discovered that the maximum powder pressure is relieved when the shot has moved one quarter of an inch in its seat when using rifle large grain powder, and six inches when using pebble powder. They have not discovered that the shot moves through the first quarter of an inch of its motion quicker with either the uniform or the increasing spiral of the same final angle; nor is it at all likely that they will ever do so. But they have found that the gun in its rifled state sustains somewhat less powder pressure than when firing the same charges as a smooth bore. If, then, any difference of maximum pressure in the chamber can at any future time be proved to obtain between the two forms of spirals having the same final angle, it is difficult to foresee in favour of which it will be found, but we are justified in assuming that it will be so infinitesimal as to be rather a curious philosophical phenomena than a practical consideration for artillerists.

3rd. If we regard the shot in its seat as a valve moved by internal pressure, it is quite evident that the maximum pressure which is relieved by that motion cannot extend outside the position of the base of the projectile at the moment when that pressure is registered. In other words, all the evil effects upon the gun due to the direct action of the maximum powder pressure must occur either in the charge chamber or within a quarter of an inch of it, if using R. L. G. powder, or within six inches of it with pebble powder. The only exceptions there can be to this rule, are when the lateral wriggling or vertical hammering action of the wabbling projectile causes a momentary obstruction, and the area of the maximum powder pressure might naturally extend to the point where the jam occurs; or, when the projectile breaks up, and the pieces become permanently wedged in the bore, inflicting a blow which causes the gun to burst explosively, as has repeatedly occurred. When, then, the shot is free to escape, the life of the gun is not materially affected by differences of powder pressure within the possible limits which could obtain under any rational supposition, between guns rifled with the same final angle of twist on the uniform and on the increasing systems. There is now in use at Woolwich a 10-inch 18-ton gun, having 18 inch-holes bored right through its walls, for crusher guages, which has fired in that state several hundred 60 to 87½ pounds charges with 400-pound projectiles, and has sustained maximum pressure of 60 foot tons, being within 3 tons of as great a strain as that sustained by the 35-ton gun in firing its heaviest (130 pound) charge with a 700 pounds projectile; yet, we are told, that the interior of that mutilated gun has not suffered from these excessive powder pressures. An 8-inch gun of only 6½ tons weight, instead of 9 tons, with 16 inch-holes through its walls, has similarly withstood hundreds of rounds of 35-pound charges and 185 pound projectiles, though its proper battering charge is but 22 pounds with 115-pound projectiles, without any internal injury from powder pressure.

So far, then, as the advantages claimed for the increasing spiral are concerned, they are pure guesses opposed to facts; and it is, as to those points, a matter of indifference whether it or the uniform spiral be adopted. But, on this baseless hypothesis, we are sacrificing in vital questions the efficiency of our great guns, for the increasing spiral necessitates the concentration of rotary effort on a single point in each groove, this point being represented by a gun-metal stud 1·45 inches in diameter, projecting ·195 inch outside the projectile, and wedged into an under-cut hole ·16 inches in diameter, and ·3 inch deep. Imagine, then, attempts to rapidly rotate an iron cylinder, 12 inches in diameter, 34·45 inches long, and nearly a third of a ton in weight (700 pounds), by a ring of nine such studs placed a few inches behind the centre of gravity. Lateral wriggling, vertical hammering, and wobbling forward motion in the bore, with waltzing gyrations, "puffing" noise, and "unsteady" movements in the flight, lessened muzzle blow, and reduced range, are the natural results. To overcome these, reduced length and weight of projectile are, in all the large calibres, vainly resorted to, with permanently crippled efficiency. More rapid twist, and consequent more perfect rotation, cannot be given, because the six-tenths limit of bearing which the increased spiral necessitates will not endure the greater effort. The sacrifice of shell-power has, therefore, been all in vain. Within the last three years six heavy guns are known to have been permanently disabled on shipboard by their own projectiles, whilst firing at targets; and five others are known to have been temporarily disabled for some hours from the same cause. How many more naval guns have been compelled to cease fire for hours has been kept secret. But when two 18-ton guns were so disabled on board the *Hercules* in 1870, the Director-General of Naval Ordnance officially remarked that "the crack in the A (inner) tube, and the strained condition of the B (outer muzzle) tube over the crack, *are exactly what I should have expected.*" And a critical examination of these suicidal inquiries shows that they almost invariably occur near the muzzle, where the shot in full flight meets with enhanced resistance from an increasing angle of spiral. The fact that two of the suicides had uniform spirals is sufficiently accounted for by the absurd notion which obtains of rejecting the great advantage it offers of employing a long iron bearing, extending over the whole cylindrical body of the projectile, and of applying it in the form of strengthening ribs cast with it, instead of a short bearing concentrated upon weakening stud holes.

The "Cemetery of Suicides" at the Royal Arsenal has had several interesting specimens added to it since the introduction of increasing spirals with short soft bearings, some of which illustrate other forms of self-destruction incidental to the French or "Woolwich" system. First in order comes the father of the system, the competitive "Woolwich" 7-inch gun already referred to, which after 567 rounds had so battered its bore and spiked its upper groove by the blow of its front upper stud, that it was ordered to "*be fired* '*under precaution*'" against bursting; whilst the rifling of the Scott uniform spiral gun with iron ribbed projectiles was as perfect after the last (417th) round as when it left the factory. The Woolwich "Infant" of 35 tons, though not yet committed to the Cemetery of Suicides, was spiked in the lower grooves by its lower rear stud, from 8 to 20 inches outside the point to which the maximum powder pressure extends, in the effort to rotate a 700-pound projectile upon nine six-tenths of an inch points, under the propulsion of 120 pounds pebble powder charges. With a uniform spiral and Scott's iron flanged shell, 100 pounds of powder would have sent the same weight to the useful fighting range of 1,500 yards, with the elevation required when using 120 pounds charges at present. Then there is a 12½-ton gun, in which a shot breaking up through its stud holes wedged itself causing a fearful explosive burst, on 25th September, 1868. A

Date.	Place.	Gun.		Self-inflicted Injuries.	Cessation of Fire.
1865	Shoeburyness	7-in.	7 ton	Upper groove cracked by stud, dented and enlarged tube	Permanent.
,,	,,	9-in.	12¼ ton	Much worn by gas after 315 rounds	No.
,,	,,	9-in.	12½ ton	Cracked grooves and burst, 400 rounds	Burst.
,,	,,	,,	,,	Cracked tube, disabled, 1,049 rounds	Permanent.
1868	Tegel, Berlin	,,	,,	Cracked tube, disabled, 311 rounds	Permanent.
,,	Woolwich	,,	,,	Explosive burst, by projectile jamming, 1 round	Burst explosively.
1869	*Bellerophon*	,,	,,	Grooves over-ridden by studs	Permanent.
,,	*Redwing*	7-in.	6½ ton	Muzzle split	Permanent.
1870	*Favorite*	,,	,,	Grooves over-ridden by studs	No.
1869	Shoeburyness	10-in.	18 ton	Grooves burred, bore dented, tube split, 534 rounds	Permanent.
,,	*Hercules*	,,	,,	Muzzle split, 43 rounds	Permanent.
,,	,,	,,	,,	Vent damaged, 46 rounds	— hours.
1870	*Staunch*	9-in.	12½ ton	Bore dented, grooves bored, gun disabled	Permanent.
,,	*Royal Sovereign*	,,	,,	Bore deeply cut into	— hours.
,,	*Warrior*	7-in.	6½ ton	Bore dented, and had to be filed down	— hours.
1871	*Bellerophon*	9-in.	12½ ton	Bore dented	No.
,,	,,	,,	,,	Bore considerably scored by gas, 165 rounds	No.
,,	,,	,,	,,	Muzzle coil split	Permanent.
1870	Shoeburyness	7-in. 68 pr.	95 cwt.	Burst violently into 76 pieces, shot jammed, 1 round	Burst explosively.
,,	Aldershot	9-pounder,	bronze	Groves worn away, &c., disabled, 243 rounds	Permanent.
,,	,,	,,	,,	Ditto ditto ditto	Permanent.
,,	,,	,,	,,	Grooves worn by studs, ditto	No.
,,	Shoeburyness	,,	,,	Grooves over-ridden by studs, bore expanded	Permanent.
,,	,,	,,	,,	Ditto ditto ditto	Permanent.
,,	*Monarch*	12-in.	25 ton	Grooves slightly burred in four guns, average 35 rounds each	No.
1871	Shoeburyness	7-in. 68 pr.	95 cwt.	Grooves enlarged near origin	No.
,,	Woolwich	12-in.	35 ton	Lower groove cracked by stud from 12 to 25 in. of origin, 68 rounds	No.
1872	*Bellerophon*	9-in.	12½ ton	? Bore dented, had to be filed down	— hours.
,,	,,	,,	,,	Ditto ditto ditto	— hours.
,,	*Royal Oak*	8-in.	9 ton	Bore dented by projectiles	No.

converted 68-pounder, of 95 cwt., met with a fearful accident on the 10th August, 1870, flinging seventy-six pieces over an area of 580 yards by 150 yards. Though this latter gun had not an increasing spiral, its 114-pound projectile was balanced on a couple of weakening studs in each groove, which is not much less fatal with uniform than with increasing spirals. The "Cemetery of Suicides" is hardly more instructive than the Ordnance Inspector's reports of abrasions, and enlargements and erosions, and other injuries of guns not permanently disabled, these maladies being either caused or aggravated by the studded system, which an increasing spiral necessitates. Of eight Lancaster 95-cwt. guns having increased spirals sent to the Crimea, three blew their own muzzles off; but once rid of that portion containing the increased strain, one of these guns did good service without its muzzle. Of forty-two Parrot guns with increased spirals used at the siege of Charleston, twenty-three committed suicide—General Gilmore reporting that the increasing strain thrown on the muzzle was the offending cause. Lancaster and the Americans both abandoned the increasing spiral, and now it destroys only British guns, with the eminent risk of some day destroying also British gunners.

There is a most instructive sphere of artillery study at present locked up, which might be opened with great advantage to science, as well as to the public service, if some member of Parliament would move for a "Return of all guns which, since 1865, had been obliged to cease fire, temporarily or permanently, owing to self-inflicted injuries; the nature and position of such injuries, and the period which elapsed before fire could resumed. Also, for a return of all guns which, since 1865, had sustained internal damages of a less disabling character, and the nature and position of such injuries." We should then be in a position to trace out, in each case, the maladies of British guns, and, knowing the cause, be a long way towards suggesting the remedy. Meanwhile, the ablest artillery officers are of opinion "that there are disadvantages in the 'Woolwich' system, and a better system of rifling might be found." That there must be ample matter for a lengthy official return is evident from the examples of the suicidal effects of "Woolwich" studded projectiles, given in the table on the preceding page.

Saturday, March 23rd.

ON QUICK STEAM LAUNCHES.

By F. J. Bramwell, Esq.

For some little time past the interest of naval architects and engineers has been excited by the reports which have from time to time been given in the newspapers of the performances of steam launches built by Mr. Thornycroft, of Chiswick.

From these reports it has appeared that steam launches of about 50 feet in length have attained speeds varying from 17 to 19 statute miles per hour, or from $14\frac{4}{7}$ to $16\frac{2}{7}$ knots per hour; speeds which, even in this day, would be considered very good for the finest sea-going steamers, and speeds which have hitherto been regarded as impossible, unless the vessels were at least 200 feet in length.

The writer having been much struck with these statements, and with those made to him by engineers who had witnessed the performance of the launches, thought it might be interesting for the Institution to have a short paper upon the subject. He therefore put himself in communication with Mr. Thornycroft, who kindly allowed him to make what experiments he thought fit. These experiments, which have taken place within the last few days, have been made on the *Miranda*, of which a longitudinal elevation is hung upon the wall.

This launch, as appears by statements in the papers, was running in the autumn of last year, but her engines having been put into another boat she was laid by, and it was not until ten days ago that steam was got up in her with the new engines. Thus it happened that the trials were made, therefore, with the boat in an incomplete state as regards her cabin fittings, and therefore at a somewhat lighter draught of water than she would otherwise have had.

As a sufficiently detailed description of this launch has so recently been given in one of the engineering papers, the writer does not feel justified in taking up the time of the Institution by entering into particulars, except in the briefest possible manner. He will therefore content himself by stating that the length of the *Miranda* over all is 50 feet; on water-line, 45ft. 6in.; the beam, 6ft. 6in.; on water-line, 4ft. $9\frac{1}{2}$in. The draught of water in running trim, with six persons on board and 3 cwt. of coal, is 2ft. 6in., taking the extreme depth of the screw. She is built of steel, the general thickness of the plates being one-eighth to one-sixteenth. She has a pair of inverted direct-acting engines, having cylinders of 6 inches diameter by 8 inches stroke. These engines make up to as much as 600 revolutions, or 800 feet, of the piston per minute; their ordinary working speed, however, is less than this. They drive a two-bladed screw of 2ft. $6\frac{1}{2}$in. diameter, and 3ft. 4in. pitch. This screw is abaft the rudder, which is made in an upper and lower part, joined by a bow, so as to pass the shaft, which is placed out of the horizontal line to the extent of 1 in 28, the after end of course being the lower. The boiler is of steel, is of the locomotive type, and has a total heating surface of 116 inches, and a total fire-grate surface of $4\frac{1}{4}$ feet; the barrel-plates are $\frac{5}{16}$ thick; the fire-box external plates also $\frac{5}{16}$; and the internal, which are of copper-plate, are $\frac{3}{8}$ thick; the stays of the fire-box are $\frac{3}{4}$ diameter and 4 inches apart. The fuel is coal. The boiler is fed by a 3 mm. Giffard injector.

The whole weight of the engines and boiler with water in it up to the working level, and of the propellor-shaft and propellor is about 40 to 41 cwt., or 4,448 to 4,560 lbs.

It had been suggested to the writer by those who had seen the boat under weigh, that when a certain speed was attained the form of wave altered very materially. For the purpose of testing this, the writer caused sockets to be fixed at the stem and stern, and at five intermediate places at the side of the boat, in which sliding markers could be raised and lowered. The boat being ready for starting, but perfectly quiescent, these markers were lowered until they just touched the water, and their position was noted; they were then raised clear of the water, and the boat was got under weigh, the engines being kept at 200 revolutions per minute. They were then lowered until they touched the then surface of the water, care being taken that the persons in the boat remained in the same places as those in which they were before the boat started. The surface of the water, as ascertained at this rate of speed, is indicated by a curve on the diagram No. 2.

The experiment was then repeated, at the varying speeds shown on diagram 2, and the curves corresponding to those speeds are indicated by the lines marked respectively.

To prevent the boat having any "list," and thus spoiling the experiments, a spirit-level was placed from gunwale to gunwale, and care was taken to keep her trimmed absolutely horizontal while running. The level was also placed fore and aft, and, having been adjusted so as to be horizontal when the boat was quiescent, the variation from the horizontal position was noted. The amount, which ranged from $3\frac{1}{4}$ in. in 100, at 200 revolutions per minute, to 3·10 in 100, at 550 revolutions per minute, is also shown on the diagram.

The writer has not ventured to put on that diagram the undisturbed levels of the surface of the water, because he thinks it must be, to some extent, uncertain. He cannot tell, therefore, how much of the "out of level" of the boat was due to the rising of the stem, and how much to the falling of the stern, but his opinion is that, in almost all cases, and certainly at the higher speeds, the water at the stem may be taken as representing the unaltered surface of the river.

The next point which the writer thought it would be interesting to note was the gross indicated H. P. at each of the speeds.

So far as the writer has ever heard, no one has attempted to indicate engines at anything like 500 revolutions per minute. In the few trials that have been made with engines running at about between 200 and 300, the indicator, even if of the very best kind, has suffered so much from momentum as to produce oscillating and unsatisfactory lines. It occurred to the writer that the only way of obtaining diagrams from engines at such high speeds as those of this boat was to limit the size of the diagrams, both vertically and horizontally. For this purpose he had made an extremely strong spring for his Richard's indicator—a spring recording only 100 lbs. per inch on the diagram equal to only $\frac{1}{4}$ of an inch movement of the piston in the cylinder for each 100 lbs. of pressure. With this arrangement very satisfactory diagrams have been got. The actual figures are lying on the table; the enlargement of two of them appears in diagram 3.

Lighter springs were used for the slower revolutions, but for the purposes of comparison they have been reduced to one standard in figure 5.

At 300 revolutions the H. P. was 11·05; at 600 revolutions, 71·61.

The next thing to be ascertained was, what was the speed of the boat at these varying revolutions.

For this purpose an attempt was made to measure a statute mile on the Surrey shore, below Barnes-bridge, but it was found really impossible to do this in the time. A quarter of a mile was then suggested, and even laid out, but it was felt that runs of so short a length would be looked upon as mere "spurts," and would, therefore, be unsatisfactory. It was consequently determined to rely upon the 6-in. ordnance map, a copy of which (diagram 4) is on the table, and a mile was taken on that from Barnes Railway-bridge down to Chiswick, as shown on the map. For the purpose of a more extended run, it was determined to take the ordnance measurement from Barnes Railway-bridge to Putney Old-bridge. This appears by measurement to be $3\frac{1}{2}$ statute miles and 88 yards. The first run was made up-stream with the tide, but against a brisk wind, from Putney-bridge to Barnes-bridge; this was done in 11 min. 33 secs. A counter was kept in gear; the total number of revolutions was 6,131, giving a mean of 530 a minute. It was clear a greater speed could have been maintained so far as the engine and boiler were concerned, but it was feared that the injector was hardly large enough to supply the required quantity of feed water, and therefore the link was notched back. This "up-stream" run gives a speed of 18·44 miles per hour. The journey down from Barnes-bridge to Putney was made in 11 min. 39 sec. against the tide (which was not a strong one), and with the wind for a considerable portion of the journey.

The total number of revolutions was 6,756, giving just under 580 revolutions as the mean per minute. This increase of 50 revolutions, and the wind being generally in the boat's favour, account for the fact that the journey against the tide was made in only six seconds longer than the journey with the tide. At the very last of the run the engines were making 600 revolutions per minute, Mr. Thornycroft having found that he had water enough in his boiler, and being thereby enabled to give the engines full steam without risk. The speed of this run is 18·28 miles per hour; the mean of the two, therefore, is 18·36 miles per hour, a mean which clearly would have been considerably increased if the "up" run had been made at the 580 revolutions the "down" run was made at.

For the purpose of discovering error in the observations, if any error had crept in, the time was taken both on the "up" and "down" trip in passing the "Crabtree," Hammersmith-bridge, and the lower end of the measured mile at Chiswick.

Diagram No. 5 shows by the horizontal line the whole distance from Putney to Barnes, and the distance between the intermediate points of observation, and by the heights the minutes occupied from the time of starting to the time of reaching any such point. If the speed had been actually uniform, of course the sloping lines would have been straight.

It will be seen that the departure from the straight is very small, and is no more than might fairly be expected in the variation of speed of engine, and not in any case such as would be due to a serious error in the observations.

The white line shows the up-stream voyage, and the red line the down-stream voyage. The dotted white line shows the up-stream voyage applied against the down-stream, in order the more readily to compare the speeds. It will be seen that these lines cross each other twice.

Runs were then made upon the mile at varying revolutions. The particulars of those are to be found in Diagram 6.

From this it will appear that 555 revolutions give 18.65, 500 gives 16·15 speed; 400, 11·82 speed; 300, 11·05 speed; 200, 4·02 speed. 100 revolutions could not be taken, as it would not have given a rate sufficient to have stemmed the tide.

Diagram No. 6 not only shows, as has already been said, the indicated H.P. at the different number of revolutions, and the speed of the boat, but it gives also that of the screw in feet per minute.

The slip of the screw will be found to be for 500 revolutions, 14·7 per cent.; for 400 revolutions, 21·9 per cent.; for 300 revolutions, 12·9 per cent.; and 200, 7·1 per cent. The highest point of observation on which any measurement of distance was taken was 555 revolutions, at which point the slip of the screw was 11·3.

The displacement of the boat at the draft of water on which she was tried was about 3·73 tons. If the speeds at the varying revolutions be reduced from statute miles into knots, and then the formula $V^3 \times D^{\frac{2}{3}} \div$ I.H.P., be employed to ascertain the co-efficient of steam-ship performance, the following results will be obtained:—

At 500 revs. the co-efficient will be 150.
" 400 " " " " 106.
" 300 " " " " 131.
" 200 " " " " 131.

In conclusion, the writer has to thank Mr. Thorneycroft, and he thinks the Institution will also thank him, for the readiness with which he has allowed these experiments to be carried out, and more than that, for having made that which the writer believes to be a real step in the science of steam propulsion; and he trusts that these unusual and wholly unexpected results of speed will call the attention of naval architects and engineers to the subject of improving the velocity of large sea-going steamers.

ON THE FORCE OF THE RUDDER, WITH A READY WAY OF CALCULATING THE SAME IN HORSE POWER; AND QUESTIONING THE SUPPOSED UTILITY OF BILGE KEELS.

By Henry Ransford, Esq., Associate.

Several papers have been read before this institution on different kinds of rudders, and referring also to the great force of the rudder, with the difficulty of controlling that force in large ships; but there are still two or three matters connected with the subject requiring further investigation, and from which useful information may be derived.

Putting the helm down, and altering a ship's course, say from north to south, compels her to perform half a revolution, by revolving on a centre within herself, her wake showing, at the same time, she has passed along an irregular semi-circle; this effect, we know, is caused by the water impinging on the rudder with a force in proportion to the rate at which the vessel is moving.

This centre, or point of the keel on which a vessel revolves, is very difficult to determine. I am disposed to think that when a ship is said to be in good trim, about the centre of the floor (taking its length and breadth) is her point of gyration; but if not in trim, the longitudinal centre of her gravity or total weight (if I may so express it), becomes the point, and I confess I do not see a way to determine it exactly.

The main thing, however, is, that a ship has a centre on which she pivots in obeying the action of the rudder, and one in particular in which she obeys that action better than when that centre is changed; and, as a rule, this action is much further from the stern-post than the stem, thus giving the rudder a longer lever to exert its force in guiding the ship, regarding that turning-point as a fulcrum.

The longer the ship the greater the power required to turn her round, hence it is important to know the whereabouts of her centre of gyration, and what excess of lever the rudder has to act on to overcome the forward resistance; because, while (say) her starboard side from this centre to the stern is turning and forcing the water one way, her port side from the centre to the stem is turning and forcing water in the opposite direction.

Take for example a ship of 300 feet long, if her revolving centre is only 130 feet from the stem, then the rudder has a leverage of 170 feet to overcome the forward resistance, and she probably steers easily; but if, on the contrary, her centre of gyration is much nearer to the stern-post, she will be found to steer badly, and the suggestion, as a remedy, would probably be to increase the size of the rudder, although altering her trim might produce a better result.

A vessel at anchor in a tide-way takes a sheer very quickly, because, if she has a pivoting point, then it must be the outer edge of the hawse-pipe, and the flowing tide quickly adjusts any displacement of water. To calculate the power of a rudder guiding a ship, the depth of water she draws has to be considered, as well as the force of current created by the speed. A ship drawing 26 feet, displacing water at her keel of a pressure of 13 pounds on the square inch, we cannot wonder if a difficulty is found in steering her, but the mean of that depth gives a pressure equal only to 6½lbs. on the square inch that the water bears on the rudder, which, forced against it at the vessel's speed per hour, is the actual power of the helm.

In ascertaining this amount of force, the area of the rudder has also to be taken. A large iron-clad is fully 150 feet, which may be got over to an angle, making it equal to a square of 50 superficial feet, dragged through water of an average resisting power of 6½lbs. on the square inch, at the rate of 10 knots per hour; the power required to do that is the force executed by the rudder in turning such a ship round when going at that speed.

Thinking it desirable that the amount of this force should be estimated in horse-power by some easy method, not being a mathematician myself, I applied to others, but they were unable to solve the problem; I have, therefore, worked it out in my own fashion, and I should be glad if any scientific gentleman present would point out if it is erroneous. I start with the data proposed in a paper I read last year, that was not contradicted—viz., that no floating body can move through water without sending the displaced water to the surface; and finding from reports of trial-trips that vessels in turning usually lose at least one-sixth of the speed they were going in a straight course, that proportion has been adopted. Take a ship drawing 26 feet, going 12 knots per hour; rudder 150 feet area put over to an angle of 30°, which in water I consider would be equal to 50 feet square, at a medium depth of 13 feet, and reducing speed to 10 knots; one knot in six minutes equal to 1,012 feet per minute. This would be equal to raising a volume of water 1,012 feet long, 10 feet by 5 feet, 13 feet high in a minute:—

$$\begin{array}{rl} 1{,}012 & \\ 50 & \\ \hline 50{,}600 & \text{cubic feet} \\ 6 & \\ \hline 303{,}600 & \text{gallons of water} \\ 10 & \\ \hline 3{,}036{,}000 & \text{pounds of water} \end{array}$$

Watts' calculation, 32,000 pounds of water raised one foot per minute = 1 H.P.

32,000 pounds ÷ 10 = 3,200 ÷ 13 = 247 gallons raised 13 per minute.

303,600 gallons ÷ 247 = 1,289 H.P. force of rudder.

Taking into consideration that the lower part of the rudder is much broader than the upper part, some of the largest iron-clads have a force of 1,400 H.P. at a similar angle, hence the difficulty of putting the helm down.

This amount of force will probably astonish many who have not gone into the question. A ship the length of the *Warrior*, 380 feet, taking her centre of turning at two-fifths from the stem, has to displace a volume of water 26 feet deep, equal to two semicircles, one a radius of 152 feet, the other 228 feet, whenever her head is turned half round the horizon, or from north to south; the power to accomplish this displacement in six or seven minutes must be very great.

Swinging a vessel round in a quiet dock is found to be a very slow and laborious process, even with a powerful and well-manned capstan. If, then, it requires this amount of power to turn these large ships round in fine weather, it is not difficult to understand why in bad weather, making but little headway, occasionally they will not answer the helm at all; or that it was found next to impossible to get the head of the *Great Eastern* round, when, during the heavy gale in which she was disabled, she rolled helplessly in the trough of the sea for so many hours.

I once saw the *Minotaur* in the Channel off Portland, under sail alone, in a moderate breeze; she might have been going five knots, when she went about. We did not time her by the watch, but it was the opinion of three or four who were looking at her that she was in stays over a quarter of an hour. The helm could have had no power the last ten minutes, it was only the two forward topsails aback that at length got her round.

When a vessel has bilge-keels—those very questionable appendages to prevent rolling—there is another force acting against the power of the rudder. A large ship so fitted, lying over at an angle of 15 degrees, brings the leeward one to a perpendicular at a depth of some 20 feet below the surface of the water, offering a great resistance to the turning of the ship; that, with equal area, would be equal to the power of the rudder, where the speed of the rotary motion equal to the forward one; but I find from the report of many trial trips, that the speed of the former is not more than one-sixteenth of the latter or forward one.

Should any advocate of bilge-keels doubt their resistance to the turning of a ship, let them take a plank 20 feet long and 15 inches deep, weighted to float edgeways level with the water; then make fast one end, and with a rope drag on the other; until the plank has made a half-circle; knowing that force, then calculate how much would be required to turn 180 feet long 20 feet below the surface. The result will be instructive.

Having termed bilge-keels as questionable appendages to prevent rolling, I do so for this reason—that a ship does not of herself roll in the water, but with the water or wave in motion. A ship is comparatively still; a heavy wave comes on, lifting her up sideways, and passing under her, the vessel rolls over to her other side, sliding down the receding wave into the hollow between it and the next one; when, if another wave did not follow on, she would soon remain still, having regained her equilibrium or perpendicular.

Although a landsman, I have repeatedly watched vessels rolling, both in rough and very heavy weather. A moderate sea on the beam or quarter lifts the ship in the direction she is going; but a heavy beam sea appears to strike the ship low down, lifting her up with the deck inclined towards its crest; and this is the critical moment when a large ship resisting or checking the base of the wave, the upper part flows on, breaks on board, and the vessel is said to ship a green sea. A vessel rolls deeper and easier before the wind with a heavy sea following, catching her sometimes under one quarter and occasionally the other; with nothing to counteract this lifting power, a ship thrown over on one side has to recover herself; but if another sea does not again lift her, the rolling quickly diminishes. What is termed the periodic time of a vessel rolling, appears then from actual observation, is the time it takes for succeeding waves to follow on, and tumble the ship from one side to the other

Watch two or three boys making a boat roll in a river, so long as they go from side to side, the boat rolls—the moment they cease, the boat becomes still again. A ship under sail heels over according to the strength of the wind, more or less as it increases or lessens; the wind dying away she becomes upright; there is no inherent power in a sailing-ship or steamer to go from side to side like a pendulum, unless some external force continually acts on them. An iron light-ship in the Bristol Channel, fitted with rolling chocks 15 inches deep, proved pretty clearly that she rolled with the water, not in it, for in a short time the spaces between the chocks were completely filled up with mussels, that when removed amounted to tons in weight; now, had the vessel have rolled in the water, the dash against the chocks would have prevented the mussels taking up such snug quarters.

If therefore bilge-keels do not prevent rolling, and interfere with the steering of a ship, why continue the use of them? I ask the question, may not the difficulty of steering some of the large iron-clads (having to be fitted with hydraulic or steam-power for the purpose), be caused by their requiring so much more helm, in consequence of the resistance of their bilge-keels? It might be a useful experiment to remove them from the one that steers the worst, and carefully observe if any change took place either in rolling or steering; I cannot fancy she would be in any way a worse ship after their removal, and most certainly an easier one to steer. I am not aware that the question of the value of bilge-keels, or their interfering with the steering of a ship, has been brought before this institution, and I feel that an expression of the opinion of practical men might be very useful, as several of our large iron-clads are fitted with them.

Now that so many merchant steamers are being built, eight and nine times the length of their beam, with comparatively small engine power for long voyages, it will be useful for the masters of those vessels to have some ready method of calculating the power absorbed by the rudder at given angles, to compare with the power of engine. A vessel of this class was lost not long since; had her captain known the relative power of his engine and rudder he would probably have kept a better offing, and saved the ship. To first-class steamers with powerful engines it may not be of so much consequence, but still a correct knowledge of speed and rudder-power would be a help—as head to sea, in heavy gales, the rudder has little guiding power; and at an angle supposed needful to get a vessel out of the trough of the sea, might almost nullify the power of the engine. It may be said a seaman knows all these things intuitively, nevertheless the observations of a landsman, without responsibility to distract his attention, may suggest new ideas, and partly with this view I have written this paper.

THE FISH-TAIL RUDDER.

By J. Macgregor Croft, M.P.

I beg to submit models of my plan of rudder, for vessels of all classes, and which I have designed from the motion of a fish's tail, when he desires to turn.

Many vessels have been fitted, and the success of the rudder proved, by quicker turning, and not stopping the way to the same extent, as with other forms of rudders. In the management of war ships, particularly of the ram class, the importance of my principle ought not to be overlooked.

I annex the latest reports, and test trials, of the fish-tail rudder in all weathers, and think the subject worthy of consideration and discussion.

ON THE CONSTRUCTION, STEERING, AND PROPELLING SCREW STEAMERS.

By George Seymour, F.G.S.

With your kind permission I feel pleasure in reading a paper on the construction, steering, and propelling screw steamers, to which subject I have for some time given a good deal of attention. By the present mode of building screw vessels, as you are aware, the hull of the vessel is built in the ordinary manner, with the exception of the after-part or run of the ship; here we find, instead of the run of the vessel continuing in an unbroken line to the stern-post, a large hole or aperture is cut in the dead wood, right through the vessel; in this hole or aperture the propeller is placed, and abaft this comes the outer stern-post, to which the rudder is attached. Now my objections to this mode of applying the screw and rudder are:—

1st. The large hole cut in the after-part of the ship must tend to weaken her in this particular part; and

2nd. The screw being placed in this aperture works at a great disadvantage, its free action being interfered with by the frame of the aperture which surrounds it, and through this confined space the screw has to force its way at an expense of several horse-power required to drive it; and further, this large hole cuts several feet off the length of the ship, in fact shortens her to that extent, as the ship ends at the inner stern-post, and the water collapsing at this point enters the aperture and forms an eddy, which, together with the after-stern-post and rudder, becomes an additional resistance or drag to the forward motion of the vessel.

3rd. The water thrown back by the screw on the after-stern-post and rudder reduces to a certain extent the effective action of the screw, and hence a great waste of power.

4th. The present position of the rudder, hung on the after-side of an isolated stern-post and exposed to being broken or carried away by the blow of a sea or the ship touching the ground, must always be a source of great anxiety to a careful master. The rudder, I may say, is the life and soul of the ship; on it depends her safety at all times whilst at sea, and custom alone has reconciled us to its being placed in its present dangerous position, without any safeguard or protection of any kind. The balance rudder lately introduced into our men-of-war is even more dangerous; this rudder is merely fastened top and bottom, working in a loose bush at the extremity of the keel, and is extremely liable to get out of order by a blow of a sea, a shot, or by the keel of the vessel touching the ground; besides, it is found, from its great size offering such a breadth of surface to the action of the screw, almost impossible to put the helm hard-à-port, or hard-à-starboard, whilst going ahead full speed by any ordinary steering gear; so the aid of hydraulic power or steam power has been called in to overcome this difficulty. The judicious application of these great powers requires very nice manipulation, and a very slight error at a critical moment, whilst running, say before a heavy sea, might smash the steering gear and bring ruin upon the whole concern.

5th. Screw steamers, in case of accident to their machinery, or running short of fuel, are found nearly unmanageable, and are to a great extent left to the mercy of the winds and waves, as it is found the aperture for the screw prevents the vessel keeping close to the wind under canvas alone, and quite destroys the weatherly qualities of the ship; besides, the rudder moving as it does in the eddy water passing through the aperture, has very little steerage power, and will have little effect on a ship going at less than five knots through the water.

Now I have stated what I consider five serious objections to the screw-ship as at present constituted, and it is now my duty to explain to you a remedy for the defects.

1st. I would build the ship in the ordinary manner, complete in her plating from stem to stern, without any hole or aperture in her after-end; thus I preserve the strength of the ship, and obtain a level side, tapering aft to the stern-post, without any obstacle to interfere with the action of the rudder or the screw-propeller.

2nd. I construct this vessel with an extended stern-post, which becomes a continuation, or part of the run of the ship; through this post I pass the screw-shaft, working in a long bearing; on the other end I place the screw, which I fasten in a secure manner, but so as it may be taken off in case of accident and easily replaced. Thus, you see, I have the screw working perfectly free from the vessel; having no obstacle to interfere with it, the whole surface of its blades works freely or directly upon the water on its after-side; and by thus placing it I get the greatest effect with the smallest power, as there is not that loss which is spent in driving the screw through a circumscribed apperture.

3rd. and 4th.—Now, as regards steering. I perform this by fixing in a secure manner two rudders, hung one at each side at the fore part of the stern-post, against which they lie when amidships; by this means I have a much more secure fastening for my rudders, and should either of them be struck by a heavy sea the rudder cannot be driven back further than the stern-post, which would effectually support it. These rudders act independently of each other—one giving the starboard and the other the port helm. The two rudders, so placed, offer a great advantage over the single rudder. This plan not only allows me to dispense with the large screw aperture but also enables me to give the ship helm much quicker than can be done by the single rudder, an advantage in narrow water, or in case of anticipated collision, which can scarcely be over estimated. This advantage is very evident, when you observe, that through a radius of say 90° from hard-à-port to hard-à-starboard, I have to move the rudder half the distance only, requiring only half the power and half the time to do it in, although the ship can be steered with one wheel in the usual way. I prefer to work these rudders by means of two steering-wheels on deck, which can in ordinary circumstances be worked by one man standing between them, a position which renders it almost impossible for the helmsman to make a mistake in giving the ship on a sudden emergency helm as instructed.

5th.—In case of accident to the machinery, or wishing at any time to economise fuel, I lift the screw completely out of the water, and the ship remains with all the advantages of a sailing vessel, without any aperture or drag of any sort to retard her way whilst under canvas alone. An *Alabama* fitted on this plan might cruise round the world as a sailing vessel, whilst carrying within herself steam power sufficient to propel her 14 knots an hour when required. I may here remark that since the opening of the Suez Canal has given the cream of the carrying trade of the East India and China to vessels propelled by steam, the owners of many of these vessels, in order more successfully to compete with constantly increasing opposition, have resorted to the plan of reducing their masts and yards to a minimum, and the number of their crew to nearly one-half; but what, may I ask, is to become of the people on board one of these steamers in case of accident to the machinery on the large expanse of solitary ocean between Aden and any of the East India ports. There is very little hope of her ever arriving at any place under such canvas as she may be able to spread; and once the disabled vessel drifts out of her usual track of steamers nothing but the prospect of dying of thirst or starvation remains for the unfortunate crew and passengers. Now, steam vessels, fairly rigged, and with engines of full power, may proceed with all confidence; as at pleasure, or in case of injury to the machinery, by means of lifting the screw out of the water, they will make as good way towards their port of destination under canvas alone as a sailing vessel of similar lines and rig, an advantage not possessed by any other form of steam vessel.

Now, I have endeavoured to make clear to you my plan for improving the construction and for propelling and steering ships, but, not being a mechanic, I am not able to explain myself in technical language, or with the conciseness and perspicuity I could have wished; but as a ship-owner, and one who has commanded a ship for many years, I bring before you some practical experience and observation; and if these plans and alterations should meet with your approval, I shall be glad that I have had the opportunity of addressing you.

THE INDUSTRIAL SCHOOL OF BRUSSELS.

Our neighbours the Belgians have, it is well known, given great attention of late to the modes of teaching the arts and sciences; striking illustrations of this were exhibited at the late International Exhibition at South Kensington.

M. Stévart, an engineer, is now occupied in spreading amongst the artizans a knowledge of the principles, and in creating a sense of the value, of economic science and industrial education, and his lectures, which take place twice a week at the Musée de l'Industrie of Brussels, attract deserved attention.

One of the first aims of M. Stévart has a general interest; it is to correct the old classification of economists, and to produce a scheme at once scientific and answering the demands of modern industry and education. Considering the part of agriculture as secondary in modern industrial movement, and attempting to classify the various kinds of human work according to the relative subordination of their characters, he has produced a scheme for which he claims the great advantage that, whatever industry may be created in future, it will find at once its proper place in the following plan:—

First Group.—Industries which are limited to the collection or extraction of natural products without transforming or radically modifying them. They are divided into three classes, mineral, vegetable, and animal.

Class 1.—*Minerals* (mineral or extractive industry), including coal mines—peat extraction; mines (iron, lead, zinc, &c.; quarries (marble, building stone, paving-stone, sand, &c.), salt works.

Class 2.—*Vegetables* (vegetable industries or cultivation). —Agriculture (fields); sylviculture (forests); horticulture (gardens); arboriculture (orchards, plantations); market gardening (vegetables).

Class 3.—*Animals* (animal industries).—Hunting; fishing; breeding of cattle (animals for meat); domestic animals.

Second Group.—Industries which give additional value to substances, by transforming them in ways rendering them more appropriate to our wants. They are divided into two classes.

Class 1.—*Chemical Industries* (which change the nature of substances).—Extraction of metals (blast furnaces, zinc, lead, and other works); chemical works; alimentary industries (baking, brewing, distilling), &c.; glass works; ceramic works; tanneries, &c.

Class 2.—*Mechanical Industries* (which change the forms and dispositions of substances).—Metal works; construction of machinery; building; carpentry, joinery, &c.; weaving, &c.; spinning.

THIRD GROUP.—Industries which give value to substances in other ways, namely :—

Class 1.—*Transport.*—Navigation (ports); river and canal carriage; land carriage (roads, railways).

Class 2.—*Sale* (*commerce*) *of Raw Materials and Manufactured Articles* (products of Groups 1 and 2).—Of money or its representations—banks.

There is no doubt that such a scheme is logical and simple, and may furnish the basis of industrial education; but it will be observed at a glance that it does not include the ornamental arts, nor indeed some of the semi-artistic or miscellaneous arts, such as printing, which, while it gives additional value to paper, neither alters its chemical nature nor its material form. But classification has baffled the most scientific as well as the most practical minds, and every serious attempt to fit it to the purposes of life—and especially to education—deserves respective attention.

The above is extracted from a report in the third number of a promising new weekly publication, based on the plan of English scientific journals, and which, although printed in Brussels, is also published in Paris, London, and elsewhere.* The new journal contains a considerable amount of information from foreign countries, as well as English news, for circulation abroad

NOTES ON SCIENCE.

The subject of astigmation is one about which less is probably known than any other in the wide range of optics. Many treatises on the transmission of light through lenses have been given to the public, but they have been directed to the passage of rays at right-angles to the lense, or at any rate to those which are brought to a focus in the axis of the lens. It is when rays of greater or less obliquity are transmitted that the phenomenon known as astigmation is encountered; and the greater the obliquity of the incidence the more skill is required in the optician to counteract its effects. If a lens, such as one of a plano-convex form, be held up so as to bring to a focus a definite bright object—a star, for instance—that object will at its focus be represented by a spec of light, without any luminous tail in either one direction or the other; this, however, being the case only so long as the plane of the lens is at a right angle to the incident stellar rays. No sooner is the lens turned obliquely to those rays than the image of the star at the focus, formerly circular and well-defined, is found to be elongated. In the previous case, although the image be examined, when, either within or without the point of sharpest focus, it becomes indistinct, but always remains of a circular shape; but in the case of the oblique incidence there is no point at which a sharp focus can be obtained. But the careful observer will observe that when the image is examined within the focus, the star appears not only indistinct, but of an elongated form, the elongation being in a vertical direction. On the contrary, when the image is examined a little beyond its sharpest focus, the same hazy indistinctness appears, but this time the elongation is placed horizontally. The subject of astigmation in lenses is one which to a greater extent interests the photographic optician than any other, for, until the necessity arose for depicting landscapes or other objects subtending a large angle on a flat field, the theory of the transmission of very oblique rays through lenses was scarcely ever studied, and even now it is thoroughly known only to the limited class above indicated. Only the most striking illustrations of astigmation is to be found in the examination of the image of a well-defined cross, or the astrigals of a window against a bright sky, formed by rays transmitted obliquely through a lens; and for the most effective way of viewing this phenomenon any small telescope may be employed, after having first unscrewed the object-glass and placed it temporarily somewhat obliquely to the body of the instrument. It will be seen that if the focus is obtained as sharply as possible on the vertical line of the cross or the vertical window-bars, the horizontal lines of these will be quite invisible, from their being so far out of focus; while again, if the eye-piece be so adjusted as to make the horizontal bars sharp, then do the vertical lines disappear. Proper correction for the oblique pencil would cause both vertical and horizontal lines to be depicted with equal sharpness. This is astigmation as applied to lenses. But there is astigmation also in the human eye, in certain diseased conditions of that organ. In a lecture recently delivered at the Royal Institution by Dr. Liebreich "On the effects of certain faults of vision on painting," with special reference to Turner and Mulready, reference was made to the effects produced in a painting when the artist had either long or short sight. The former, or hypermetrophy, the lecturer explained, did not essentially influence painting, and was easily corrected by the use of convex spectacles; whereas shortsightedness influenced both the choice of subject as and its manner of execution. In addition to these two departures from normal vision, the eye, he said, sometimes diverges from its spherical form, producing astigmatism. This particular phase of vision has only been closely investigated since Airy discovered it in his own eye. Ocular astigmatism was illustrated in the following way :—Let meridians be supposed to be drawn on the eye as on a globe, so that one pole is placed in front, then astigmatism might be defined as a difference in the curvature of two meridians, which might stand perpendicularly upon each other, the consequence of which would be a difference in the power of refraction of the eye in the direction of the two meridians. An eye might, for example, have a normal reflection in its horizontal meridian and be short-sighted in its vertical meridian. Differences of this kind to a very small extent were, he said, to be found in almost every eye, but were unperceived; higher degrees of astigmatism were, however by no means uncommon. Of the importance of freedom from this defect by painters who had to reproduce what they saw, there can be no doubt, and Dr. Leibreich has rendered important service to the cause of science by the prominent manner in which he has directed public attention to the defect. The remedy proposed is the adoption of glasses the surfaces of which are of a cylindrical instead of a spherical curved form.

Much useful information concerning that part of Asia Minor formerly known as Armenia, was given on Monday evening, by Mr. W. G. Palgrave, whe read a paper before the Royal Geographical Society, describing scenes visited by him during his late residence as consul in Asia Minor. From observations made in the neighbourhood of the range of mountains known as Kolat Tagh, he considered it as established beyond doubt that at some period or other glaciers must have formed and existed in these immense tracts of mountains, although at the present time the climate was too genial to allow even the snow to remain on the ridges and peaks throughout the year. The mineralogical formation of the soil was such that, in his estimate, mines might be opened which would prove highly lucrative, from the quantity of silver and lead that would be yielded.

It is known that the Australian eclipse expedition proved a failure in consequence of the bad weather experienced; beyond this no details have been known till within the present week. From the particulars that have just been received, we learn that the arrangements for recording the solar phenomena were very complete. From a special account, written by a gentleman connected with the *Melbourne Argus*, we condense the following:—The Victoria party had two analysing spectroscopes and an integrating spectroscope, both equatorially mounted. The first was in the hands of Mr. Ellery, and the second was to be worked by Mr. Foord, both gentlemen having assistants to use the finding telescopes attached to pick out portions of the corona for examination. The two analysing spectroscopes were for examining the nature of the light of the chromosphere and the corona; and the integrating spectroscope, entrusted to Mr. M'George, was designed to examine the nature of the whole light, all the observations being directed with a view to determining the character of the orb from which the light proceeds. Professor Wilson had two Savart's polariscopes. The object of polariscopic observations is to ascertain whether the light of the corona is that of a self-luminous body or a reflected light; also, in the case of its being a reflected light, to determine the angle of incidence, the great question to be settled being whether the corona is an appendage of the sun, or whether it exists in our atmosphere. There was also a magnetic theodolite, to record magnetic disturbances. Mr. Moerlin, assisted by Mr. Walter, had charge of the photographic department. The principal instrument was one of Dallmeyer's rapid rectilinear lenses, of four-inch aperture and thirty inches focal length, giving an image about three-tenths of an inch in diameter, equatorially mounted, and driven by clockwork. It was intended to take ten views during totality. Mr. White, assisted by Mr. Black, directed the instruments for determining the position of the station, and predicting the time of the different phases of the eclipse. The Sydney party were furnished with an equatorial telescope, made by Merz, of Munich, with seven and a quarter inches clear aperture and ten feet four inches focal length, mounted on the German plan. Attached to the telescope was an apparatus for taking photographs in the principal focus of the object glass; also a photographic lens and camera by which a second series of photographs could be taken simultaneously, the photographic lens having a three-inch aperture and thirty-inch focal length. There were, in addition, two small telescopes of two-inch aperture, with a magnifying power of twenty, mounted equatorially and driven by clockwork, and a third telescope of three and a-half inch aperture and four feet six inch focal length. The party intended to take a double series of photographs, to make two independent drawings, and to make naked-eye drawings and observations. When the day of the eclipse arrived the instruments were all working admirably. There had been numerous rehearsals to secure the utmost economy of time, and all felt that nothing but clear weather was needed for success. On Monday afternoon, the 11th December, for the first time since leaving Melbourne, the sky became seriously overcast. The clouds had been gathering in dense dark masses all the earlier part of the evening, and at ten at night there was an awful thunderstorm, which lasted over an hour. The glow of the lightning, which came down in sheets of flame, and the rattle and crash of the thunder which followed the flash instantly, were inexpressibly grand. A portion of the astronomical party returned from the shore in the middle of the storm. While they were ascending the ship's side the lightning struck the iron rigging, leaped from stanchion to stanchion in balls of fire, and broke off at the ropes depending from the dead-eyes with loud crackling noises before it reached the sea. The vessel was lit up from stem to stern with a blinding light, and those on deck could see nothing for some seconds after each flash. This storm, unfortunately, did not clear the atmosphere. Next morning, the day of the eclipse, every eye was turned heavenward. To our dismay, there was not a speck of sky to be seen. At ten o'clock there were several breaks in the clouds, and the sun showed himself for a few seconds, but an hour and-a-half later all was dense cloud again. Things looked brightest at mid-day, when there seemed to be a possibility of a fine afternoon. Then dark clouds swept by from the horizon, and extinguished every hope. A sharp shower fell at this time, and the instruments exposed had to be covered up. A drizzling rain continued during the remainder of the afternoon. At the faintest indication of a break in the clouds the astronomers ran out of their tents and endeavoured to take observations, but without any result. Seven minutes before the commencement of totality there was a gleam of light from the sun, but the phase of the eclipse could not be discerned. Never was nature more assiduously wooed to reveal her treasures to science; but it was all to no purpose. Of the upward and onward march of the moon, the successive disappearance of the solar spots, the brilliant breaking into view of Bailey's beads, the passage of the shadow through the air, the rose-coloured prominences and coronal radiations during totality, the re-appearance of the solar crescent, and the final retreat of the lunar shadow into space, we had seen nothing. No observation could be taken by instrument. Mr. Russell exposed a photographic plate for twenty second during totality, but got no result.

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* *Chronique de l'Industrie*, a weekly journal, published in London by W. Lloyd Wise, Chandos-buildings, Adelphi, &c.

A new method of obtaining potassium has been discovered by Professor Dolbear, of Bethany-college, Virginia, and is described by him in the *American Chemist*. He takes white stick caustic potash, and dissolves it in water, treating the solution with sulphuretted hydrogen in the way commonly described for making potassium sulphide. The solution is evaporated until it becomes solid when cool, when the yellowish mass is mixed with more than its bulk of iron filings or chips, the whole being then put into an alembic for distillation. The heat of a furnace is applied till the alembic becomes of a bright red heat, and the products of distillation are received in common coal oil. Professor Dolbear believes that sodium can be obtained by an analogous process, but he has not yet tried it.

GENERAL NOTES.

Bethnal-green Branch Museum.—We understand that her Majesty the Queen, the Duke of Edinburgh, the Duke of Abercorn, the Marquis of Westminster, Lord Elcho, Sir Richard Wallace, Sir Coutts Lindsay, and others will lend works of art to the Fine Art Galleries in this new branch of the South Kensington Museum.

Preservation of Meat.—In America, carbolic acid paper is used for packing fresh meat. It is made by melting five parts of stearine at a moderate heat, and by stirring in subsequently two parts of carbolic acid; five parts of melted paraffin are to be added. The compound should be stirred until cool, then it should be re-melted, and applied to the paper with a brush, in quires, in the manner in which waxed paper is used for wrapping various articles.

Heating Apparatus.—Mr. Thomas Parker, of Newcastle-on-Tyne, architect, has patented a new hot-water heating apparatus, which is stated to be more efficient (by applying heat locally), more economical in the cost of apparatus, and less cumbrous, as flues under floors are not required. Pipes of small-bore are used for the flow and return of the hot water, laid on the floor of the building—subject to the rules of the Building Act within the metropolitan district—and heaters are used similar to those used in railway vehicles, or placed in the pews, or in rooms, and in other buildings.

Suppression of Cape Horn.—Such is the startling heading of an important announcement received by the *Moniteur de la Flotte* of Paris, from Valparaiso. Everyone knows the difficulty, especially for sailing vessels, of doubling Cape Horn, and nearly all sailors know the dangers of the Straits of Magellan. To meet the circumstances of the case, and render the passage of sailing vessels to the Pacific comparatively easy, a service of steam-tugs is about to be established in the straits, to tow sailing vessels through its narrow and dangerous channel, under the guidance of men well acquainted with the peculiarities of the navigation. Trading vessels will thus gain a month's time in their voyage, on the payment, it is said, of exceedingly moderate towing dues. The establishment of such tugs, and the careful survey and marking of the Straits of Magellan, will form almost as important facts in the history of navigation as the piercement of an isthmus.

Third-Class Trains.—A very desirable innovation in railway management (the *Manchester Guardian* says) is spreading so rapidly that we may anticipate its soon becoming universal. The Midland Company was, we believe, the first to proclaim its adoption of the policy of running third-class carriages by all trains. The North Staffordshire quickly followed suit. Our advertising columns of this day contain an official announcement that on and after the 1st of April all the trains of the London and North Western will convey third-class passengers with the exception of the Irish and the Scotch limited mails and the suburban trains running in connection with the North London line. The Manchester, Sheffield, and Lincolnshire Company also announce that on and after April 1st they will issue third-class tickets over all parts of their line, by all trains. The introduction of the new system is happily timed to give the public the advantage of it in Easter week. Its adoption throughout the country will confer a boon not easily to be overrated on the poorer classes of society. Not only will their opportunities of going about be greatly multiplied, but there will be an end of the practice of compelling them to chose between travelling at inconvenient hours of the day and paying the higher fares.

Colouring Veneers.—Some manufacturers of Germany, who had been supplied from Paris with veneers coloured throughout their mass, were necessitated by the late war to produce them themselves. Experiments in this direction gave in the beginning colours fixed only on the outside, while the inside was untouched, until the veneers were soaked for twenty-four hours in a solution of caustic soda, containing ten per cent. of soda, and boiled therein for half an hour; after washing them with sufficient water to remove the alkali, they may be dyed throughout their mass. This treatment with soda effects a general disintegration of the wood, whereby it becomes in the moist state elastic and leather-like, and ready to absorb the colour; it must then, after dyeing, be dried between sheets of paper, and subjected to pressure, to retain its shape. Veneers treated in this way, and left for twenty-four hours in a hot decoction of log-wood (one part of log-wood to three of decoction), removing them after the lapse of that time, and, after drying them superficially, putting them into a hot solution of copperas (one part of copperas to thirty of water), will, after twenty-four hours, become beautifully and completely dyed black. A solution of one part of picric acid in sixty of water, with the addition of so much ammonia as to become perceptible to the nose, dyes the veneers yellow, which colour is not in the least affected by subsequent varnishing. Coralline dissolved in hot water, to which a little caustic soda and one-fifth of its volume of soluble glass has been added, produces rose colours of different shades, dependent on the amount of coralline taken. The only colour which veneers will take up, without previous treatment of soda, is silver gray, produced by soaking them for a day in a solution of copperas (one of copperas to one hundred of water).

CALENDAR OF MEETINGS.

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ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

April 3rd.—"On the Losses to Arts, Manufactures, and Commerce, consequent on the late Franco-German War." By G. C. Mast, Esq.

April 10th.—"On Hindrances to the Progress of Applied Art." By Dr. Christopher Dresser. On this evening Sir Digby Wyatt will preside.

April 17th.—"On the Great Central Gas Company's Works." By Col. Crole.

CANTOR LECTURES.

The Third Course of Cantor Lectures will be by Professor Barff, on "Silicates, Silicides, Glass, and Glass Painting." The Lectures will be on Monday Evenings, commencing Monday, 8th April.

Lecture I.—Monday, 8th April.

On Silicon, Silica, and compound of these with other substances—Fluorine, &c.

Lecture II.—Monday, 15th April.

Solvents of Silicic Acid—Silicates—Glass (composition of)—Different Kinds of Glass—Methods of Making Glass.

Lecture III.—Monday, 22nd April.

Manufacture of Glass (continued)—Coloured Glasses—Glass Staining—Glass as a Decorative Material—Glass Painting.

Lecture IV.—Monday, 29th April.

Glass Painting (continued)—Mosaics—Enamels.

Lecture V.—Monday, 6th May.

Styles of Glass Painting—Illustrations with the Electric Light, illustrative of the Nature of Colour.

Lecture VI.—Monday, 13th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose are issued with the *Journal.*

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon. ....Royal Institution, 3. General Monthly Meeting.
Entomological, 7.
Victoria Institute, 8.

Tues. ...Civil Engineers, 8.
Pathological, 8.
Biblical Archæology, 8½. 1. Dr. Henry Fox Talbot, "Notice of a Curious Myth respecting the Birth of Sargina, from the Assyrian Tablets containing an account of his Life." 2. Mr. Richard Cull, "The Assyrian verbs 'Basu,' to be, 'Qabah,' to say, and 'Isu,' to have, identified as variant forms of Verbs having the same Significations in the Hebrew Language." 3. Rev. A. H. Sayce, "On the Origin of Semitic Civilisation, chiefly upon Philological Evidence."

Wed.....**SOCIETY OF ARTS, 8.** Mr. G. C. Mast, "On the Losses to Arts, Manufactures, and Commerce, consequent on the late Franco-German War.'
Royal Society of Literature, 4¼.
Obstetrical, 8.
London Institution, 7½.

Thurs...Linnæan, 8. Mr. Bentham, "On the Geographical Distribution of the *Compositæ*" (conclusion).
Numismatic, 8.
Artists and Amateurs, 8.

Fri.......Geologists' Association, 8.
Archæological Institute, 4.

Sat.......Royal School of Mines. Swiney Lecture. Dr. Cobbold, "On Geology."

Journal of the Society of Arts.

No. 1,011. Vol. XX.

FRIDAY, APRIL 5, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 3rd, 1872; George C. T. Bartley, Esq., Treasurer to the Society, in the chair.

The following candidates were proposed for election as members of the Society :—

Clark, Adolphus, 1, Chandos-street, Strand, W.C.
Haig, Major R. W., R.A., Royal Artillery Institution, Woolwich, S.E.
Jellicoe, Charles, jun., 20, Kildare-terrace, Westbourne-park, W.
Oppert, Emil, 180, Piccadilly, W.
Pulman, G. P. R., the "Hermitage," Crewkerne, Somerset.
Scammell, Samuel, B.A., 217, Caledonian-road, N.
Scott, Robert, C.E., Blackhill, Durham.
Stevens, C., 172, High-street, Wapping, E.
Stewart, Charles, West-hall, High Leigh, Knutsford.

The following candidates were balloted for and duly elected members of the Society :—

Brandon, Jonathan, 12, Fenchurch-street, E.C.
Clarke, J. Moir, Messrs. Moir and Sons, Aberdeen.
Harrison, Charles William, Whitmore-lodge, Beckenham.
Jupe, J. M., Mere.
Millar, D. C., Milrevan Works, Lambeth, S.E.
Piggott, David S., 39, Gresham-street, E.C.
Previté, Joseph Weedon, 82, Addison-gardens North, W., and 3, Newman's-court, Cornhill, E.C.
Price, W. C., 14, Bow-lane, E.C.
Stevens, Warwick, Darlington Works, 37, Southwark-bridge-road, S.E.

The paper read was :—

THE LOSSES TO ARTS, MANUFACTURES, AND COMMERCE, CONSEQUENT ON THE LATE FRANCO-GERMAN WAR.

By **G. C. Mast,**
Principal of Belgrave College.

I.—Introduction.

On the 6th July, 1885, it will be just 200 years since the last battle was fought on English ground. The advantages resulting from this long immunity from war appear in the unexampled development of every kind of manufacture, in the gigantic proportions which commerce has assumed, and in the general prosperity and accumulation of wealth enjoyed by Great Britain, such as never was enjoyed before by any nation, ancient or modern. These acquisitions naturally engendered the wish for an uninterrupted peace, and many intelligent men gave themselves up to the delusion that an era of such peace was ushered in through the Great Exhibition of 1851.

It was asserted that the community of interest which binds the whole civilised world together, and which such exhibitions strikingly illustrate, would be a sufficient safeguard against the interruption of peace on all but the most serious grounds. Few people would then have believed it possible that a war like the last between highly-civilised France and learned Germany would break out so suddenly, and on so trivial a pretext. But the more delicately spun the net is, and the further the meshes reach, which commerce has spread over the world, the more mischievous is the rent made in it by a rude hand.

And so the late war fell upon the various material interests of humanity, especially in those countries directly involved, like a hailstorm upon a cornfield ripe for the harvest.

To estimate these losses is the main object of this paper. My calculations are necessarily approximate; they will prove, however, amply sufficient to indicate the enormity of the evil of international strife, and the serious devastation which ever marks the track of war. I will first give statistics of the losses of France; secondly, of those of Germany; and then of those referring to both countries conjointly.

In the details which will follow, I have endeavoured to avoid everything unnecessary, knowing that I address an audience both intelligent and well-informed; and in every manner I have studied to be brief, as far as was compatible with justice to the subject placed in my hands.

II.—Statistics of Losses.

A.—Referring to France.

According to Mr. Martin's "Statesman's Year-book" for 1872, the expenses and losses of France were estimated as follows :—

1. Imperial war armaments	£40,000,000
2. Fortifications destroyed, which have to be rebuilt	60,000,000
3. Losses of muskets, cannon, and other war materials destroyed or captured	60,000,000
4. Destruction of buildings and fields by both armies	80,000,000
5. Total or partial ruin of manufacturers and other proprietors......	40,000,000
6. War idemnity to Germany	200,000,000
7. Trade and other losses	80,000,000
Total of losses....	£560,000,000

B.—Losses of Germany.

The German expenses of the war were estimated as follows by the German statistician, Dr. Hirth, early in September last* :—

I.—MILITARY EXPENDITURE.	francs.
1. Mobilisation of the troops; armament of the fortresses and transports ..	100,000,000
2. Purchase of horses	110,000,000
3. Pay and rations, at the rate of 40 thalers per man per month, for six months	900,000,000
4. Ammunition and loss in *matériel* ..	70,000,000
5. Naval expenses	25,000,000
6. Provision and transport for 100,000 French prisoners, at the rate of 20 thalers per head per month	45,000,000
II.—DIRECT LOSSES.	
1. Loss of labour of 700,000 men (Reserve and Landwehr) during six months, at the rate of 200 thalers a year per man	260,000,000
2. Loss of 10,000 men (dead and invalided), amounting to 2,000,000 thalers a year, capitalised at 4 per cent.	190,000,000

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* From "Facts and Illustrations."

3. Pensions for invalids, widows, and orphans, 2,000,000 thalers a year, capitalised at 4 per cent.	190,000,000
4. Losses incurred by the blockade and the bombardment of Kiel and Saarbrücken	500,000,000
5. Indemnity to be paid to the German territories occupied by the German troops at the beginning of the war, as well as to the inhabitants of the German fortresses, for losses inflicted in consequence of the armament of those fortresses	40,000,000
6. Indemnity to the 70,000 Germans expelled from France	50,000,000

III.—INDIRECT LOSSES.

1. Losses of the Railway and Steam Navigation Companies and the Post Office	100,000,000
2. Reduction of the national income,	950,000,000
3. Depreciation of the national property	1,200,000,000

IV.—WAR INDEMNITY.

1. To Alsace and Lorraine, particularly Strasburg, Thionville, Metz, &c...	200,000,000
Total	4,930,000,000
Or	£197,000,000

The total of the losses of France and Germany together amounts accordingly to	£757,000,000

Professor Leone Levi, in a paper read at the Social Science Congress at Newcastle in 1870, estimated the losses as follows, after the war had lasted only three months:—

1. Loans and credits obtained by the governments of France and Prussia	£200,000,000
2. Loss in crops and buildings destroyed, cattle seized, &c., in both countries	200,000,000
3. Loss from suspended production, calculating the average value of production at £22 per head of a population of about 78,000,000. Supposing only one-fourth less is produced in 1870 than in any ordinary year of peace the amount is ..	400,000,000
4. Loss to trade (10 per cent. profit) of one-third of the value of exports and imports of France and Germany ($\frac{1}{30}$ of £400,000,000)	13,000,000
5. Value of labour lost by 200,000 men killed and wounded on both sides (the capitalised value of each man estimated at £564)	112,000,000
6. Loss of productive labour from fatigue, want of food, want of shelter, &c. (the capitalised value of 1,500,000 men at £80 per man) upwards of	100,000,000
Total loss for both countries..	£1,025,000,000

While the latter sum may appear too high, even if we take it to represent the losses of the whole war for both countries, a little examination of the statistics of B, that is, the losses of Germany, will show that several of the items are evidently estimated too low.

Instead of 100,000 prisoners, the expenses of 385,000, amongst whom were 11,860 officers, ought to have been calculated. Again, in estimating the loss of labour, instead of 700,000 men, 1,062,000 of the German army, as engaged in the war, ought to have been taken into consideration. Above all, the figure of 10,000 men of dead and wounded in the German army is only the 18th part of the real number.

Taking for granted that otherwise the estimates of the losses as given above are at least near the truth, we are forced to the conclusion that the total amount of losses for both countries resulting from this war is between eight hundred and a thousand millions pounds sterling.

In order to show more clearly the work of destruction that was wrought, and to prove that the above quoted statisticians were justified in affixing such high figures to the various losses, I deem it necessary to give a few details.

III. — Details of Losses.

A.—In reference to Arts.

Artists, and all those who administer to the requirements of luxury, are always the first to suffer through war. "There is no doubt," wrote Mr. Henry Weekes, F.R.A., in a letter addressed to myself, "that the contest has created almost a total stoppage in the studios of living artists both in Germany and in France, but especially in the latter country." Many of the artists found a new home and employment in England; others entered the army or the ranks of the Franc-tireurs, several of whom fell, as for instance the sculptor Cuvillier, the painters Henri Regnault and Gustave Lambert.

Of monuments destroyed I will mention the column on the Place Vendôme; but architectural art suffered most through the burning of the Chateau at St. Cloud, through the bombardment of Strasburg, and through the total or partial destruction of the Tuilleries, the Hotel-de-Ville, and other buildings of national interest. The loss of the Palace at St. Cloud is incalculable. According to an estimate made in the year 1736 the Chateau was valued at £330,000. Napoleon I., who had made it his residence while he was Consul, spent 3,140,000 francs on it. Its noble apartments, the "Salon de Mars," the "Galerie d'Appolon," the "Salon de Venus," &c., contained a large number of paintings, tapestries, &c. Many of the paintings were by the first French and Dutch artists, among whom we may mention Mignard, Le Moyne, Coypel, M. Alaux, Jean Nocret, and Nicholas-Pierre Loir.

Through the bombardment of Strasburg irreparable damage was done, not only in the destruction of the picture gallery, but immensely more in that of the great library with its 200,000 volumes; and according to Mr. Zeller, the rector of the Academy of Strasburg, no one can restore so many "*éditions principes*, so many unique manuscripts, admired, studied, handled with profound respect by the *savants* of all nations."

B.—In Reference to Manufactures and Commerce.

(a.) France.—Of the extent to which the French railways were turned from their ordinary productive use to that of destruction we may form an idea from the following facts. The Orleans Company alone, from July to December, 1870, transported 1,500,000 men, 150,000 horses, and 120,000 tons of stores and provisions. All the other companies worked in the same proportion. The damage done to the rolling-stock of the company of the East was valued at 57 millions of francs. For the company of the West it was 10,000,000. Other companies suffered similar injuries, but the amount was not yet ascertained. How much the receipts must have been diminished we may judge by the fact that from 17,000 kilometres open to traffic, 7,000 were occupied by the enemy during considerable periods, and so were entirely deprived of revenue. Even those parts not occupied by the enemy suffered severely, particularly the wine-growing districts. The Mayor of Montpellier estimates at 25 or 30 millions the loss which will result to the wine-growers of the South. The coal mines also suffered greatly through want of means of conveyance; and, indeed, a general suspension of business resulted every-

where. Of a total effective of 120,000 waggons, 16,000 were turned away from their commercial destination; a nearly equal number had been destroyed or rendered useless during the campaign, so that the companies were deprived of a quarter of their ordinary resources of transport.

The loss to France through the requisitions must have been enormous. The amount of requisitions imposed on some of the towns was as follows:—

Paris	£8,000,000
Chalons	64,000
Rheims	120,000
Nancy	200,000

And it must be borne in mind that this pressure fell not on the rich proprietors, nor the more wealthy classes, for all such fled away before the time of requisitions, but upon those whose poverty obliged them to remain. It is no wonder that a correspondent of the *Times*, describing such a state of things in Luneville, tells us he heard the wretched inhabitants mutter, "Better be shot down at once than endure this." Another correspondent wrote from Bordeaux:—"Business for France is everywhere broken up, and one-third of the country is devastated and ruined. I saw in 1815 the Lyonnais, part of Lorraine and Alsace, Champagne, Montmirail, Soissons, Chateau-Thierry, Ain, Bourg; there were great ruins, but the mischief now is twenty-fold, and millions of money destroyed—the buildings, the *objects d'art*, the cattle, everything laid waste, surpass, according to the wounded returned from the field, all description or comprehension."

Elsewhere the *Times* pictures the ruin of France as follows:—"Credit gone, work ceased, no one borrowing, no one paying, the officials receiving no salaries for half a year, the railways in the hands of the enemy, the public departments administered by hostile commissaries, the taxes flowing into the enemy's cash-box, the roads and highways nearly destroyed, the whole society to be reconstituted, the whole country to be reconstructed by glazier, carpenter, joiner, and bricklayer."

I subjoin from the *Times*, 11th October, 1871, some details on the effects of the revolution of the Commune on commerce and trade:—

"Some of the members of the Paris municipality have published a report upon the present condition of trade, and of the working classes in Paris. They complain that the revival of trade is checked, not only by the heavy taxation, but also by the diminished number of skilled workmen, of whom they calculate that 100,000 have been lost to Paris through death, imprisonment, or flight. Of the 24,000 shoemakers, one-half are missing; the 30,000 tailors have become reduced to 20,000; and other trades are similarly affected.

"Parisian revolutions," says the *Debats*, "are expensive things; and it is not often, whatever their authors may think, that they in the end are found to be worth their cost. Putting aside the question of the propriety of converting a capital city into a fortified town, the *Debats* observes that, from September to June, Paris ceased to produce those special articles which were at once its pride and its wealth. During that time the only articles manufactured were '*demonstrations*' and '*manifestations*,' and the only exports were prefects and dictators. The other articles of Paris ceased to be produced; but, although Paris would not work, the rest of the world would not go without hats, boots, perfumery, or jewellery, and consequently, when the existing stocks had been exhausted, other countries set to work to produce the articles for themselves, and the prolonged action of the siege by the events of March gave foreigners time to perfect themselves in what had hitherto been a Parisian speciality, and to supply a demand which Paris had failed to meet."

(*b.*) *Germany.*—All reports are unanimous on the almost entire suspension of peaceful enterprise all over Germany during the war. Upwards of 30 per cent. of the male population (of the soldier age) were engaged in the work of destruction, a large proportion of them being married. One regiment alone of 2,000 men is said to have left 7,000 children in their villages to pray for their return. Consul-General Crowe described recently what he witnessed at Leipzig after the outbreak of the war, as follows:—

"In the first fortnight of July reserves and landwehr were called out; all horses—except stallions, foals, and three-year olds—were ordered for impressment. The immediate sufferers by these measures were manufacturers and farmers. Numerous houses at home and abroad hastened to countermand their commissions, and so contributed their share to the paralysis of industrious production. Corn dealers from all parts of Germany had flocked to the Leipzig International Corn Market in July. There were prospects of a moderate harvest, and for that cause a brisk inquiry for grain for delivery. Bargains almost instantly ceased as war threatened to break out. On the 20th July all goods traffic on railways was stopped. Trade of the mouths of the Elbe and Weser, and at the outposts generally, though not arrested by an immediate blockade, was impeded by extinguishing lights, removing buoys, and laying torpedoes. While the course of international trade was thus suddenly impeded, the circulation of money received an equally rapid and violent check; State and private bank notes fell to a discount; and those notes especially which were not exchangeable on the spot for silver were looked upon with marked suspicion, and changed at a heavy loss.

IV.—Damages Consequent on the War.

A. Through the Augmentation of Armaments.

If a thunderstorm has passed over, the consequence generally is that the air becomes clearer, and the sun, hidden for a while, shines all the brighter. Unfortunately, the late war does not seem to have had the same effect in the political atmosphere. On the contrary, it seems to be only the prelude to a greater catastrophe, for we find all the large States on the Continent withdrawing the strength of their manhood and the wealth of nations from productive labour to an extent which dwarfs all previous warlike preparations with which we are acquainted. We are told that universal compulsory military service will be the law in France, and that an army which already is 632,000 strong will be doubled in twelve years. Authentic information represents the German army at the conclusion of war to have consisted of—

569,875 infantry	On French soil.
63,465 cavalry	
250,000........	In Germany.
Total...... 883,340 men.	

The number of men has since been rather increased than diminished, and in twelve years will be augmented to 1,700,000.

B.—Through Alteration of Navigation Laws, &c.

In quite a different direction from those hitherto indicated has the war had a damaging effect upon commerce. I refer to the alteration of navigation and commercial laws regulating the international relationship of France with other countries. The advantage of this alteration to France is very doubtful; but it is quite sure to injure other countries, for the effects of war are like poisonous vapours arising from a pestilential ground, casting their deadly blast far beyond the area where they arose. According to the new Navigation Act which has recently come into force in France, duties on foreign vessels entering French harbours have been raised from 7½ fr. to 20 fr. a ton. Considering that in 1871, 2,490 vessels entered the port of Havre, more than half of which carried the English flag, it is evident that the raising of the tax will seriously affect the shipping interest of

England, and, by diverting commerce into other channels, will probably do no trifling injury to the trade and manufactures of France itself. Also, the bad effect upon commerce resulting from the denunciation of the commercial treaty between England and France must partly be set down as damage consequent on the war.

These various details will suffice to enable us, in some degree, to realise the extent and enormity of the losses; and, coming back once more to the figures representing the total of losses, it will be difficult to decide whether the smaller sum, about 800 millions, or the larger, upwards of 1,000 millions, comes nearer to the truth. That the loss of France alone cannot have been much less than £600,000,000 is borne out also by a different method of calculation from that above given. The new annual outlay which war has imposed upon France is upwards of £30,000,000. Taking this sum as the interest of five per cent., it represents a capital of £600,000,000.

V.—Comparison of the Amount of Losses.

The two figures, £800,000,000 and £30,000,000 annua interest, will at once suggest their comparison; the larger, with the national debt of Great Britain when it was highest (840,000,000 in 1817); and the smaller, with the amount of the annual interest and management of that sum (£32,000,000). But nothing will show more clearly the costliness of the late war than the fact that, while England contracted the above amount of national debt within a period of 130 years (1689 to 1817), and had waged seven great wars during that time, lasting in their aggregate 65 years; at least the same amount of damage has just been caused by a war the fighting of which lasted only six months. Besides, the wars through which England contracted her debt were all carried on at considerable distances from home, which of course largely increased the costs; and here we had two next-door neighbours, barely separated from each other by a middle-sized river, engaging with each other in a conflict which, within the brief space of six months, involved the most ruinous expenses. Can we withstand the conviction that the next war could only be waged at a cost increased in the same fearful ratio? Surely the misery occasioned by past wars might be considered sufficient cause for serious reflection; but one yet stronger arises in the apprehension of the greater horrors in store for our race, unless a stop be put to international war; and this leads me to the last part of my paper, for which I beg a few minutes more of your kind attention.

VI.—Suggestions and Conclusion.

Even in the storm which has just passed, and the black clouds still on the horizon, are there no silver linings visible—the signs of a clearer sky and bright sunshine? If religion, settled governments, arbitration, commerce, international exhibitions, and peace congresses have hitherto failed to secure peace, are we to despair that their combined and continued action may not finally triumph over the destructive elements of national jealousy and pride? Could nothing be done to intensity their efficacy? Our generation cannot be accused of want of energy and enterprise. It does not remove mountains, but tunnels them. Arms of the sea are bridged over, and will soon be passed under; and the skill displayed in the construction of various machines for manufactures, printing, &c., is really wonderful. Shall we for ever be satisfied with the most elementary and barbarous mode of settling our international differences? Shall we continue, nay, even increase at a hitherto unknown ratio, the burdens both of warfare and of armaments in time of peace? I will point to one period in the history of Europe which offers a certain similarity to our age, with the view to guide us in our difficulty. More than six centuries ago, when, in consequence of the Crusades, a warlike spirit had taken possession of the whole civilised world to such a degree that even religious Orders obtained quite a military organization, and performed military duties, those engaged in the peaceful pursuits of art and commerce were greatly harrassed. The numberless knights, small and great, safe in their castles and fortresses, fell on defenceless cities like birds of prey on their innocent victims. The consequence was that large protective leagues of the cities were formed all over the Continent. The most powerful of these was the *Hansa* or *Hanseatic League*. The citizens of Lübeck, Hamburg, and Bremen having understood the advantages of faithful co-operation, formed a league in the year 1241 for the protection of their interests. This league soon comprised all the principal cities of Northern and Central Europe, and afterwards extended beyond the German Empire. In the east it reached as far as Novgorod; in the north, as far as Bergen; and in the west it included London, where the Guildhall was the meeting-place of members of this most powerful organization. The Hansa had their own laws and courts of arbitration; introduced equal weights and measures among themselves; built canals and harbours; abolished prohibitive laws; and put down the piracies on the Baltic and the North Seas. Their power increased to such an extent that princes and kings had to submit to treaties of commerce dictated to them by the Hansa. In the 15th century, the number of allied cities rose to 85. Commerce and trade under their protection expanded, and the free cities became not only the depositories of wealth and luxury, but also the cradles of liberty, both municipal and national, extending their beneficial influence far beyond their walls. Without the influence of the commercial cities during the middle ages Europe would never have obtained that position she now enjoys, and would probably have succumbed to a military despotism similar to that of most countries in Asia, whose civilisation either perished or became stagnant, for the want of that healthful influence resulting from international commercial intercourse. The Hanseatic League gradually lost its influence after it had served its purpose. It received a severe blow through the thirty years' war. In name it exists still in the Hanseatic towns, Hamburg, Bremen, and Lübeck; and only recently Graf Moltke wrote to the latter town, "That the towns of the old Hansa may flourish afresh in a new Hansa, for that the brave sons of Lübeck fought valiantly and victoriously."

Could we not take a lesson from this great example set us by our forefathers? Should it not inspire us with courage to grapple earnestly with our difficulties? If they, less wise and less enterprising than we, as it is often asserted, succeeded by co-operation in restraining the numerous robbers that impeded commerce, and finally triumphed over them, so as to make the robber-knights mere relics of the past, could not we by similar co-operation restrain the comparatively *few* who still advocate war, and finally, as true civilisation progresses, stamp out war altogether?

To make a beginning in that noble work, I should suggest that an International Commercial League be formed, with the object of protecting arts, commerce, and manufacturers against the fearful losses caused by war, as well as against the disturbing influences of the fears of war. The increase of armaments, and the construction of fortresses, I fear, will be as inadequate as the famous walls in China or the fortresses round Paris. The commercial treaty between England and France was effectual, within the short time of its duration, in diminishing the chances of a war between the two countries, even before the late war. Consider also how much the Zollverein did in preparing the political unity of Germany, and removing the dangers of war there; for it is a telling fact that now all the states that formerly constituted the Zollverein, and only those, now form the German Empire.

It is not very creditable for our age almost utterly to disregard the strength of moral means, in spite of the proofs history furnishes us with of their great power.

Could not a well-organised union of the commercial and manufacturing communities bring about such a state of public opinion in enlightened Europe and America, as to diminish greatly the chances of war in and within these two continents?

Besides the immediate object, that of protection against the losses of war, such an association would advocate the principles of free trade, and would support every measure of an enlightened international policy. It would demonstrate the brotherhood of nations, not by vain declamation, or by acts of destruction, but by promoting the mutual interests of all countries and classes. Or shall we leave the strength accruing from organisation for the sole use of the powers of retrogression and destruction?

A closer commercial union of this country with Germany would create a better understanding, and greater confidence between these two branches of the great Teutonic family; and now that Germany is the strongest power on the Continent, as England still is the most powerful at sea, the two combined, and in union with the United States of America, would be sufficiently strong to protect their common interest against any power or combination of powers, without burdening their peoples with increased armaments.

Even from France such an association would receive most powerful support. The cry for revenge has not yet silenced all advocates of a more humane policy. In one of the Cobden Club Essays of 1871, Mons. Emile de Laveleye expressed the hope that governments would substitute arbitration for war; "but, he adds, if no government will take the initiative towards realising the magnificent idea conceived by American philanthropists, and advocated by Cobden before the parliament of Great Britain, it is then for the public itself to take up this noble cause. A vast international association ought in that case to be founded, having for its sole object to make the system of International Arbitration prevail."

In England we are not accustomed to look so much to the Government for guidance; and in this case I think the people can only secure their object by taking action themselves; and time and money spent in setting on foot such an association might do much towards obviating the necessity not only of estimating the losses of a future war, but also of bearing such losses. For the *next* war, if it were to break out between any two of the great European powers, or between England and America, might cost, even in six months, a sum which I should scarcely dare to estimate.

I am confident our Society will use its powerful influence to assist in averting such a fearful calamity by giving their moral and active support to the principles advocated in this paper.

DISCUSSION.

Mr. Pickstone thought the lecturer had made one serious mistake in the figures, having charged France with £200,000,000 to satisfy Germany, but not crediting that amount on the other side, which of course made that much difference in the result. It was a most difficult thing to estimate the cost of a war in money value. The effect produced on a nation was largely to economise the consumption of all articles of food and clothing; and it was quite clear that France, although she had to find the Germans with supplies, had managed to survive, and was said to be now, with all her increased taxation of £30,000,000 per annum, going on towards prosperity, so rapidly, in fact, that she was, according to the *Times*, thinking of at once establishing an army of 1,600,000 men. This showed she could not be in a very bad state financially, though she might have to borrow £120,000,000 more from the rest of Europe. It seemed to him there was a great difficulty in estimating the money value of the cost of a war. America, with all her debt, seemed more prosperous than before; and the elder Sir Robert Peel wrote that our own national debt, which was caused by war, was the source of our national prosperity. Every man in the United States who holds 5-20's or 7-40's, or any other species of debt, and at the same time holds everything which he held before the war, must be so much the richer. In addition to the money they had borrowed from Europe, they owed about £2,000,000,000 in their own country, and therefore each man who holds that debt had to receive from the national government annually so much interest, and was so much the richer. It was quite true those who did not have it had to pay in conjunction with those who did. Still the future had largely to pay this, and possibly the general advance of the country in consequence of that war would lead to this result—that the future itself would not be seriously taxed. If France were in the same position, relatively, and most of the money expended in the war must have been supplied by her own people, it was evident these people had not been made as poor by the war as would appear, as they had the representatives of this £600,000,000—or, at any rate, £400,000,000—in their own pockets. As was the case with all war, the rich, or those who supplied the Government with money, became richer, and those who had to pay the interest on that in the future became so much poorer by it; but if the energies of the people were so much more taxed in order to pay it, and were not taxed too severely, France would really be none the poorer for the war.

Mr. Walter Smart said, in his opinion, a nation might be better off for having a large debt if the whole of the debt be held by persons living in the country; but when that money was advanced by other nations, then all the interest of the debt was sent out of the nation, and, consequently, the country must be poorer, as in the case of the Americans. So long as the debt remained in the possession of the Americans, the money was taken out of one pocket and put into the other. The only difference was that one portion remained idle while the other worked double time; but when part of the bonds were purchased in England or Germany, and it became necessary to send the interest out of the country, America became poorer. With regard to international war, he was of opinion that the time might come when there would be the same union between nations as had taken place in former times, in the case of the Saxon Heptarchy, between England, Scotland and Wales, &c., but he feared that such time was yet very far distant.

Dr. Heinemann said he regretted that he had not been able to be present at the commencement of the lecture, but if Mr. Pickstone's view were correct the best thing which any nation could do would be to go to war as often as possible. When the late Charles Dickens was in America he had a conversation with an American with reference to the future of the world, the latter being very sanguine as to the time coming when the lion would lie down with the lamb, but Charles Dickens said he thought the lamb would be inside the lion. J. Stuart Mill, in his Principles of "Political Economy," speaking of the losses sustained by war, said it was possible that a nation might not always be impoverished by war, and that if it only destroyed bridges, railways, railroads, or even if it destroyed the harvest of a single year, though the loss might be painful, still the nation would not be ruined; but if the productive power of a nation were undermined, then the nation would be ruined. If only the money losses were taken into account, perhaps the losses of France were not very great; but taking a broader view, and considering the productive power which was lost during the war, he must say France was impoverished. With reference to the Hanseatic League he could not quite agree with the lecturer, knowing as he did the history of the origin, growth, and end of the league. It did not, and could not always prevent war; and he much feared the time was yet far distant when wars would cease, owing to a peaceful combination amongst the nations of the world.

Mr. Hancock said he could not agree with the remark as to the wealth of the country being increased by the national debt. Nothing could be more clear than that a national debt was raised for supplying instruments for destruction, supplying men for destruction, for repairing the losses caused by the destruction of manufactures and crops, and it would have been just as prudent to take the money and throw it into the fire at once. All this represented money absolutely lost. He could scarcely follow the comparison between the losses of France and Germany, they not having been drawn by the same person, and being calculated on a different principle; and he thought the French losses would be rather larger than smaller than the amount stated in the paper, because there was no estimate made of the loss of labour, and he believed that the French losses were as nearly as possible equal to those of the Germans. One of the most serious losses arising from the war was the thorough disorganisation which it caused throughout the country, not only to the actual business of the country, but in the warlike spirit which was engendered, and which prevented for a long time the return to work again with their accustomed energy of the men who had been in the National Guard. Allowing, therefore, for the £200,000,000 which should certainly have been credited to Germany, the loss having been paid by the other party, he still thought the total would come to something between eight hundred and a thousand millions, the greater portion of which had been spent for unproductive work, which represented absolute loss, and which would saddle those countries with something like forty or fifty millions interest for ever. In our own case, our national debt of £800,000,000, which some people called a flea-bite, necessitated taxation to the extent of about thirty millions out of our seventy millions annually, so that if it were not for that debt, each man would be relieved to the extent of three-sevenths of his taxes. There was something to be said for a national debt from another point of view, because, if widely held, it had an influence in maintaining the stability of the country's institutions, those who held it feeling naturally anxious to support those institutions which would secure the payment of the interest upon their monies. As regards the money, however, he could not for one moment agree that money expended in destroyed fortifications and wasted powder, and the loss on men's lives and exertions, could be replaced. Future saving might recuperate to some degree what had been wasted, but that which was once lost could never be replaced.

Mr. Mast, in reply, said he was fully aware of what might be said with regard to the £200,000,000; but as that would not be applied by the German government for productive labour, he considered he was right in not taking it into account, inasmuch as he was estimating the loss to productive labour. With regard to a national debt being the cause of stability of a government, he must differ from those who said so. No doubt it would be so far a source of stability that people would be very careful not to disturb institutions, and would like, perhaps, to stay in the country where the money was invested. But, on the other hand, would not the population prefer to dwell in a country where taxation was light, and would not that be a higher source of stability than any national debt? If in England only half the amount of taxes were required, he thought it would be far better in every way. There was a country on the Continent which, but for the expenses occasioned by the Austrian and Prussian war, would have been placed in the happy position of paying no taxes at all. the railways, which were the State property, bringing in revenue sufficient for all public purposes. In his opinion, such a country was in a much happier position than if it possessed the blessing of a national debt.

The Chairman said the discussion had turned to some extent on the question of two millions being reckoned twice in the calculation, but, unfortunately, in the Franco-German war the figures were so enormous that one or two millions, more or less, seemed of very little consequence. It was certainly a novel way of looking at things to consider a national debt as an advantage to a country, and it seemed a pity the same principle could not be carried out in private life, so that every individual should be richer the more his debts accumulated. A great deal had been said about money, and, of course, losses could only be reckoned in money, but it must be remembered that there was no absolute destruction of gold; it was the destruction of capital which was really referred to. The gentleman who had referred to persons owning 5-20's and so on, forgot that, in the first place, he had to take the money out of his pocket, and that in many cases his property was destroyed as well. Probably the amount of coin in Europe was as great now as before the war, but the produce of labour to an enormous amount had been absolutely destroyed. Everybody had agreed that war was a dreadful thing, but we need not go to the opposite extreme and suppose that there was nothing worse. Many wars had done incalculable good, and he was not sure that the Franco-German war had not done good also. He believed France would ultimately be the better for it, and there was no doubt that it had powerfully aided the consolidation of Germany. War was better than living in a state of misery, or submitting to a despotic power, and, cruel as it was, and much as all must wish that it would never again occur in England, it must not be supposed that national honour and everything else must give way rather than engage in it. The tendency of this sort of calculation was rather to look at everything from a monetary point of view, which was not the only one involved, for if it were necessary war must be submitted to let it cost what it might. He concluded by proposing a vote of thanks to the lecturer, which was carried unanimously.

Professor Leone Levi writes as follows:—

"I regret I am unable to hear Mr. Mast's paper on 'The Losses to Arts, Manufactures, and Commerce consequent on the late Franco-German War.' The tale of such losses is a very sad one. The European nations pride themselves on their civilisation, their learning, and their morals. They count themselves as far above the 'barbarians' of the East, yet I wonder if we can find any parallel, at least within recent times, of so large, imposing, and destructive a conflict as the late Franco-German war, in any other part of the civilised or uncivilised world. To what purpose are the arts and sciences, if they do not humanise our nature? What is the use of labouring to make conquests over nature, to build museums, and to advance education, if periodically we are to return to the condition of brutes? We had formed brilliant hopes from the Universal Exhibition of 1851. How they have been falsified! Since then we have had wars in Russia, Denmark, Austria, France, Germany, United States, Paraguay, and I do not know how many other countries. It is a mistake to count the losses of war by the money grants, or the army or navy expenditure. That is only the amount of loss invested in the act of destruction. The destruction itself constitutes by far the greater loss. And what is this? It is the loss of produce, loss of labour, loss of mental and physical power. What has France lost by her last war? She has lost all she had gained during the previous twenty years, and more than half of what she can hope to gain for twenty years to come. Look at the loss of life. Every labourer lost, every man of genius departed, is so much capital absolutely destroyed. Only the other day I spoke at the Society of the financial blunders committed by the present French government. But what is the cause of it all, except the wretched war, which has thrown everything into disorder? Do not think that the losses from war are losses which press only on the nations which engage in it. No. There is a solidarity of interests among all nations which we cannot shake off. The misfortunes of one are the misfortunes of all. It is not France and Germany alone which have to pay the penalty of the crime of the last conflict. All nations, and we in particular, suffer from it, whether directly or indirectly, from a limited trade and crippled resources. But, may I ask, is the Society for the Encouragement of Arts, Manufactures, and Commerce to behold this powerful cause of discouragement at full work, and not to put forth its voice against it? It is difficult to say what is and what is not within the province of the Society of Arts; but certainly it would be proper for the Society to step forward and protest against an evil which frustrates every means of progress, and which throws one nation after another back for half a century. There is but one means to prevent war. It is the reprobation of war itself as the clumsiest and most brutal of all the modes for the redress and settlement of international grievances. Difficulties and disputes will probably ever arise, but need we solve them at the point of the sword? We have seen duel between private individuals put down by the force of public opinion. I do sincerely trust we shall see war, or duel between nations, also put down by the unanimous voice of civilised nations.

At the close of the evening Messrs. Bond and Charles exhibited their patent keyless railway chair.

The keyless railway chair does away with the use of keys or wedges, as used with ordinary chairs, and bolts as used with half chairs. It consists of a movable jaw, an immovable jaw, and a bed of a chair; the former is fixed in position after the rail is laid in the bed of the chair, and can be removed to admit of a new rail being laid. The mode of securing the movable jaw to the bed is as follows:—In the upper part of the bed is a cavity, consisting of two sections, the smaller of which has its sides dove-tailed, and is intended as a recess for the bolt-head, which has its sides bevelled; the larger section is necessary as a first receptacle for the bolt-head, which is pushed thence into the dove-tailed section; the bolt is introduced through the movable jaw, above which the thread part of the bolt projects, and a nut or nuts being screwed on it, the fastening is made complete. The inventors claim the following advantages for the chair:—It renders the permanent way of railways more secure, economises labour, and, by rendering unnecessary the use of keys, otherwise saves expense. The position of the jaws render impossible the accidental displacement of rails. It is certain to maintain the gauge of the line. It is not affected by contraction or expansion of rails, or extremes or change of temperature. When used in conjunction with the double-headed rail, the lower head does not become indented, and may, therefore, be reversed without the prospect of unpleasant sensations being experienced (as is the case when keyed chairs are employed) when travelling over them. It cannot be affected by the vibration of passing trains. Renewals and re-laying of permanent way can be expeditiously effected by employing them; indeed, experiments have shown that a rail may be removed and replaced in half the time that is required in cases in which ordinary chairs are employed. The line does not require to be ballasted above the surface of the sleeper; hence a depth of about six inches of ballast is saved by its use; this, besides the saving of the expense of the ballast and labour, is, in the event of deep snow, of vast importance. As no force is used in making the chair fit tightly against the rail, breakage need not be apprehended. In driving home the keys, thousands of tons of ordinary chairs are broken annually. In the daily inspection of the line the only tool necessary for the platelayer to carry is a spanner.

INDIA COMMITTEE.

A Conference was held on Friday, March 8th, Sir Donald McLeod, C.B., K.C.S.I., late Lieut.-Governor of the Punjaub, in the chair, when a paper was read, "On India as a Field for Private Enterprise," by Frederick Campbell, Esq. (See *Journal*, p. 329). A discussion followed the reading of the paper, which was as follows:—

The Chairman invited the gentlemen present to offer remarks on this excellent paper.

Mr. Vesey Fitzgerald asked if the castor-oil plant grew in Assam.

Mr. Campbell said—Yes; and in great variety. The silk grown from worms fed upon it was very coarse, and almost like a hempen fibre.

Mr. Fitzgerald asked was there a market for it? Could it be disposed of? And did it require a rich soil?

Mr. Campbell—There was only the Calcutta market, and it required a rich soil.

Dr. Campbell wished to remark, with reference to the Tusser silk, which could be exported in large quantities from Goalando, that it was the same kind of silk he had exhibited two years ago in that room. They had several specimens of it at the India-office. It was used by the inhabitants of the parts in which it was grown to make wearing apparel; and though forty years ago it was almost unknown, when introduced by General Jenkins, it had since become looked upon as a most useful fabric. He would like to have spoken upon the whole paper, but it covered so much, and their time was so limited, that he felt he must compress his remarks, and he would, therefore, confine them to a district with which he might be considered perfectly conversant, having been its commissioner for 22 years, viz., the district of Darjeeling. Mr. Campbell had said that Darjeeling, Cossiah, and other districts, being on the same elevation as Assam, the same results might be expected. He must say that he had not been prepared to hear that, for as the places mentioned differed in their climate, they must consequently differ in their productions, and in the manner in which the articles are produced, for whereas the one had a moist climate, the other became drier and drier as the year advanced. He believed that the quantity of tea produced in the Darjeeling district was nearly as much as that produced in Assam, and was quite equal in quality. There was one point which would show how extraordinary was the contrast between Darjeeling and Assam, and that was in the price of labour. In Assam, the coolie, with the amount paid for him by contractors, was 12 rupees a month, whereas in Darjeeling, in consequence of labour being abundant in the district and in the immediate neighbourhood, the cost of the coolie does not exceed 5 rupees, so that, in that respect, Darjeeling could compete with Assam, and, in fact, with any other tea-producing district. Mr. Campbell had said that the means of communication with Assam were satisfactory. If he was satisfied, then he was about the first person he had ever heard say so. Why, it takes a steamer laden with machinery stores two months to reach Assam from Goalando. Was that a favourable picture to draw of the means of communication to a country? Mr. Campbell had talked about the good Darjeeling road, but he thought that, even to the present day, no worse road ever existed. In the rainy season it was literally impassable, and but little better for two months after the rain had ceased, so that the tea-planter who sows his seed in April, and gets his crop in October, has to store it up till the following December, at most serious inconvenience to himself.

When we find petition after petition being made by the people of this part for a line of railway 140 miles, to connect them with the East India Railway, could it be said that that was a favourable picture of the means of communication? Mr. Campbell's glowing statement that 50 per cent. could be realised in Assam, would, if it could be realised, shut up every other district. His last advices from Darjeeling showed that tea-growing was yielding 15 per cent., and he thought that was a safe investment, and one in which Englishmen ought to be content to invest large amounts of capital, but there would be no chance for Darjeeling, or any other district, against the 50 per cent. of Assam. He would like to point out to the meeting that such a state of things could scarcely be realised. It was easy, and had been done over and over again, for gentlemen to say that, from certain fixed products certain fixed profits must be realised, for, as every gentleman present must know the risk of any such speculation as tea-growing was, that you were at the mercy of the seasons, and unless one could secure a dry season, with a strong sun, tea could not be manufactured. These calculations were beyond anything to his knowledge—they were beyond what experience told one was likely to be realised; but yet they would shut up every other district if only they could be proved.

Mr. Tayler, ever since his attention had been directed to the affairs and interests of India, now a very considerable time, had always felt convinced that the native of India, as he now was, was not a productive animal in the history of the world; and that when we looked at the extraordinary richness of the soil, and of the lavishness of nature in its favour, and then at the little, the very little, advance it made beyond the ordinary return, and then at our rapid growth there, he had come to the conclusion that it was one of the mysterious purposes of Providence that India should be ruled by the Anglo-Saxon race. Having listened to the very favourable and rose-coloured statements of Mr. Campbell, so interesting in their details, he had felt inclined to rise and speak in congratulatory tones of the prospect of 50 per cent. in return for one's capital as offering every attraction and allurement to an industrious race like our own. But his new-born ardour had been somewhat damped on hearing another authority—perhaps a greater authority—say that these favourable descriptions were not exactly—well, "according to book," He was not capable of offering the slightest opinion on the mere details of agriculture, whether the produce would be 50 per cent. or 15 per cent.; whether the castor-oil plant produced a good silk, instead of the disagreeable effect it was known to produce in this country; but he could fully realise the picture Dr. Campbell had drawn of the troubles of the tea-planter, in consequence of the bad state of the Darjeeling. When he was post-master of Calcutta, unfortunately now 20 years ago, he had had the honour of passing over this Darjeeling road, and he had done so once or twice since, and he must say a worse road he had never had the honour of sticking in in his life. It was very much to be desired that, when descriptions like those given that evening were put forth, both sides of the question should be known; because, however infinitely important the introduction of the Saxon's energy, enterprise, and capital might be in India, they should not be carried away by such glowing descriptions to throw in their capital, and then have, as Mr. Campbell had graphically put it, to come home with a wife and family on their hands, and all their money gone. There was very little doubt indeed that there were great capabilities for Englishmen in India with capital, and it was one of the great things, in the prospects of the future development of India, that the whole of it should be put, more or less, under the control of Anglo-Saxons; but every Englishman taking up the idea that he could make a fortune in India must also take into the account the many obstacles he will have to encounter. Well, taking the description as reliable, what were they? There was not much to dread; there was one small fever, not so bad as an attack of cholera in England. That was rather a curious comparison, as he always thought cholera was an attribute of India. And with this description, "one small fever"—the fever being, as he had always understood, the most terrible disease in the world—many enterprising and meritorious young men would be induced to leave the domestic hearth, and start in the idea that they would soon raise a fortune. But any man going to India ought to take off 25 to 30 per cent. from the favourable account, and ought to make up his mind for certain obstacles and inconveniences, for he would be going to a country as to the prosperity of which many vital questions have yet to be decided; and he would have to consider as to the probability of the future stability of our empire, of the state of the officials, of the principle of the legislature, and the disposition of the natives towards the settlers; and he must remember that the history of our rule in India did not show that the Englishman had always been received with that spirit of fairness and conciliation customarily granted to him by European nations. Owing to the unwise and injudicious policy till lately adopted, English capitalists of character and education had not engaged in the cultivation of the Indian soil. Though things were greatly changed for the better, though the Englishman was more welcomed than he was, there were still many inconveniences to be put up with, troubles met, trials sustained, and battles fought, which he ought to take a fair stock of. If the account of Mr. Campbell went forth to the world without the account of the other side to-morrow morning, they would hear of some great company having been formed, and of 500 of the youths of England starting for India with the idea that they were going to make great and rapid fortunes in a paradise. A fool's paradise it would be. But this he believed, that no one would rejoice more than himself if these large tracts of waste land in India could be brought under cultivation by the application of native skill and industry, for then would be advanced at the same moment the development of the country and the happiness of its native races.

Sir Thomas Bazley, Bart., M.P., had listened with great attention to the statement of Mr. Campbell, and he perfectly agreed with him as to the vast resources of India. He had painted what might be called the sunshine of the picture, while the two gentlemen on his left had painted some of the shades which might possibly prevail. He himself took the sunshine view of the question. Possibly there might be difficulties and obstacles, but he thought the natural intelligence and indomitable perseverance of the English race would remove all obstacles, and that we should soon see Assam a most flourishing country. The reference to cotton was most gratifying. That there are four million acres of land yielding cotton of a good quality, and by that is meant bales of 400 lbs., implies, if it can be received as a fact, that the yield of a good quality of cotton would be equal in value to 50 millions sterling. That was an enormous sum with which to stimulate the industry of those already at work, and would be a great stimulant to those who had capital to spare to invest it in the soil of India. In one thing Assam stood its own ground. Assam tea was unsurpassed, even by Chinese, and he anticipated that if there were a cultivation of the soil with industry, there would be ample reward for those who took up cultivation in that province. It was, he feared, the custom of our countrymen to take English habits to these eastern countries; but if we carried temperance with us we should promote those good habits and that enterprise without which no progress could be made in any new country or sphere of life. There was a great field for Englishmen in Indian agriculture, and they should look to see the native element develop its latent power. In that respect this country owed a great deal to its early conquerors. If the Romans had not taught us rudely the arts of civilisation and of science, we might yet have been in the darkness of barbarism. Though the Saxons by their incursions destroyed life and impeded progress, yet we derived even benefit and instruction from them, and it may be said that the first teachings of a nation must always be severe. With reference to our scholastic institutions, we have a kinder and more merciful system than we had in former days, and now kindness was the great persuasive element in all improvements and in all progress, and if we would but go to India with that spirit, and with the intelligence of Englishmen in cultivation gained by an experience, say of two thousands, and communicate our results, we should enable them to begin where we were perhaps ending in the career of our progress. Agriculture is necessary to a nation's progress, and its want in India was one of the greatest obstacles industry had to contend with. He should like to see not only railway but water communication throughout India, for the latter would not only serve the purposes of traffic, but would supply that great essential in cultivation, irrigation. He was delighted to hear that in Assam irrigation was scarcely needed, because of the rains and the constant moisture of the soil on the mountains. What was required was, that we should induce the people of India to invest some of the vast accumulations stored up in the centre of India in the cultivation of the soil. He was reminded by Mr. Campbell's request that one hundred millions of English capital should be invested in Indian soil, of the fact that, since the commencement of the American Civil War, that was, during the last twelve years, the cotton trade of England had paid, in excess of the previous low prices, a sum not less than one hundred millions. That was the sum asked for by Mr. Campbell. If the excess of prices could be called forth for the purpose of investment in the cultivation of the soil, there would be a progression of which we were unprepared to estimate the extent. It was said by some India was not a civilised country. But that was not so. India was a country highly civilised, but it was on principles which we did not recognise, and which we thought incapable of producing any real or rapid progress. It might be that old castes and superstitions kept them a great deal to old customs, but if the maxim of Lord Bacon, who gathered up the threads of the inductive theory, that the past should be always the lesson for the future, could be brought to bear on India, he felt sure there was in store happiness for that great dependency. Now, though we might be somewhat in excess of population in this country, he very much feared that our young men would not be disposed to practice that self-denial so necessary on going into a new country, and he thought if the dark side of the picture were to be believed, their inclinations would be unstrengthened. But he would ask the young men not to be daunted by, or over-scrupulous as to how they destroyed the lions that might be in the way to oppose them. Let them clear the way for themselves, and they would be rewarded for their energy, if it were conducted with prudence, for they would, by their example, raise the natives of India to their own standard. In conclusion, he could but say that he fully believed in the realisation of the anticipations of Mr. Campbell.

Mr. Elliott said, with regard to the question of climate, of which Mr. Campbell had given them such a flourishing description, when he said it engendered certain complaints "which would cause a well-fed abstemious man no inconvenience,"—well, when he was in the East he was certainly abstemious, and so he believed were his neighbours, and yet they all suffered most serious inconvenience from fevers, and hardly less so from the other complaints mentioned by Mr. Campbell, and he did think that when such statements as the one he was referring to were put forward, they ought to be received with considerable caution. Then, as to the inexpensive quality of the land on which cotton could be grown, it was well known in England that a bad farm paid better than a good farm, for two very simple reasons, viz., that its owner was obliged to give it much greater personal attention, and, if he were obliged to employ labour, the labourers, being in almost the same condition as the master, would work much harder for him than they would for the good farmer. That, too, he believed, from what his father had been told by his tenants, was the case in Scotland; they would not do as much for the gentleman as they would for the man. Now, with regard to these cotton farms, it must be considered quite impossible that gentlemen could cultivate them themselves; and if land could be had in such quantities, and if a man could save enough money out of his wages as to get a couple of acres and set up for himself, it must be expected that, after a very short time, the men would leave the gentlemen in the lurch. As regards the breeding of horses, he had only to add that, from information he had received from a gentleman of good position in the north of India, he was able to say that, after some trial, it had to be abandoned. He thought that when such statements as those made to-night, and made no doubt in perfect good faith, were put forth to induce persons to go to a region which was simply infernal, and to embark in speculations which might entail terrible ruin, some protest should be made against them. He had often heard of people coming out on the faith of similar representations, that large fortunes could be made, and then finding themselves reduced to almost destitution; and in Ceylon, in some cases, subscriptions had had to be started to send back such persons to England.

General Clarke said it had been often remarked that large subjects were shoved into a hole, and there had never been a greater proof of the truth of that remark than in the proceedings of that evening. They were invited to discuss India as a general field for private enterprise, and the paper, a very interesting one, it was true, related to a mere province. What they had really to consider was, whether the middle classes of England could find a field for anything to do in India. It appeared to him that as far as trade—internal trade—was concerned, it was idle for us to hope to compete with the Indians, save simply as overseers, from our superior knowledge. But, though that door was shut, there were still open certain things in which a trial might be made by the application of machinery to the handicraft of the country. That was a point worthy of attention. There was no people in the world possessing greater aptitude than the Indians for the manufacture of carriages and vehicles, general household furniture, and all descriptions of fabrics. It was most probably well known that the people were so employed in Upper India, such as the Punjaub, and all the mountain tracts; they were all exercised in making goods of a very cheap class, which could be well produced by machinery. There were no better weavers in the world than the cashmere weavers, and now a larger number of them were settled in our provinces at Umritsur, some 36 miles south of Lahore, and he believed that if a capitalist went from here, he would there find that he could establish woollen mills with great advantage. There might be temperance men there to-night, but it appeared that there were several breweries in India, and that again was a branch capable of great development; and he had been sorry to hear Mr. Campbell's expression, "the curse of India, brandy-drinking." He had been 35 years in India, and during the whole time he had never seen an officer drunk at a mess table; and he had had the honour of knowing many gentlemen in India, merchants and their assistants, and, as far as his own experience went, he could say that the men there represent us worthily, and that they are more temperate than we are here at home. It might have been different 50 years ago in India, when men were isolated, and for months and months never saw a fellow-countryman; but it was not so now, and we might do well if we followed the example set us by Englishmen in India on the score of drink. As regards agricultural matters, he might say the natives of India were very good hands at agriculture, and that theirs had been quite as good as ours before the introduction of machinery. That is all they want. Many of the practices we have introduced into this country have been recognised for ages in India, as for instance, in the matter of manuring; it had long been the custom here to manure very heavily, but now it was found much better to use only small doses. Well, that had been recognised long ago in India, as also the treatment of land with sulphates, and all those other chemical compounds which Liebig and other great men now so strongly recommend. He did believe that in the branches he had mentioned there was a field for our middle-classes, and that it would be greatly to their advantage to engage in them, for they would obtain better society and more comfortable homes than they could ever hope for here; and they would do better by going there than by going to America. Now, one of his servants was engaged to a gardener who had lately gone to Richmond, Virginia, and settled there. He had asked him whether he still intended to subscribe to his club; he replied "Yes; he received all the privileges he would have here by a mere transfer of his tickets; how else did he think they could manage to live." But he did not think that would be the case in India, but that it would pretty much depend, so far as the small capitalist and the labourer was concerned, upon themselves how Europeans would live in India.

Mr. Hyde Clarke moved the adjournment of the discussion.

Mr. Botly seconded the motion, which was carried, and the meeting adjourned to Friday, April 12th.

FOOD COMMITTEE.

The Committee met on Wednesday, March 13th, at 4 o'clock. Present—Mr. Benjamin Shaw (in the chair), Mr. F. H. Abel, F.R.S., Sir Antonio Brady, Dr. Peyton Blakiston, Dr. Pitman, Mr. E. B. Savile, Mr. J. T. Ware, and Mr. J. A. Youl.

Mr. Ash attended, and explained to the Committee the construction of the meat-vans as designed and made by him for the Great Western Railway Company. He said—Mr. Wood, the deputy-chairman, came to me and asked how such a van should be constructed. I made a plan for him, and he was so pleased with it that he allowed me to make experiments on the railway. I told him that I must be permitted to take out a patent, which I did, and I have now a legal agreement, under seal, with the company, and the vans are in constant use. Besides that, they are talking about building vessels to run between Milford Haven and Waterford to carry meat, and they think of fitting up the hold on the same principle. The plan is this:—There is an ice receptacle at one end of the van, but the quantity of ice used is very small, and except in very hot weather it may be dispensed with. The railway carriage is made double in every part, the interstices being filled with charcoal-dust, similar to an ordinary refrigerator. The top, bottom, sides, and door are all filled in the same way. The ice is put into the receptacle through a hole in the top, which has a tight-fitting cover; a very small quantity is sufficient. Surrounding the ice receptacle there is an air-tight chamber, with a funnel-shaped opening to the external air; this end of the van is always kept in front, and the opening is made to expand a little at the sides, so that the air rushes in, and passes down against the cold metallic surface of the ice receptacle. It passes under it through a charcoal filter, which removes the dust, comes up at the other side, and comes out into the carriage through holes made for the purpose. As the trains go along at a rapid speed, a considerable quantity of air comes in in this way, and, within certain limits, the quicker the train goes the colder the carriage becomes as more air rushes in. There are holes again at the farther end of the van, which allow the air to pass out, so that a current of air is constantly passing through, and there is found to be but a very slight difference of temperature between one end of the van and the other. The ice does not melt much; in fact, last summer one van ran for a whole week without being refilled. The plan at present adopted is to fill the vans with ice in London, and run them down empty to Chipping Norton, where they are loaded with meat, so that there is some waste. The one great difficulty to be overcome was the large amount of dust which a railway carriage always produces, especially in hot, sultry weather. In these vans the dust is all removed by passing through a charcoal-filter at the bottom of the ice-well; and as the ice gradually melts, the water collects in a trough at the bottom, and when that is full runs over through the charcoal, thus keeping it constantly clean, and ultimately runs out through a bell-trap at the bottom. This construction has the additional advantage of preventing the air from rising up through the ice, which is not desirable, as it would melt the ice more quickly, and a great amount of cold is not required. If the temperature were reduced too much, the butchers would not like the meat when it reached them, and it would not keep so well. The temperature in these vans was found to range from 50° to 55°, when the outside air was at 80° or 90°. Mr. Wood says, in one of his letters to me, that during the hot weather the temperature has been much below 60° all over the van. That is because the volume of air that gets cooled in passing over the ice receptacle rapidly distributes itself throughout the van, and only gets so much warmer as it takes up the heat from the other portion of air.

The Chairman asked how the air was deprived of dust? —By going through the wet charcoal; whatever volume of air comes in the same goes out. It might be thought that that would soon melt the ice, but it is not found to do so, and, moreover, if the ice is decreased in volume, the metallic surface of the receptacle is still sufficiently cold to cool down the air enough for all practical purposes. Both Mr. Wood and Mr. Grant have expressed themselves perfectly satisfied on this head. If the weather is not sufficiently hot to require the use of ice, there is then a little water put in a vessel at the top of the ice receptacle, and allowed to trickle down so as to damp the charcoal and make it act efficiently. The simple fact of blowing a large quantity of fresh air through the van is a great advantage to the meat, but when the weather is so hot that some artificial means of cooling is required, then by the use of ice a kind of March atmosphere is obtained. It is well known that all butchers try to hang their meat in a draught, for it is not only a cool atmosphere which is required, but a change of the air, so as to blow away any germs which may be floating about, and to remove any moisture arising on the surface of the meat. I may add, that I prepared a long report on this subject, giving statistics as to the quantity of meat lost in the course of a year, and the result of these experiments. Mr. Wood had no objection to its being published, and I sent it to the *Times*, but it was simply returned to me, with compliments.

The Chairman asked if this method had been used for the transit of fish as well as meat?

Mr. Ash said he believed not; and did not think it would be efficient for that purpose, whilst fish was packed in boxes, as at present. There must be some provision for allowing the air to reach the surface of the fish. If it could be packed on trays, so that the air might pass readily through it; then no doubt it would travel very well in a van of that description.

The Chairman asked if the fish could be hung in large wire baskets.

Mr. Ash said that might be done with the larger fish. He had been in an empty van, which had brought fish from Newhaven the night before, and found the stench was something fearful, so that it was really astonishing how any one could eat the fish out of it. It struck him that the fish at the bottom of the boxes, or pads, must be much worse than that at the top, for it was the practice to put lumps of ice at the top of the boxes, and the water trickled through. Milk cans also might travel very well in this kind of van. It must be remembered that ice is extremely cheap now, the quantity required for filling each van only costing a few shillings. Mr. Ash then proceeded to describe in detail his patent refrigerators, stating that in them there was no mixture of the air, the coldest stratum remaining at the bottom, so that different articles of food placed in these refrigerators at different levels never affect one another in any way. He had recently made a great improvement in the method of fixing a filter within the refrigerator, by which he avoided the difficulty he had formerly experienced with regard to the cement being decomposed by the purity of the water. In answer to a question he stated that these meat-vans had been in operation on the Great Western line since last March, and they had answered every expectation; there had been no complaint of the filters choking up, and it had not been tried many weeks before the solicitor to the company called upon him with an agreement. He had not been in negociation with any other railways, as he preferred waiting for them to come to him, as in the case of the Great Western.

Dr. Pitman said it was important to bear in mind that the temperature attained by this means ranged between 50 and 55°, for it was pretty well known that too low a temperature was as great an evil as too high.

Mr. Ash said he was not aware how many of these vans were in use, nor the cost, as the company made them all themselves. The first one was adapted from an old wagon at the works at Paddington, and was made under his direction, but all the others had been entirely constructed by the Great Western Company, who told him they bought pig-iron and made the whole of their own work throughout. The only stipulation he made was that each van should have painted upon it "Ash's patent," and that whenever it was advertised it should be in connection with the name of his company, and the address in Oxford-street.

The Chairman said that some time ago a great difficulty was experienced in bringing milk by railway.

Mr. Ash said the great object in such a case was, in hot weather, to keep out the atmosphere as well as to refrigerate it. He had seen some milk vans open at the top and covered by tarpaulin, which he supposed was wetted, but he thought that a mistake. There was no perceptible draught in the vans on his construction, except close to the holes by which the air entered or by which it left the van. Close to them a match would be immediately blown out, but otherwise the only sensation was a sort of gentle breeze, which was very pleasant, though there was a danger of a person catching cold, as had been found by experience.

Mr. Stephen Darby, F.C.S., then attended to explain to the Committee his method of preparing fluid extract of meat. From a pamphlet published by Mr. Darby, the following description of the preparation is taken:—

"'At the suggestion of Dr. Pavy, of Guy's Hospital, I undertook some experimental investigations to determine whether or no such a preparation were practicable, and after the expenditure of much labour and thought, and the experience of many failures, I at length succeeded in making a complete fluid meat in a condition rendering [illegible] and very agreeable article of diet.

"My fluid meat contains all the constituents of fresh meat which minister to nutrition. It is prepared in the form of a moist extract, perfectly soluble in water. It possesses a full meaty flavour, like that of roasted meat, and therefore is very agreeable to the taste. It may be eaten spread upon bread and butter, or biscuits, or dissolved in water as a substitute for fresh beef tea, but is far more nourishing.

"Before bringing it prominently to the notice of the profession or the public, I have had it tried and tested by use, pretty extensively, in cases of dyspepsia, and invariably with great benefit for convalescents and persons of weakened stomachs; those debilitated by mental or bodily overwork or sedentary habits; and I can now confidently recommend it to the profession as a great desideratum for weakly persons, and in all cases where nourishing food is called for and where the digestive powers are impaired.

"In order to enable the profession clearly to understand and justly appreciate the value of fluid meat, I shall give below the process by which it is prepared, premising that it has not escaped the attention of practical physicians, who have perceived the want existing for such a means of affording nourishment to their patients when the stomach is too weak to take or digest animal food.

"'I have often thought,' says Dr. W. Marcet,* 'that if there were a means of preparing meat so as to enable its easy digestion by weak stomachs, a great boon might conferred on a very large class of sufferers.'

"Accordingly Dr. Marcet proceeds to describe a process, the object of which he explains is to extend the preliminary digestion of meat one step further than is done by cooking before it is taken into the stomach, thereby relieving this organ from the task of carrying out, unassisted, the digestion of cooked meat.

"Dr. Marcet's process involves the use of pepsin, carbonate of soda and hydrochloric acid, and a simple enough apparatus, and is intended to be carried out by persons not accustomed to chemical operations; consequently, I think I am warranted in saying, it would fail in such hands nine times out of ten; and when successful, the author candidly says—'This food contains all the constituents of beef tea and albuminous substances besides; although it only supplies a portion of the nourishment possessed by the meat which has been used for preparing it.'

"What then Dr. Marcet aimed at, I believe I may confidently say I have in my fluid meat actually accomplished, and I am sure the profession will see the propriety of having it prepared for them, as these processes can be so much better and more economically effected on a large scale and under the superintendence of skilled chemical operators than in the domestic kitchen.

"My fluid meat, as I have already explained, contains all the constituents of lean meat, including fibrine, gelatine, and coagulable albumen; but by the process pursued these are all brought into a condition in which they are soluble in water and are not any longer coagulable on heating—in which state they have been designated peptones. This change is effected, as in ordinary digestion, by means of pepsin and hydrochloric acid.

"The pepsin employed is very carefully prepared—without addition of starch or any extraneous substance. Lean meat, finely sliced, is digested with the pepsin in water previously acidulated with hydrochloric acid at a temperature of 96° to 100° Fahr. until the whole of the fibrine of the meat has disappeared.

"The liquor is then filtered, separating small portions of fat, cartilage, or other insoluble matters, and neutralized by means of carbonate of soda, and finally carefully evaporated to the consistence required, namely, that of a soft extract.

"The resulting extract represents in all its constituents the lean meat employed, but with the fibrine, albumen, and gelatine changed into their respective peptones or soluble forms. This change is effected solely by the pepsin and hydrochloric acid, or artificial gastric juice, without the evolution or absorption of any gas or the formation of any secondary products.

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* See a pamphlet "On a new process for preparing meat for weak Stomachs."—By W. Marcet, M.D., F.R.S., &c. Churchill & Sons, 1867.

"The peptones thus formed, although agreeing exactly in chemical composition, and even in many physical properties, with the substances from which they are derived, differ from them by a ready solubility in water and even in diluted alcohol. The changes thus effected coincide precisely with those which physiologists tell us occur in the stomach in normal digestion when the food has been acted on, brought into a soluble state, and fitted to be passed through the pylorus, to be mixed with the bile and pancreatic juice in the duodenum.

"It is important to observe that in this preparation the relations between the several proximate elements of the meat are not disturbed, far less is there any change in the state of the saline, or, as they are called, inorganic constituents, such as occurs when they are separated in the form of ashes by burning or otherwise totally decomposing the flesh.

"But this process, whatever care may be taken, leaves the fluid meat with a strong bittter taste. This bitterness attaches always to meat digested with pepsin; and this, in the opinion of medical men, would wholly preclude its acceptance and adoption as an article of food. At the same time, it curiously illustrates the identity of the process in the laboratory and digestion in the living stomach.

"In order to remove this bitter taste, and to obviate the objection to fluid meats on that ground, I have made many experimental researches, and at length have discovered that the purpose is completely and satisfactorily effected by addition, in a certain part of the process, of a small proportion of fresh pancreas.

"The fluid meat so prepared is entirely free from any bitter flavour."

Dr. Pitman said he had examined the pamphlet, and as far as that was concerned the statements were very satisfactory. He should like to know what proportion of fluid meat was obtained from a pound of solid meat.

Mr. Darby said about one-fourth in weight of fluid extract was produced from fresh, lean meat free from fat. Of course he did not get so large a yield from meat bought in the market, because there was the fat to be deducted. The meat was rendered fluid by the chemical agents—hydrochloric acid and pepsine—and the whole of the otherwise insoluble portion of the meat was given in the soluble state. The water of the meat was driven off, together with another portion of water added in the preparation. A small amount of pancreas was added, to remove the bitter flavour of the digested meat.

Dr. Pitman—So that you not only go as far as the primary digestion—that which takes place in the stomach—but you go a step further, and you effectuate that process of digestion which really is carried on in the bowels, where the pancreas pours out its secretions. I mean you are doing the whole work of the body. In fact, when you have digested the meat you leave it to the body to absorb it. But no doubt certain actions which take place in the body are as essential to its health as the presence of the meat. I mean, it is as essential that the body should get rid of those secretions which the body furnishes to digest meat, as that it should be supplied with meat for those secretions to digest; and if, by your chemical operations, you prevent the first taking place, the question is how far, in a medical point of view, that is desirable?—I may answer that by saying that I use a very small portion of pancreas, and apply it but a short time. If I added more pancreas, or used it for a longer time, I should split up the peptones into ultimate products of decomposition.

Q.—You would arrive, in fact, at those products which are the result of lost tissues?—Yes, possibly. I think there is work enough left for the pancreas in the body to exert its proper action after I have removed the bitter substance. I find that bitter is formed in every case where the meat is thoroughly digested. I can partially dissolve and almost free it from bitter; but when I get it thoroughly dissolved it is intensely bitter always.

Q.—We look at digestion first as an acid process, and, when the food passes out of the stomach it meets in the bowels with an alkali, and there the acid is neutralised. Then it proceeds onwards, and becomes fit for absorption and nutrition. The meat in your process, as far as I can understand, is digested by pepsine and hydrochloric acid acting as the primary digestion in the stomach. Then you add carbonate of soda to neutralise the acid of the hydrochloric acid, and then further you add the secretion of the pancreas to take away the bitter?—Yes; but nothing more than that. In the body, I apprehend the pancreas exerts some further action.

Q.—The practical effect of taking that as food has yet to be shown?—I may say that I have had very good experience in that way, enough to warrant the assertion that it possesses the same power of nourishing as meat itself, particularly in the case of persons engaged in exhausting pursuits where the digestive power is weakened. They tell me that by using this fluid meat they get the same amount of stamina given as in eating solid meat when in health.

Q.—Do you suppose it possible for a person to live a month on your fluid meat and to come out at the end of that time as hearty and well as if he had been eating three-quarters of a pound of rumpsteak every day?—I think so; but I am happy to say that that question is now in process of investigation by a gentleman, whose name I will not mention, but who is above suspicion in every way. He has kindly taken that in hand for me, and he is in a position to do it most thoroughly, so that I shall actually know, under very trying circumstances, whether it is as valuable as at present I have reason to believe. It is only practice which can show that.

Q.—Would it be economical as an ordinary diet?—Clearly; that is, if it were manufactured where meat is low in price. This is evident, from the price at which I can supply it from well-fatted beef of England. And even now it is less costly for the preparation of beef-tea, broth, or soups, for which only the soluble portion of the meat is taken; for by boiling or stewing, 20 lbs. of lean meat are requisite to provide 1 lb. of soluble extract; whilst there remains about 4 lbs. of insoluble nutritive matter, which is commonly rejected. I require only lean meat, and this is generally least acceptable for cooking purposes.

Q.—What is the price you sell it at?—10s. 6d. a pound; but it is made from the best English beef, merely as an article for invalids. I hope it will go beyond that, and be used as an article of food, to be given especially in cases where persons have to undergo considerable fatigue. We know very well that, after a hard day's work, a little fillip of some kind or other is often necessary to coax back an appetite for solid food; and I think for men exposed to such, this kind of food will prove very advantageous.

The Chairman—What you speak of arises from the digestive power being lowered by the bodily fatigue, and it requires something to supply present nourishment, in order that it may have the power to digest the ordinary food.

Dr. Pitman—That is just it.

Mr. Darby—It has taken me a long time to overcome the various difficulties. Originally the bitter flavour was a great drawback, although it was even then eaten by some; subsequently there were other difficulties, but these have, step by step, been overcome.

The Secretary said he had tried the fluid meat, and found his appetite very well stayed by a few slices of bread and butter with the fluid meat upon it.

Dr. Blakiston asked what pepsin Mr. Darby employed.

Mr. Darby said he used pigs' pepsin, made by a process very similar to Dr. Beale's.

Dr. Blakiston—Is it made in the same way?—Not exactly.

Q. Is it dried on plate-glass, and so forth?—No, not on plate-glass; but that is a matter of very little consequence.

Q. I beg your pardon, any difference in the preparation of pepsin is everything. I have tried it for many years, and never found any equal to Bullock's, made by Dr. Beale's process.— If you get similar results the method of preparation is not of such great importance. If I did not employ good pepsin, I should find no meat digested. The best test of my having the pepsin properly prepared is, that I get the meat digested. My process is a little modification of Dr. Beale's.

Dr. Blakiston said it was a great pity that pepsin could not be made in Cork and Devizes, and other places where pigs were largely killed, so as to make it economically, and bring it within the reach of all classes.

Mr. Abel—I think you are in a position, Mr. Darby, to know a good deal about Bullock's pepsin?—Yes, but at the same time I am not in a position to say much about it.

The Secretary—Your opinion is that if you could get the meat in our colonies or other countries, where it is cheap, the preparation might be sold at a cheaper rate than the equivalent in solid fresh meat could be bought for in this country?—That is my impression, most clearly. The preparation contains all the properties of the meat except the fat, and I do not think it is advisable to include that, as there is always a liability to its turning rancid. It may be either diluted with water for beef tea or soup, or eaten on bread and butter, like anchovy. Some few days since a gentleman who is rather interested in these matters, told me that having a hard day's work before him, and only time for a very hurried breakfast, he used some of my preparation on two or three slices of bread and butter, and found that he went through his day's work very well. The next day he tried Liebig's, but it did not answer at all, for he soon found he wanted something to eat. The next day he tried solid meat, and the next day he tried my fluid preparation again, and he found it the most satisfactory of all.

ANNOUNCEMENTS BY THE COUNCIL.

EXAMINATIONS, 1872.

The days fixed for the Final Examinations this year are April 16th, 17th, 18th, and 19th. The necessary forms for making the return of intending candidates have been issued to those Institutions which have already applied for them. Any Institutions having candidates for these examinations, and which have not yet applied for forms, should communicate with the Secretary of the Society of Arts immediately. Programmes of examinations can be had gratis on application.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

The Council invite members of the Society to forward to the Secretary, on or before the 29th of April, the names of such men of high distinction as they may think worthy of this honour.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscription paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society. Season ticket holders will be invited to a reception that will be held by his Royal Highness the Duke of

Edinburgh and Her Majesty's Commissioners on April 27th. The Albert Hall, the Conservatory of the Royal Horticultural Society, and the Picture Galleries of the Exhibition, will be thrown open, and military bands will play.

MOSCOW POLYTECHNIC EXHIBITION, 1872.

The Committee of the above Exhibition are desirous of forming, for reference in Moscow, a collection of catalogues or price lists of makers of machines and tools of all kinds, and of mathematical instruments. Parties willing to assist are requested to send at once to the Secretaries of the London Committee for the Moscow Exhibition, now sitting at the Society of Arts, Adelphi, London, two copies of each such catalogue or list (illustrated preferred), and the same will be forwarded to Moscow, free of expense.

Members of the Society are requested to give publicity to this notice, as it is very desirable to render the collection as complete as possible.

BARRY'S ETCHINGS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, are about to have a limited number of sets of the 29 plates etched by the late James Barry, printed. The impressions will be taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, will be £10 10s.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ON THE PROFITABLE CULTIVATION OF TEA IN INDIA.

By Frederick Campbell, Esq.

In order to ensure the greatest amount of success in the cultivation of tea in India, there is no doubt that, as a primary step, the intending settler would do well to spend six months in the various tea gardens of Assam, in order to form a judgment for himself as to the best sites for a farm, the quality of soils, systems of management, and the best methods of manufacturing tea. In the absence of this, however, there are plenty of both natives and Europeans, who are well acquainted with tea-making and general management of a tea estate, who may be employed at very reasonable rates, and for the first year would be found useful.

The first point in Assam at which tea-gardens are met with is Gowhatty, on the south side of the Brahmapootra. The formation of the land here resembles Cachar, and is unsuitable for tea. The soil is poor, and the rainfall uncertain. I cannot, therefore, recommend it as a desirable district to settle in.

Proceeding in an easterly direction, the next district to Gowhatty is Nowgong; it contains some very good land for general purposes, but the tea land is not very extensive or of very good quality. The most valuable crops to grow would be cotton, rice, seeds, jute, &c.

After reaching the tea-garden of Kooliarbar, on the bank of the Brahmapootra, it is necessary to proceed by steamer to the next landing-place, called Dhunseree Mook (Mook being the native name for the mouth of a river). The country lying between these two points is very broken and hilly, the hills in places projecting into the river, or large tracts of clear land, formed by the deposits of the river, extending to the hills. Ten miles inland from this point is the garden of the Central Assam Tea Company, and the country opens out to a very considerable width. Leaving this garden, the road lies through fine plains covered with grass, intersected with light forest jungle, and extending to the Mekur hills. At 16 miles the road passes the fine tea-garden named Namallaghur, the property of the Jouhant Tea Company; it is situated on the banks of the River Dhunsere. This river is navigable to Golah Ghat, a civil station 30 miles from Brahmapootra. It passes through some fine land, especially towards the hills. Many large and valuable gardens have been opened out, the best of which are the late Mr. Williamson's private garden, the Golah Ghat Company, and the Brahmapootra Company's gardens. There are many valuable sites in this district worth the attention of settlers.

The land is of high quality for any crop, and might be cultivated with great advantage by the steam plough and cultivator. The forest is generally not of large growth, and could be cleared with little cost, and the grass land would be still less expensive. This description of country extends to the town of Jorehaut, and then commences the Dessoi Forest, in which the celebrated tea-garden, "Soonary," is met with, being the chief garden of the Jorehaut Tea Company, and is, undoubtedly, one of the finest in India. At this point commences what is considered the finest tea land in the province, and no doubt justly so; it skirts the foot of the hills, and is of varying width, and extends to the eastern confines of Assam. After leaving Jorehaut, the river Dessoi is crossed; it is useless for navigation, but remarkable as containing gold. The road then goes to Seebsagar, a distance of fifty miles, and numerous gardens of great excellence are passed, the most noticeable of which are:—Noacacherry and Messrs. Doyne and Berner's garden. At Seebsagar is the river Dikoo, which is navigable for steamers to Nazarah, the head station of the Assam Tea Company, a distance of thirty miles from the Brahmapootra.

After Seebsagar is the military station of Delrooghur, about sixty miles distant. The principal river crossed on the road to it is the Dehing, leading up to the small station of Jaipore, on which are situate the coal-mines and the petroleum springs. The next station to Delrooghur is Suddya, and is the last in the province. The whole of this district, from Jauhaut, is tea-land of the highest quality; and, provided the land is high enough for thorough drainage, it is almost impossible to make a wrong selection; but, as a rule, I am of opinion that the very best land is in the immediate vicinity of the hills, and on the first gentle slopes leading to them; and, if not too steep, the first ranges are of great richness and value. The forest is, as a rule, superior to grass-land. A very large proportion of this tract of land is under tree jungle, containing timber of the most valuable quality and vast size. The tea-gardens of greatest note around Delrooghur are, the Upper Assam Tea Company's gardens, the Dehing Company, and the private gardens of Mr. Hannay and Col. Holroyd.

On the south bank of the river, opposite Gowhatty, is the district of Durrung, which is generally entered by the station of Mungledye; here tea-gardens have been opened, the most important by Mr. Mackenzie, Mr. Severin, and the Durrung Tea Company; some have been opened on the plains, and some on the lower slopes of the Himalayan mountains, and are all very fine, especially those on the hills.

There are no tea-gardens after leaving Mungledye till Tezpore is reached; here there are several, the best of which are those of Mr. Martin; about ten miles distant are the Bisuath Company's gardens. The country lying between Durrung and Tezpore consists of vast grass prairies of magnificent black land, admirably adapted to the growth of cotton and the use of all steam cultivators; tracts of level land, containing hundreds of acres, are to be found without a break or obstruction of any kind. In some parts belts of bamboo jungle are met with.

In cultivating these plains, the houses of the planters may be healthily placed on the first ranges of the Himalayas.

There are no other tea-gardens on this bank, till Luckimpore is reached, the principal of which are those of the Luckimpore Tea Company and Mr. J. P. Wise; there is, however, much valuable land, and some very fine forests.

It will be seen from this that there is very little tea cultivation on the south bank, as compared with the north; this is, I think, accounted for from the fact that the soil on the north bank contains little of the necessary ingredient, iron, and the singular fact that, whereas on the south side of the river large quantities of indigenous tea is found in all the forests, on the north bank none has been discovered.

The tea, however, grows with equal vigour here, and is quite equal in appearance to any other part. Whether this will be maintained or not, time alone can show.

The most convenient place for a stranger to visit on first going to Assam will probably be Seebsagar. At the landing-place known as Dikoo Mook is a hotel, from which he can reach Golah Ghât, and Subsagur, and all the valuable country round; and the steamers on the river, which are constantly passing, would convey him to Delrooghur, or to any of the stations on the opposite bank of the river. At this place, ponies and elephants (the only means of travelling in Assam) may be hired at reasonable rates. From this point good roads now traverse the country; from the Dhunsuree river to Suddya, which are available for the interior, and the river forms communication with all the principal stations. The Bengal Dooars can be reached from Assam by Dobree, or from Bengal by railway from Calcutta to Sahibgung, where a steamboat takes you to Carrigolah Ghat, and from thence Darjeeling and the Terai is reached by horse-carriage or palkee. The Cossiah Hills can be visited from Gowhatty by walking or riding ponies to Shillong, the civil and military station, or from Calcutta by steamer to Chuttuck, which is only about ten miles from Cherrapoongy. The proper time for selecting land is the rainy season, after the middle of June, as the land liable to inundation can then be best seen. As a rule, the best timber is an indication of the best land, and that on which nahoar trees flourish is most desirable. The tea-plant is tap-rooted, and if the root goes deep enough to reach a stratum of water it is injured. It is necessary, therefore, in selecting land that the land is sufficiently high to prevent this contingency.

Having made a selection of land, the next step is to become possessed of it. This is done under the waste land rules of the government of Bengal, and all information may be obtained from the different deputy commissioners in the province. The present price of waste land is 2 rupees 8 annas (five shillings) per acre, paid by instalments extending over ten years. It is, however, I believe, intended to double the price, that is, 5 rupees, or ten shillings. A copy of the most recent waste land rules is appended to this paper.

The next and most important consideration is the procuring of labour for the cultivation of the land. Up to the present time, it has been usual, especially with companies, to determine upon a certain acreage of tea-garden, without at all considering where the labour was to come from to carry on the cultivation. The reason for this was, that at the outbreak of the tea mania enormous prices were given for land which could, by any stretch of the imagination, be called a tea-garden. All the labour available was, therefore, devoted to planting out, without any provision for the future. This, more than anything else, led to the disaster which followed. Proprietors found themselves in possession of half-cleared and half-planted land, and no adequate amount of labour to keep it in cultivation, and thousands of acres were abandoned which had cost them £100 per acre.

I would, therefore, most earnestly impress on the intending settler to avoid this most disastrous course, and, instead of heedlessly rushing into extensive cultivation, reverse the existing rule, and first make sure of the labour, and then cultivate only so much as that labour will keep in the highest state of cultivation. The quantity of land to be taken up must, of course, be regulated by the capital at disposal. I propose, however, to show what may be done with a capital of two thousand pounds (20,000 rupees).

Hitherto, planters have most unaccountably devoted their sole attention to the cultivation of tea; but the plan I advocate is to make the creation of a tea-garden a secondary consideration, and the cultivation of other crops subsidiary to it, and for the following reasons. A poor man cannot afford to wait three or four years till his tea-garden will maintain him and his family. The planter is, by law and necessity, compelled to find provisions for his imported coolies. These provisions generally have to be imported from Bengal, and sold to the labourers at a loss; but if they were grown by himself, instead of a loss they will be a source of very large and immediate profit; and instead of waiting four years he will, at the end of the first year, receive a very handsome income. Take, for instance, only one article of consumption, rice. To import it, it will cost him at least three rupees per maund, whereas he can grow it at his own door, on his own ground, which would otherwise be lying idle, for four annas, that is, one-quarter of a rupee, per maund. But perhaps the most important reason for varied cultivation is the following:—The labour required for the cultivation of tea is very considerable, the amount, at the same time, is very much greater at certain times than at others, and, as a matter of course, there are at times many of the hands remaining idle; and as it is compulsory on the planter to maintain his imported coolies, whether they work or not, it is clear that if there is a sufficient number of coolies on the garden this must be a source of great loss to the planter. It is to utilise this spare labour which I aim at, and thus convert a certain loss into a very considerable profit. This equally applies to the bullocks, which must be kept and fed whether there is work sufficient for them or not throughout the year.

To illustrate this more fully, I will give an instance of the loss sustained by one company in Assam by not utilising the spare coolie and bullock labour it was obliged to maintain for the cultivation of its tea-gardens. The consumption of rice annually was about 40,000 maunds, which would cost them three rupees per maund, often more. The total cost would be 120,000 rupees, nearly the whole of which would have been saved by utilising the land and labour lying idle in their hands. This sum would have added 7 per cent. to their dividends. A man, therefore, possessing the capital named, I would advise to confine himself to the creation of a tea-garden of 100 acres, and to occupy three years in the operation of opening out.

The first thing to be done is the selection of tea-seed. There are four varieties, the Chinese, the light-green leaved, Assam (indigenous), the dark-green Assam (indigenous), and the hybrid. The two last I believe to be the same, and only vary in appearance according to the land on which they are grown; be this as it may, I have no hesitation in recommending these two last varieties in preference to the others; they are more hardy, productive, and durable, and give tea of greater strength.

The gardens from which I should advise tea-seed to be selected are, Moahkacherry, or the garden belonging to Mr. Smart, the manager of the hilly part of Namullighur, and the head garden of the Jorehaut tea company, at Jorehaut, Mr. Mackenzie's home-garden, in Durrung, and Col. Holroyd's garden.

This is a matter of great importance, and by taking a small quantity from each of these localities you will insure the best kinds, and the first year will enable you to judge which is the best suited for your land. Too much attention cannot be given to this subject, and every effort should be made to obtain the seed which is earliest ripe, as this is the best; it will also enable you to get it into the ground before the rains are dried up, which will insure the quick germination of the seed.

The land and seed having been arranged for, no time should be lost in getting up coolies, cattle, stores, &c. The coolies may be obtained, as already described, either by the private sirdar, or through a Calcutta contractor. To any one well acquainted with India, the first method is the most advisable. To a perfect stranger, the contractor would probably be the better medium of supply, care being taken that the coolies are carefully selected at the depot before leaving for Assam. One hundred work-people will be sufficient to start with; of these, there should be one blacksmith, one carpenter, some ploughmen, wood-cutters, &c. The very best coolies are undoubtedly the Coles and Santhals, who resemble each other, and the Daughers; they are met with in the Santhal Pergunnas and the hill districts near Midnapore, from one to three hundred miles from Calcutta. They are industrious, easily contented, and free from caste-prejudices, eating and drinking anything which comes within their reach, and thrive wonderfully in Assam, or in the locality.

Having obtained a few good men in advance, the next thing to be done is to build a temporary shanty of grass and bamboos to live in, then to construct huts for the reception of the labourers as they arrive, care having been taken to obtain provisions for their use.

On their arrival, no time must be lost in commencing the first operations for the plantation; this will be to prepare the seed-bed. For this two acres of good, sandy soil should be selected, as near as possible to the land which is to be planted out, in order to save labour in carrying the plants to their destination. This seed-bed should be turned up to a depth of eighteen inches, all roots and rubbish removed, and the soil thoroughly pulverised, care being taken that the top soil is not buried. It is desirable that this seed-bed should form part of the future plantation, as the thorough cultivation it receives renders it very valuable. This operation should be completed by the first week in October, and the tea-seed at once sown, as the sooner the seed is put in the ground after it is gathered, the quicker it will germinate, and the soil will not have had time to dry after the rains; the plants also will have longer time to grow before transplanting.

The seed should be planted singly, at six inches distance each way; this will give ample room for them to mature, and give sufficient earth to form a ball round the roots when transplanted.

The quantity of waste land taken up for such a farm as that under contemplation should not exceed six to eight hundred acres; this, from the nature of the country, will probably contain a variety of formation, suitable for rice and other crops; but if deficient in rice-land, a hundred acres should be purchased in the neighbourhood, as this will form one of the most important and valuable portions of the plantation.

The next thing to be done is to select a suitable site for a bungalow, which should be as central as possible, and a space cleared for a vegetable garden. European and native vegetable seeds should at once be sown, for the use of the planter and his labourers, and a number of fruit trees planted; the most useful of these will be found to be the orange, lime, peach, guava, lichee, mango, and jack-fruit, all of which can be obtained in Calcutta, of the Horticultural Society, or on the spot. This garden is of great importance, as the supply of good vegetables to the coolies, who are accustomed to them at home, is a great source of health and contentment to them, as well as the planter himself.

Having completed these preliminary operations, the general work of clearing will commence, and a bungalow built.

The best men may be employed in clearing the forest trees, the weaker hands in grubbing up, and collecting and burning the smaller jungle and rubbish, and clearing away and burning the grass-land. All diligence must be used in the work, so that not a day of the dry season, which commences in November, may be lost.

It has been usual, in opening out land for tea-planting, to clear only so much of the forest as would enable the men to put in the young tea. This plan has been followed, in order that the greatest quantity of land may be planted and called garden, also under the plea that young plants require shade, and that the larger trees may be cleared at greater leisure. The system, however, is vicious in the extreme, and should not be adopted. Every jungle plant and tree should be grubbed up by the roots, with the exception of the largest trees, from 18 inches in diameter; these should be what is called "rung," that is, a deep notch cut all round the tree at a foot or two from the ground, this will kill the tree, and it will gradually decay, and disappear without injury. The soil should be thoroughly stirred and turned up to a depth of a foot or eighteen inches, for it must be borne in mind that, when the plants are once in the ground, this can never be thoroughly done without injury to the plants; and so far from shade being necessary, it is a positive injury. The young plants cannot have too much sun and air; shade only gives unnatural growth, and causes weakness; without it, growth will be slower, but the plant will take firmer hold of the ground and become more hardy.

Early in June, the rains will probably commence in earnest, and, preparatory to this, the land must be staked out and the holes ready dug to receive the tea. This course I have never seen adopted, but the advantage is manifest. The sun and atmosphere at this time of the year are very hot, and land which has been recently stirred soon becomes dry, and unfit to receive the plants; but if the holes have been ready open, they form receptacles for the rain, and remain damp for some time, and your tree is planted in a wet soil instead of a dry one. Again, when once the rainy and cloudy weather comes, the whole force of the garden can be employed in transplanting, and treble the quantity of trees removed than would be the case if two-thirds of the people were employed in digging the holes at the same time. At the time of transplanting, care must be taken that all plants of the China variety and bad plants be carefully cast aside. It is probable that the plants will have acquired a length of a foot or eighteen inches; in this case it will be well to cut off a few inches at the top, as it is better to remove this portion with the knife than to allow it to wither and die. The tea being a tap-rooted plant, requires a hole of considerable depth, and the greatest care must be taken that as much of the root is removed with the plant as possible, and when planting, the root must be put in the ground perfectly straight, as if the lower point is turned up or bent, that plant will never thrive. The holes should be at least a foot in diameter, and a foot to fifteen inches deep.

The question of distance from plant to plant has been much discussed, and there are a variety of opinions on the subject. Six feet by six is advocated, on the ground that a tea garden being a permanent institution, the plant requires that space for healthy growth, and to afford sufficient space for cultivating the land. Others, again, recommend planting the trees close in rows, so as to form hedges, with a good space between. Both these extremes should be avoided; six feet by six feet is unnecessarily wide, and gives very few plants to the acre, the number being only 1,200 per acre, and is not sufficient to ensure a good crop. The hedges, again, form so dense a mass as to exclude the sun and air, which are absolutely necessary for the health of the plant. As a fair medium, therefore, I advise the distance of four feet by four feet; this gives each plant 16 superficial feet of ground, which is sufficient for health, vigour, and ample cultivation. At this distance, there will be 2,700 plants per acre, more than double that of six by six, and though the plants will require to be kept smaller, a small plant gives much more leaf than a large one in proportion. And by this plan a much quicker return for capital will be obtained.

After the plants have taken well hold of the groundl there is nothing more required than light hoeing til, winter. The best implement for this will be the broad sharp, steel hoe, such as that used in Norfolk for turnip hoeing, six to nine inches broad. When forest land is first cleared, it will produce very few weeds, and may be kept clean at very little cost. Every care must be taken to eradicate weeds at their first appearance, and not neglect them for a single day; such is the fertility of soil and climate, that they run up and seed in an incredibly short space of time, and the expense of weeding is greatly increased.

(*To be continued.*)

ANCIENT JEWELLERY EXHIBITION AT SOUTH KENSINGTON.

The Lords of the Committee of Council on Education, having determined that an Exhibition of ancient and modern jewellery and personal ornaments should be made at South Kensington Museum, for purposes of public instruction, in June, 1872, have appointed a Committee of Management, consisting of H.R.H. the Princess Louise, Marchioness of Lorne, H.R.H. the Princess Mary of Teck, the Duchess of Manchester, the Marchioness of Westminster, the Marchioness of Ripon, the Countess of Tankerville, the Countess of Warwick, the Countess Spencer, the Countess of Carnarvon, the Countess of Cork, the Countess of Somers, the Countess Granville, the Lady Mildred Hope, the Lady Dorothy Nevill, the Lady Londesborough, Lady Wyatt, Mrs. Fortnum, Mrs. Gladstone, Mrs. Holford, Mrs. Alfred Morrison, Mrs. MacCallum, Mrs. Gambier Parry, with MacLeod of MacLeod as secretary. This committee has made the following announcement:—1. The Committee request the possessors of ancient and modern jewellery and personal ornaments, remarkable either for the artistic design, or the fineness of the stones, or the skill displayed in their setting, to lend specimens to the South Kensington Museum, with the view of promoting the general improvement of the taste of the designer, the producer, and the public generally. 2. The specimens may consist of jewellery and fine art in gold and silver of all kinds used for personal wear. All kinds of orders, badges, &c., would thus be admissible. 3. It is known that there is much ancient family jewellery in this country, and the Committee desire to borrow it for this Exhibition. 4. Arrangements will be made to enable lenders of jewellery to have the use of their loans whenever they desire it. 5. It is proposed that the Exhibition shall open early in June, and the objects returned, if it be wished, at the end of July. 6. Possessors of jewellery, &c., willing to lend objects are requested to fill up a form and return it by post unpaid on or before 20th July, 1872. This form may be had of the Secretary, South Kensington Museum, on application by letter.

GENERAL NOTES.

Tonic Sol-fa System.—The Committee on Books and Apparatus of the London School Board have recommended that managers of schools be advised to adopt the Tonic Sol-fa System of teaching vocal music in the schools provided by the Board.

An Interesting Discovery has been made in a field near Apremont, in France. The mouth of a cave was found within eighteen or twenty inches of the surface, and on exploring there was found a mass of enamelled pottery, consisting of small figures, which are attributed to Bernard Pallissy. The Comte de Grandpré, to whom the property belongs, intends to continue the research.

Clearing House in Paris.—The clearing house has been adopted in Paris, after long years of discussion, by the exertions of M. Coullet, one of the directors of the Messageries Nationales, who is well acquainted with England. It opened on the 8th instant, with the co-operation of the Crédit Foncier, the Comptoir d'Escompte, and about 20 other financial societies and banking companies and firms.

Punshon's Gun-Cotton.—Another trial of this improved quality of gun-cotton took place on Wimbledon-common, on Thursday, the 28th March. An account of the last trial will be found in the present volume of the *Journal*, page 186. On the 28th the object of the trial was to show that it is practicable to introduce it into the barrel of an ordinary breech-loading rifle, and to use it in precisely the same way as a cartridge of gunpowder. In appearance a cartridge containing 50 grains of Mr. Punshon's gun-cotton is identical with one containing 84 grains of Curtis and Harvey's No. 6 powder. The difference in weight, however, is of considerable value, as it enables 10 cartridges of gun-cotton to be carried in place of six of powder; and if some experiments which Mr. Punshon is making to further compress the cotton are successful, there will be a decrease of bulk as well as of weight, which, supposing it to be introduced as army ammunition, will enable the soldier to practically double the number of rounds he at present carries, an important matter with breechloading arms. The results of the seven shots fired by Mr. Punshon at fifteen deal boards, clamped together and placed in front of an iron target, was much the same as at the first trial—namely, that 50 grains of guncotton have an equal, if not a little higher, explosive force than 84 grains of powder, the bullets in both cases penetrating the fifteen boards, and striking the target behind; the bullet, in the case of the powder, being partially flattened, in the gun-cotton entirely so. The results may be summed up as follows:—That the explosive force of Mr. Punshon's gun-cotton is at least one-third greater than that of powder; that, fired by a fulminate, it is perfectly adapted for use in the form of a cartridge; that its explosive force, when fired, is regular and certain, the whole of the cotton being ignited; that it does not foul the barrel; and that there is an absence of smoke, an important matter in warfare. To this may be added the fact that the cost of its production is less than half that of powder, and that it can only be fired by a strong fulminate; no amount of concussion will explode it, and its manufacture may be carried on without danger. Its action is as perfect and regular when used in firing at long ranges as at 50 yards.

Newspapers in Italy.—The *Opinione* of Florence gives the following statistics of newspapers published in Italy, from which it appears that there are no less than 765 journals of various kinds, of which 349 are political, 133 literary, 43 artistic, 132 commercial and industrial, 69 scientific, 19 administrative, and 20 comic. Milan seems to be the head-quarters of Italian journalism, no less than 92 papers are published in that city, of which 19 are political, 22 literary, 13 artistical, 25 commercial and industrial, 10 scientific, 2 administrative, and 1 comic. Florence stands next as regards number, with 79; Naples 63; Rome 49; Turin 46; Genoa 43; Bologna 38. Political papers are most numerous at Naples, where no less than 36 are published; Rome has 26; Florence, Milan, and Bologna, have 19 each. Florence stands at the head of the list as regards literary papers, with 25; and at Milan 22 are published. The greatest number of art papers are at Milan, which has 13; with 25 commercial and industrial journals. At Turin, 11 scientific papers are published, and 10 at Florence; Milan has 10. At Florence, naturally the highest number of administrative papers are published, namely 5.

Industrial Establishments on the Canal Cavour, Italy.—The branch canal from the Canal Cavour for the irrigation of the Lomellina, is now nearly completed, and is expected to be opened early in April. This canal, which is about 28 kils. in length, in addition to contributing largely to increase the agricultural prosperity of the district through which it flows, by irrigating large tracts of land which at present, for want of water, yield but scanty crops, will also give an impulse to manufacturing industry by the opportunities that it affords for establishing manufactories on its banks, and utilising upwards of 16,000-horse power at the falls which regulate the slope of the canal, which is less than that of the land. Already several concessions for water-power have been made by the company, amongst the most important of which has been made to a company recently formed at Milan, who intend establishing a silk-spinning factory near Novara, at one of the falls on the canal, where water-power amounting to 500 horses can be obtained. This factory is intended for spinning floss silk (bourre de soie), and is designed for 10,000 spindles, for the annual production of 80,000 kils. of spun silk. The capital of the company is 4,000,000 francs (£160,000). Another concession of water-power has been made for establishing mills for the cleaning of rice, and the company are at present in treaty with other manufacturers, who propose availing themselves of water-power on this canal.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

April 10th.—"On Hindrances to the Progress of Applied Art." By Dr. Christopher Dresser. On this evening Sir Digby Wyatt will preside.

April 17th.—"On the Great Central Gas Company's Works." By A. Angus Croll, Esq. On this evening Lord Alfred Churchill will preside.

April 24th.—"On Nuts: their Produce and Uses." By P. L. Simmonds, Esq.

CANTOR LECTURES.

The Third Course of Cantor Lectures will be by Professor Barff, on "Silicates, Silicides, Glass, and Glass Painting." The Lectures will be on Monday Evenings, commencing Monday, 8th April.

Lecture I.—Monday, 8th April.

On Silicon, Silica, and compounds of these with other substances—Fluorine, &c.

Lecture II.—Monday, 15th April.

Solvents of Silicic Acid—Silicates—Glass (composition of)—Different Kinds of Glass—Methods of Making Glass.

Lecture III.—Monday, 22nd April.

Manufacture of Glass (continued)—Coloured Glasses—Glass Staining—Glass as a Decorative Material—Glass Painting.

Lecture IV.—Monday, 29th April.

Glass Painting (continued)—Mosaics—Enamels.

Lecture V.—Monday, 6th May.

Styles of Glass Painting—Illustrations with the Electric Light, illustrative of the Nature of Colour.

Lecture VI.—Monday, 13th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose were issued with the last *Journal.*

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS. 8.** Cantor Lectures. Prof. Barff, "Silicates, Silicides, Glass, and Glass Painting."
British Architects, 8.
Medical, 8.
Anthropological, 8.
London Institution, 4. Prof. John Ella, "Elementary Music."
Institute of Surveyors, 8. Mr. C. Cadle, "Leases versus Yearly Agreements."
Royal United Service Institution, 8½. Capt. Boyle, "H.M.S. *Agincourt*, on and off, the Pearl Rock."

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. Discussion upon Mr. J. H. Latham's Paper on the "Soonkêsala Canal of the Madras Irrigation and Canal Company."
Royal Institution, 3. Dr. Guy, "Statistical and Social Science."
Photographic, 8.

Wed.....**SOCIETY OF ARTS, 8.** Dr. Christopher Dresser, "On Hindrances to the Progress of Applied Art."
Geological, 8. 1. Mr. Robert Mallet, "Notice of some of the Secondary Effects of the Earthquake of 10th January, 1869, in Cachar." Communicated by Dr. Oldham, of Calcutta." 2. Mr. S. J. Whitnell, "Notes on Atolls or Lagoon-islands." Communicated by Prof. N. S. Maskelyne. 3. Mr. J. R. Dakyn, "On the Glacial Phenomena of the Yorkshire Uplands." Communicated by Prof. Ramsay. 4. Rev. W. Bleasdell, "Modern Glacial Action in Canada." Communicated by Prof. Dawson.
Graphic, 8.
Royal Literary Fund, 3.

Thurs...Royal Institution, 3. Dr. Tyndall, "Heat and Light."
Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.
London Institution, 7. Mr. Thomas Adams, "The Political Economy of Railways."

Fri.......Astronomical, 8.
Royal Institution, 9. Mr. John Morley, "Rousseau's Influence on European Thought."
Quekett Club, 8.

Sat.......Royal Institution, 3. Mr. Proctor, "The Star-depths."
Royal Botanic, 3¾.
Geological Museum, 8. Swiney Lecture. Dr. Cobbold, "On Geology."

Journal of the Society of Arts.

No. 1,012. Vol. XX.

FRIDAY, APRIL 12, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND FOR THE SOCIETY OF ARTS.

The following statement in relation to the establishment of an Endowment Fund for the Society of Arts, will, it is believed, be read with interest by the members :—

"The Society of Arts was established in 1754, and incorporated by Royal Charter in 1847. The objects of the Society for the Encouragement of Arts, Manufactures, and Commerce (known to the public as the Society of Arts), as recited in the Charter, are as follows :—

"The encouragement of Arts, Manufactures, and Commerce of the country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom ; and for meritorious works in the various departments of fine arts, for discoveries, inventions, and improvements in agriculture, chemistry, mechanics, manufactures, and other useful arts ; for the application of such natural and artificial products, whether of home, colonial, or foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm, by extending the sphere of British commerce ; and generally to assist in the advancement, development, and practical application of every department of science in connection with the Arts, Manufactures, and Commerce of the country.

"These objects it was the endeavour of the founders of the Society to carry out on a broad base, and the results obtained and given to the public are set forth in the 55 volumes of 'Transactions' which the Society published previous to the year 1846, at which period application was made to her Majesty for a charter of incorporation.

"Since its incorporation the Council of the Society has carried on its work, it is believed, with, if possible, greater vigour and energy than did its founders, and much that it has accomplished is recorded in the 20 volumes of its *Journal*, published since 1851. The support which it has received from its subscribing members has yearly increased, and the number of its members at the present time is between 3,000 and 4,000. Great as has been the success which has attended the Society's labours, the Council feel, and have long felt, that compared with the magnitude and breadth of field for the Society's operation, its action has been necessarily limited, owing to the fact that the Society has never possessed any funded property or endowment, by means of which competent men could be secured to conduct specific lines of investigation in the interests of Arts, Manufactures, and Commerce. It has at all times expended its annual income at the time it was received, and it is now felt more strongly than ever that if the Society is to continue to extend its work, it cannot hope to do so by means of annual subscriptions alone. It is therefore proposed to raise an endowment fund, out of which the necessary cost of such continued and systematic lines of investigation may be defrayed.

"The Council have accordingly directed :—

"That the attention of members and the public be specially called to the results obtained in the promotion of Arts, Manufactures, and Commerce, by the very limited funds at the disposal of the Society.

"That it be represented that the Council have a confident belief that it could render yet further public service if it had adequate funds placed at its disposal for the attainment of objects for which there are now no public trusts.

"That representations be made of the eligibility of the Council of the Society, from its past services, and the responsibility of its public position, to become trustees for the administration of any moneys which private individuals may choose to devote for any special public purposes coming within the scope of the Society's objects.

"That, in justification of this appeal, it be represented that, whilst large funds are solicited and bequeathed for the alleviation or the mitigation of evil, but little has yet been bestowed on measures coming within the scope of the Society's objects for the prevention of evil, by promoting the extension of existing fields of industry and the creation of new ones.

"That the Secretary and the Financial Officer be authorised to make representations to merchants, manufacturers, and others of known wealth, who may be willing to devote money to public purposes, and to consult their wishes as to any special object they may be disposed to promote.

"In accordance with the above instructions, permit us to point out that the Council desire to establish permanent departments, with competent officers, who may investigate and report on the progress of new discoveries calculated to promote new industries in connection with chemistry, electricity, mechanics, agriculture, and raw produce generally, thereby affording an increased amount of information and advantage to the people in general. We express a hope that you may be disposed to extend your support to the Society by contributing towards the establishment of an endowment fund, either for the furtherance of the general objects of the Society, or for such specific lines of investigation, bearing upon Arts, Manufactures, and Commerce, as you may consider need especial encouragement.

"We may add that the Society has from time to time raised Guarantee Funds in aid of public objects—such as the Exhibitions of 1851 and 1862—in the latter case the guarantee amounted to nearly half-a-million of pounds sterling. The Society of Arts has, however, never derived pecuniary advantage from these or any other objects it has carried out ; but by means of the profits arising from exhibitions an extensive estate has been purchased, the income derived from which is now being applied, under a Royal Commission, in promoting a wider knowledge of the Commerce and Industries of our own and foreign countries.

"It is, therefore, now desired to raise an endowment for the Society of Arts of at least £100,000, to enable it to carry on its work with increased advantage to the community.

"The accompanying Forms of Bequest and Cheque for Donation or Subscription to the Endowment Fund are suggested.

"All cheques should be crossed, and made payable through Messrs. Coutts and Co., the Society's bankers."

To persons inclined to leave a sum of money to the Society by will, the following form is offered for that purpose:—

"I give and bequeath to the Society for the Encourgement of Arts, Manufactures, and Commerce, of John-street, Adelphi, London, W.C., incorporated by Royal Charter, and known as the Society of Arts, the sum of £ , which said sum I will and desire may be paid out of my personal estate for the general purposes of that Society."

Donation to Endowment Fund.

Messrs. of Bankers,

Pay to the Society for the Encouragement of Arts, Manufactures, and Commerce, of John-street, Adelphi, London, W.C., or Bearer, the sum of £ as a donation from me to the Endowment Fund of the Society, and charge the same to my account.

Usual signature..................
Address in full..................
Date..........................
£

The above, when filled up, should be crossed Coutts and Co., and returned to the Secretary or Financial Officer, at the house of the Society of Arts, John-street, Adelphi.

Subscription to Endowment Fund.

Messrs. of Bankers,

I request that you will pay now to the Society for the Encouragement of Arts, Manufactures, and Commerce, of John-street, Adelphi, London, W.C., or Bearer, the sum of £ as my subscription to the Endowment Fund, and that you will continue to pay a like sum to the same fund yearly on the 1st of January till further orders, and charge the same to my account.

Usual signature..................
Address in full..................
Date..........................
£

The above, when filled up, should be crossed Coutts and Co., and returned to the Secretary or Financial Officer, at the house of the Society of Arts, John-street, Adelphi.

POST-OFFICE SAVINGS BANKS.

The following Memorial has been sent from the Council:—

To the Right Honourable Wm. J. Monsell, M.P., Her Majesty's Postmaster-General.

The Memorial of the Society for the Encouragement of Arts, Manufactures, and Commerce,

Sheweth,—That this Society, acting in the interest of Arts, Manufactures, and Commerce, fully recognises the vast amount of good which the Post-office savings banks have effected during the eleven years they have been in existence, by providing all over the country a safe place of deposit for the savings of the industrial classes.

That the Society is convinced that the time has arrived when several of the restrictions imposed in deference to public opinion, when the scheme was first started, and when the idea of a government department becoming a deposit bank was new and considerably in advance of the times, might with great advantage now be removed, and that several alterations might be made in the regulations which would render the Post-office savings banks far more available than they are at present to those persons for whom they were originally intended.

That the following alterations, entered into more fully in the appended memorandum, appear to the Society to be most urgently required:—

1. The opening of the Post-office savings banks in the evening, particularly on Fridays and Saturdays.

2. The abolition of the restriction that whole shillings alone can be paid into Post-office savings banks.

3. The reduction of the minimum deposit, now fixed at one shilling.

4. The abolition of the following rules:—

a. That no depositor may pay in more than £30 in any one year.

b. That no depositor may have more than £150, exclusive of interest, in the Post-office savings bank.

c. That no depositor in the Post-office savings bank may be a depositor in any other savings bank.

5. The greater ease and readiness of withdrawing money, both by depositors and after the death of the depositors.

6. The introduction of some plan of providing in all small villages where a post-office is established a Post-office savings bank, to be open periodically.

That inasmuch as it is believed that any alteration in the Post-office Savings-bank Rules would involve the obtaining of an Act of Parliament. The Society would also strongly urge that any such Act should include a slight alteration in the Post-office Deferred Annuities Regulations.

The alteration required is that the resolution which prohibits any deferred annuity from being granted, in the first instance, under £4, be cancelled, and that any one be allowed to commence with purchasing a £1 deferred annuity on the returnable scale, as he can at present do on the non-returnable.

The regulation as it at present stands, as explained in the memorandum, renders this branch of the excellent system of Deferred Annuities almost useless to the industrial class.

Your memorialists therefore humbly pray that You will be pleased to take these matters into consideration, and as speedily as possible, to frame an Act to carry out the alterations suggested, which your memorialists feel convinced will be of great benefit to millions of her Majesty's subjects.

And your memorialists will ever pray,

Sealed with the seal of the Society for the Encouragement of Arts, Manufactures, and Commerce this 11th day of April, 1872, in the presence of P. Le Neve Foster, Secretary.

L.S.

Memorandum on Post-office Savings Banks. By George C. T. Bartley, Hon. Treasurer of the Society.

The Post-office savings banks have been in existence for eleven years; they were established by an Act of Parliament, passed in 1861. Their operations have gone on steadily extending, and according to the last return they hold £15,099,104 money, from 1,183,153 depositors.

Private savings banks also exist throughout the country, the greater number having been started by philanthropy, and many of them are in a thoroughly sound position. Not a few private savings banks have closed, and become absorbed into the Post-office during the last few years. The larger part of the savings of the people are, however, still deposited with private banks, many of which, judging from the continual collapse of such institutions, are not to be depended upon. It is impossible to expect the average workman or mechanic to discriminate between a sound and an unsound private bank. As a rule, he will take the least safe, from the simple fact that it offers greater facilities, and usually a higher rate of interest than a perfectly secure one can attempt to do.

It must not be forgotten that when the scheme was first commenced, and the Act of Parliament obtained, the project was considerably in advance of the times, and those who framed the regulations were compelled to consider the fears and prejudices of persons who were either altogether against the plan, or lukewarm in its support. Experience has, however, shown the vast amount of good which the Post-office savings banks are capable of effecting; and many, if not all, of the objections to the system of a Government department as a savings bank have ceased to be made. Whilst fully acknowledging, therefore, the immense good which has been effected by the operations of the Post-office savings banks throughout the country, the time appears to have come when the principle might with advantage be introduced of encouraging the use of the Post-office savings banks to the utmost extent, and of working them with the fewest rules and restrictions compatible with safety and efficiency. There are also several rules which require immediate alteration, as they prevent the banks from being made use of as much as they might be by the working classes, for whose benefit they were especially established.

The following alterations appear to be more immediately required, and it is urged that they should be submitted to the favourable consideration of the Postmaster-General, with a view to some amendments being, as soon as possible, introduced into the system:—

1. The opening of the Post-office savings banks in the evening, particularly on Friday and Saturday.
2. The abolition of the restriction that whole shillings alone can be paid into Post-office savings banks.
3. The reduction of the minimum deposit, now fixed at one shilling.
4. The abolition of the following rules:—
   - *a.* That no depositor may pay in more than £30 in any one year.
   - *b.* That no depositor may have more than £150, exclusive of interest, in the Post-office savings bank.
   - *c.* That no depositor in the Post-office savings bank may be a depositor in any other savings bank.
5. The greater ease and readiness of withdrawing money, both by depositors and after the death of the depositors.
6. The introduction of some plan of providing in all small villages where a post-office is established a Post-office savings bank, to be open periodically.

I.—The Opening of Post-office Savings Banks in the Evening, particularly on Friday and Saturday.

The mode of life of working men renders it very difficult for them to avail themselves of a bank only open during the day. It is true that they might, as indeed is frequently done at present, send their wives with the money, but their wives are almost as much occupied as they are themselves, and can ill spare the time; besides which it is the man's earnings which have primarily to be saved before they come into his wife's hands. Every difficulty imposed on those who must always make a great effort to put by at all is undesirable, and has an immense influence in preventing deposits being made. The principle of opening in the evening has been recognised by the partial opening of the banks on Saturday to 8 p.m. A great number of the wages are, however, paid on Friday and other days, and the safest way is, for a man to be able, as soon as he has received his wages, to pay the money at once into the bank. This can only be done if the banks are open in the evening. A publican would hardly thrive if he closed his house in the evening. How can a savings bank, then, hope to do a good business if it is only open from 10 a.m. to 5 p.m.?

II.—The Abolition of the Restriction that whole Shillings only can be Paid into a Post-office Savings Bank.

There seems to be no valid reason for the continuance of the regulation which limits deposits to whole shillings. It cannot even lessen the trouble of making up the books, for persons may and do draw out what sums they think proper, and pence enter into the calculations for interest almost universally. Many cases could be adduced of depositors presenting shillings and pence, as, for instance, half-a-crown, to be placed to their credit, in which case the odd sixpence is returned to them, the two shillings only being accepted. The effect of this probably is that the sixpence is spent instead of being put by, and the depositor is annoyed, and perhaps deterred from coming again for some time, by a regulation which he cannot understand, and which he probably regards as a piece of uncalled for despotism. It is strongly urged that any sum of whole pence over the fixed minimum deposit be accepted by all Post-office savings banks.

III.—The Reduction of the Minimum Deposit now Fixed at One Shilling.

The great success of penny banks, and the enormous sums which are saved in pence, seem to indicate that the shilling is too high a minimum for the Post-office. The great difficulty in inducing the working classes to be provident is the first step. It is a great effort for a working man to come for the first time within the walls of a bank, and if, in addition to overcoming this difficulty, he has to bring a whole shilling with him, the task is rendered almost impossible in numerous cases.

It might, perhaps, be undesirable to reduce the minimum so low as one penny, but it is submitted that threepence, or sixpence, at the outside, would induce many thousands to open an account who now spend every farthing they earn.

In connection with this subject, it might be possible, perhaps, somewhat to simplify the system of acknowledging money paid into the Post-office savings banks, particularly in the case of these smaller sums. The present cost is enormous, each deposit or withdrawal entailing an outlay of sevenpence. Would not the postmaster's stamp be sufficient without the letter afterwards sent from the central office? Perhaps some arrangement could be made by which depositors might themselves fill up deposit tickets in duplicate or otherwise. These might be stamped by the postmaster, and one retained by him, and one sent to the General Post-office. As an extra precaution in this case, depositors might be allowed to send their books monthly or quarterly to be made up, if they wished, instead of yearly. This would save considerable expense. The security then would be greater than an ordinary bank gives, for receipts are rarely, if ever, given when sums of money are paid into joint-stock banks.

IV. The Abolition of the following Rules:—

- *A.*—That no depositor may pay in more than £30 in any one year.
- *B.*—That no depositor may have in more than £150, exclusive of interest, in the Post-office Savings Banks.
- *C.* That no depositor in the Post-office Savings Bank may be a depositor in any other Savings Bank.

These restrictions really act only against the most provident. It would seem to be to the advantage of the Post-office for large sums to be paid in rather than small ones. A man depositing more than £30 a-year would hardly ever pay in less than £1 at a time, and as interest to the depositor does not commence until the beginning of the next calendar month, such deposits would tend to reduce the cost of administration.

The same considerations apply to the limit of £150. Many working men save more than this during their lives, and although not a few invest it in other ways, there seems no reason why they should be debarred from keeping it in the Post-office bank, where it is quite safe, if they think proper to do so. There is little fear of very large sums being deposited, owing to the rate of interest; but should this at any time happen—as when the Bank rate is below 2½ per cent., and thus speculators might be inclined to deposit with the Post-office—a clause could be introduced by which the Postmaster-General might be authorised to refuse, at his discretion, to accept sums over, say, £10 at any one time.

The condition that no depositor may be also a depositor in any other savings bank seems to be hardly needed. It is often evaded, and the fact of a man holding two accounts cannot in any way affect the Post-office. He may deposit in a penny bank as well as in the Post-office savings bank, and indeed such an arrangement is encouraged by the Post-office regulations. It also seems strange that a man may place money in any number of joint-stock banks, and be eligible to deposit in the Post-office savings bank, but that he may not have a small account at two savings banks if he has a mind. Such restrictions and unnecessary regulations are evaded by the unscrupulous, and act as a deterrent to the conscientious and careful.

V.—The Greater Ease and Readiness of Withdrawing Money, both by Depositors and after the Death of the Depositor.

The system of withdrawing money now is somewhat cumbrous. A depositor must sign a form, and send it to the General Post-office, on which an order is forwarded to him at his address. This order he presents with his bank-book, and obtains the money on signing a receipt. It is true that all these steps are precautions against a depositor losing the bank-book, but virtually the possession of the bank-book and the signature decides the matter.

The working classes are, it is to be hoped, now learning to write as a matter of course, so that the signature will soon become as good a means of identification with them as it is with the customers of ordinary banks.

Would it not, therefore, be possible to pay a depositor a small withdrawal, say under 5s., on demand, by presenting his book and signing his name to the ordinary receipt form, which handwriting would, of course, have to agree with the signature on the book itself? A saving clause might be introduced, that if the postmaster had not sufficient funds at his disposal to meet the claims thus suddenly presented, he would be at liberty to postpone payment until the next day. These cases would, however, not often occur, as the deposits so greatly exceed the withdrawals.

In the case of the death of the husband or wife, the delay in the payment of the deposit is so great as to be practically useless for the immediate exigencies of the family, which are, of course, most pressing at that time. In no case under a month can the widow obtain the money.

VI.—The Introduction of some Plan of Providing in all Small Villages where a Post-office is Established, a Post-office Savings Bank, to be Open Periodically.

The number of Post-office savings banks is but few compared with the number of Post-offices which exist. In the smaller villages, the difficulties in the way of finding a safe place of deposit for small savings are much greater than in other districts. A labourer, who can at best only put by a few pence a week, if that, cannot be expected to walk miles to deposit it, even supposing the bank were open at such hours as he could attend. It would seem possible that one of the staff of the nearest post-town savings banks might visit the various outlying village post-offices one evening a-week, or oftener, or more seldom, as the case might be. If this were difficult or impossible in places, some arrangement might, perhaps, be made by which the clergy, or guardians, or some other trustworthy persons who were willing to do so, should be commissioned to attend at certain times in order to receive deposits or issue withdrawals. It might, perhaps be done now by the schoolmaster at the school-house. This sort of thing is done by private savings banks, with immense advantage and wonderful results. Fraud on the part of the depositors in withdrawing would be practically impossible, as they would all be well known. To prevent any accident, it might be understood that withdrawal without notice could only be made if the funds received on any particular evening were sufficient to meet them. An arrangement could easily be made by which any one wishing to withdraw a large sum could give notice the day before to the district post-office in time to obtain the amount, if some such alteration as that suggested in IV. were carried out.

Some arrangements such as this would, as it were, bring the savings banks to those who should be depositors, instead of requiring the people to go to them.

The above suggestions are submitted to the favourable consideration of her Majesty's Post-master-General, in the hope that some immediate steps may be taken to render the Post-office savings banks more available for all the wage-classes. No time can be more favourable to the inculcation of provident habits than the present, owing to the remarkable prosperity of almost every branch of industry throughout the country.

Post-Office Deferred Annuities.

As any alteration in the Post-office savings bank regulations will have to be submitted to Parliament, the Bill might as well include a small but very important alteration in the Post-office Deferred Annuity Regulations.

Deferred annuities are granted in two ways.

1st. On what is called the returnable scale. That is where the whole of the money is returned if the annuity is never taken advantage of or whenever the purchaser thinks proper to ask for it.

2nd. On what is called the non-returnable scale. That is when the purchase money is not returned under any circumstances.

The first is the scale which is practically made use of. The payment is higher to obtain the same annuity, but the wage-classes prefer it, as their money does not seem hopelessly small, and can be claimed back at any emergency.

The most advantageous way for the wage-classes to purchase deferred annuities is for them to purchase small annuities outright. Thus £2 7s. 4d. on the non-returnable scale will purchase for a man of 20 a deferred annuity of £1, to begin when he is £55. By putting by one shilling a week for a twelvemonth he can save this. After he has purchased it it is done with. If he is prevented from saving in a year or two, it does not in any way affect the one or more pound annuities he has purchased.

By the regulations of the Post-office, however, the smallest deferred annuity that can be purchased in a lump sum on the returnable scale, is £4. This means that a man must have saved £12 or £14 to begin with. He can add one pound at a time to the annuity after once commenced, but the difficulty is to induce him to make the first effort; and having to save so long without any apparent result, is but too apt to prevent his beginning at all. On the other hand, on the *non-returnable* scale, he may begin with £1.

The alteration required is that the resolution which prohibits any deferred annuity from being granted, in the first instance, under £4, be cancelled, and that any one be allowed to commence with purchasing a £1 deferred annuity on the returnable scale, as he can at present do on the non-returnable.

EXTENSION OF POST-OFFICE MONEY ORDERS TO INDIA.

The following letter has been received in reply to the memorial addressed by the Council to the Secretary of State for India:—

India Office, S.W., March 27th, 1872.

Sir,—I am directed by the Secretary of State for India in Council to acknowledge the receipt of your letter of the 20th instant, and to acquaint you in reply that a copy of the memorial therewith forwarded, praying for an extension of the Post-Office Money Order

System to India has been transmitted for the consideration of the Government of India, and on the receipt of a reply from that Government, a further communication will be made to you. I am, sir,

Your obedient servant,
Herman Merivale.

P. Le N. Foster, Esq., M.A.

CAB IMPROVEMENT.

The Council, in accordance with the recommendation contained in the Report of the Committee, given below, offer the prizes for Improved Cabs as therein proposed. The Council reserve to themselves the power of withholding the prizes, or any of them, in the event of the Judges reporting that the cabs sent in competition are not deserving of any reward.

Report of Committee.

I. Your Committee, appointed to consider and report what premiums can be offered for the improvement of London cabs, have agreed to the following report:—

II. Your Committee consider that the cabs now in use in London are especially defective in the following particulars:—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.
2. The seats in the four-wheelers are too high, and not commodiously made.
3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.
4. The arrangements for opening and closing the window in the Hansom.
5. The confined space and want of ventilation in the Hansom when the windows are closed.
6. Imperfect locking of the wheels in four-wheelers.

III. Your Committee have been in communication with several cab proprietors and others connected with the cab business, and it appears to your Committee that unless a prize be offered of a magnitude sufficient to cover the cost of producing an improved cab, it is not probable that a satisfactory response will be obtained.

IV. Your Committee therefore recommend that the Society offer, subject to the conditions below—

One prize of £60 for the best improved cab of any description.
Two prizes of £20 each for the next two best.
Two prizes of £10 each for the next two best.

V. That the competing cabs be exhibited in the International Exhibition of 1873, and that, on their delivery at the Exhibition building, they be certified to the satisfaction of the judges as having been in regular use in the streets of London for three months previously.

VI. Your Committee further recommend that the judges to adjudicate on the carriages sent in be instructed to seek the advice and assistance of a certain number of experts connected with the business, such as builders, proprietors, and drivers.

VII. Your Committee desire to point out for the consideration of those likely to compete, that in continental towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

VIII. A suggestion for a cab to be used either closed or open has been brought before the Committee, and a model submitted. The principle might be adapted to existing four-wheelers, but the Committee do not prescribe this model or any special form of carriage; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

By order of the Committee
P. Le Neve Foster, *Secretary.*

EXAMINATIONS, 1872.

The days fixed for the Final Examinations this year are April 16th, 17th, 18th, and 19th. The necessary forms for making the return of intending candidates have been issued to those Institutions which have already applied for them. Any Institutions having candidates for these examinations, and which have not yet applied for forms, should communicate with the Secretary of the Society of Arts immediately. Programmes of examinations can be had gratis on application.

ALBERT MEDAL

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

The Council invite members of the Society to forward to the Secretary, on or before the 29th of April, the names of such men of high distinction as they may think worthy of this honour.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscription paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society. Season ticket holders will be invited to a reception that will be held by his Royal Highness the Duke of Edinburgh and Her Majesty's Commissioners on April 27th. The Albert Hall, the Conservatory of the Royal Horticultural Society, and the Picture Galleries of the Exhibition, will be thrown open, and military bands will play. (See notice on page 449.)

MOSCOW POLYTECHNIC EXHIBITION, 1872.

The Committee of the above Exhibition are desirous of forming, for reference in Moscow, a collection of catalogues or price lists of makers of machines and tools of all kinds, and of mathematical instruments. Parties willing to assist are requested to send at once to the Secretaries of the London Committee for the Moscow Exhibition, now sitting at the Society of Arts, Adelphi, London, two copies of each such catalogue or list (illustrated preferred), and the same will be forwarded to Moscow, free of expense.

Members of the Society are requested to give publicity to this notice, as it is very desirable to render the collection as complete as possible.

BARRY'S ETCHINGS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, are about to have a limited number of sets of the 29 plates etched by the late James Barry, printed. The impressions will be taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, will be £10 10s.

THE LIBRARY.

The following books have been presented to the Library:—

Memoirs of the American Academy of Arts and Sciences, new series, vol. x., part 1. Presented by the Academy.

Discussion on "Experimental Stations," introduced by E. Packard, jun., F.C.S. Presented by the Framlingham Farmers' Club.

How to Make Money by Patents, or Hints and Suggestions to Inventors and Patentees. By Charles Barlow. Presented by the author.

The Year Book and Almanac of Canada for 1872.

On the Cleansing of Rivers. By C. E. Austin, Mem. Inst. C.E. Presented by the author.

Notes on Continental Schools. By John F. Moss. Presented by the author.

Sewage Utilization. By U. R. Burke. Presented by the author.

Revenue Resources of the Mughal Empire. By Ed. Thomas, F.R.S. Presented by the author.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 10th, 1872; Sir M. Digby Wyatt in the chair.

The following candidates were proposed for election as members of the Society:—

Chisman, Herbert C., 3, Adelaide-road North, St. John's-wood, N.W.
Denison, Christopher Beckett, M.P., 16, William-street, Lowndes-square, S.W.
Dewhurst, John Bonny, Skipton.
Forden, Robert, Mayor of Winchester.
Iles, Henry William, 1, Circus-place, Finsbury, E.C.
Lace, Francis John, Stone-gappe, Cross-hills, Leeds.
Lay, George William, A.K.C., 44, Poultry, E.C., and 24, Addington-square, Camberwell, S.E.
Marchant, Robert, Phœnix Mills, Dartford, Kent.
Pim, William Harvey, jun., Junior Carlton Club, S.W.
Pyne, Joseph John, Hope-house, Heald-grove, Manchester.

The following candidates were balloted for and duly elected members of the Society:—

Adye, Brigadier-General John M., R.A., C.B., Woolwich-common, S.E.
Clow, Henry, 182, Trongate, Glasgow.

Crawford, Capt., Frederic Augustus Buchanan, R.N., United Service Club, Pall-mall, S.W.
Highton, H., 2, the Cedars, Putney, S.W.
Holt, Nathaniel, J. W., 5, Cowper's-court, Cornhill, E.C.
Lane, J. W. Beaufoy, 17, Alexander-street, Westbourne-park, Bayswater, W.
Packard, Edward, jun., F.C.S., Grove-house, Bramford, Ipswich.
Peters, Leonard, 85, Bartholomew-road, Kentish-town, N.W.
Rigby, John, 7, Meal-street, Mosley-street, Manchester.
Seligman, Isaac, 3, Angel-court, Bank, E.C.
Simmons, B. D., 68, Upper Thames-street, E.C.
Sumner, Edmund, 14, Godliman-street, Doctors'-commons, E.C.
Taylor, R. Minton, Tile Works, Fenton, Stoke-on-Trent.
Wade, Charles, 79, Great Tower-street, E.C.
White, H. C , 88, Great Tower-street, E.C.
Will, J. Shiress, 3, Pump-court, Temple, E.C.

The paper read was :—

HINDRANCES TO THE PROGRESS OF APPLIED ART.

By Christopher Dresser, Ph.D., F.L.S., &c.

Before commencing our consideration of the subject which I have the honour of bringing before you this evening, I must ask you to call to mind a few facts, as these will enable us to see that all hindrances to the progress of applied art result in pecuniary loss to the nation. Notice, first, that England is essentially a manufacturing country ; second, that it exports its manufactures to every part of the world ; and, third, that the intrinsic value of the article produced is, in many cases, of less importance than the pattern which the article manufactured bears. Bad note paper in a handsome wrapper sells ; bad carpet, if it has a graceful pattern, sells ; bad jewellery of elegant design fills our shop windows, and secures to its producers large profits. Indeed, we everywhere meet with "shoddy" material, wrought into forms of beauty, selling as though it were of real worth. Art, then, has a commercial value !

I cannot too strongly urge upon your notice the fact that nearly every material may, by the agency of art, be rendered valuable, even if, as mere material, it be almost worthless. Clay is, of all substances capable of art treatment, perhaps the most common and the most valueless, yet in the hands of the artist it assumes forms which so exalt it as to render it both estimable and lovable, and of great commercial worth. One man forms it into bricks, another into works of art ; thus the same quantity of the same material becomes in the one case worth a fractional portion of a penny, while in the other it will sell for many pounds. That man is of greatest value to his country who draws to it the largest amount of wealth with the least expenditure of material.

I might say much more upon the commercial value of applied art, and show that many of our vast manufactures depend for their success upon the art which the articles produced bear upon them. Window curtains—whether of lace or damask, wall-papers, earthen vessels of all descriptions, silversmiths' work, jewellery, carpets, and many other forms of goods, depend for their sale largely upon the form into which they are wrought or the pattern with which they are endowed, and these goods constitute the major portion of our exports and our wealth.

Having called your attention to the fact that decorative, or applied art, has a commercial value, I can proceed to my subject, as you now perceive that whatever hinders the progress of applied art stands in the way of our commercial success and militates against national progress. The hindrances to art prosperity, to which I am about to call your attention, are not such as concern the artist only, but are impediments to our manufacturing interest, and concern others to the same degree at least as they do the artist. A faithful treatment of my subject, then, would involve the expression of no merely personal grievances, but the discovery and revelation of whatever hinders the progress of applied art in our country, and if so treated my subject would clearly be within the province of the Society of Arts to introduce, and of its members to consider ; but were I to express to you the hindrances impeding the progress of merely personal ideas, I should not be justified in standing before you in this institution.

In commencing my subject, let me say that while I shall express to you my feelings fearlessly, and with that boldness which a firm confidence in the truth of the opinions which I shall express induces, yet I know that, for lack of knowledge, I may err in my judgment, and that even my reasoning faculties may be misguided ; yet having devoted myself earnestly to the study of applied art for more than five-and-twenty years, I may at least claim to have thought upon the subject which I now introduce to your notice ; and if in this paper I am severe in my censures or harsh in my denunciations, believe me that all results from a sincere love of my art and an earnest desire to see removed whatever stands in the way of its progress.

One of the chief hindrances to the advancement of decorative art is to be found in designers themselves, for there are many pattern-drawers who are a disgrace to the profession, inasmuch as the works which they produce manifest only gross ignorance, and are, therefore, altogether unworthy of notice. Of these I will not speak, but I desire that they should understand that whatever is produced which is of debasing character tends to the extermination of decorative art, for who would not prefer a plain article to one covered with graceless forms and inharmonious colours.

Passing from these men, to whom the name of "artist" cannot be applied, to those designers who have a certain amount of art-ability, we notice that the works produced by these latter are often inconvenient to use while they are beautiful in form, and are thus of a character calculated to bring art into disrepute. An art object should be useful as well as beautiful, if it is intended to fulfil a utilitarian purpose, yet not one poker out of a hundred is so formed that it can be used with comfort, nor is one tea-pot out of fifty so made that it will admit of the tea being poured from it without an expenditure of force greater than is necessary in order to the support of the weight which has to be lifted. By leverage a pound may balance a hundredweight, as in the steel-yard ; so in the case of a tea-pot, by leverage that which weighs four pounds may be as heavy to lift as that which weighs eight. Although the law which regulates the placing of handle and spout on all vessels from which liquids are poured is thoroughly understood, yet it does not appear to be known to one designer in a hundred, judging from the vessels which we see offered for sale in our shops. In like manner, pokers have become so inconvenient to use that it is impossible to break coal or even poke the fire with one without hurting the hand ; hence ladies have begun to regard fire-irons as mere ornaments, and to keep a little second poker and tongs for *use*, which latter are hidden in some corner, as objects unfit to be seen. There is nothing which tends to retard the progress of applied art more than the production by designers of objects which are inconvenient to use ; and be assured that the most perfect beauty may be combined with the most complete utility ; in other words, that which is most beautiful may be perfectly useful. How is it, I ask, that designers will not inform themselves upon subjects which, to them, are all important, and without a knowledge of which they cannot produce acceptable works ? I am often amazed at the ignorance of my fellow ornamentists upon subjects which they ought perfectly to understand ; and yet many of these men can draw well, and combine forms in a truly artistic manner, but their works, through not being adapted to answer the end of their creation, only tend to bring the beautiful into disrepute, by leading persons to suppose that if a work is graceful and lovable it cannot be used with comfort.

Our worst enemies are those of our own household; so, in like manner, the worst enemies to the progress of applied art are ignorant designers. If we, as designers, will but educate ourselves, we shall thereby remove one of the chief hindrances that impedes the progress of applied art.

It is a strange thing that to this hour the great majority of the designers, or pattern-drawers, employed in our manufactories are men almost wholly without education, and chiefly from comparatively low life. The son of a weaver in a carpet-works or lace-factory, if he manifests any taste for drawing, is put in the designing-room and is trained to draw patterns, but as he is placed there at the age of from ten to twelve years, and is the son of parents who could not afford to have him educated beyond being taught to read and write, he has but little knowledge when he commences his art-training, and as, in the great majority of designing-rooms, he never sees a work on ornament, nor a good example of true art-work, he gains simply a technical knowledge of the manufacture, and acquires no insight into the character of true art. A man cannot help his origin, neither is he to be despised for being the child of poor parents; but if he remains in ignorance he cannot be expected to produce noble works, nor to exalt the manufacture which he strives to adorn with forms and colours. While a man is not to be blamed for being born of poor parents, he is open to censure if he does not strive to gain whatever knowledge is placed within his reach. Nearly every town in the kingdom has now its drawing-school, where a certain amount of art-knowledge may be gained, and connected with these schools there are frequently art-libraries. That youth who is worthy to be called an art-student will avail himself of whatever means are open to him, and even if he be employed for long hours in the factory, he will strive by reading, sketching, and, beyond all things, by thinking, and by the study of nature, to gain such knowledge as will lead him to draw patterns such as will please persons of education, by revealing to them the fact that he who addresses himself to them through the agency of form and colour is also a man of education.

If it is any consolation to you, my fellow-students of applied art, let me say that I, with you, have felt the want of education, and have known the poverty of small means, but by foregoing for a time the pleasures which others enjoyed, and by continued close application to the study of our beloved art, I gained the victory over that poverty, and that utter want of education under which I for a time suffered; and now I can say that I sit at the tables of rich men, and that men of learning honour my table with their presence. I would not for a moment say what I do were it not for the thought that these words may encourage some poor student to work on till he rises through his poverty to that position in which he can present his works fairly before our notice, and charm us with his knowledge.

Certain manufacturers may truly be regarded as hindrances to art progress. Some men are honourable, others are dishonourable; some men are noble, others are ignoble; some men are pioneers of progress, others retard all onward movements. It is curious that there are many men who would not rob another of a farthing, and yet who eagerly look for every new pattern which more honourable manufacturers than themselves produce, with the view of copying them if they be good and are not protected by registration, or of producing others as nearly like them as they can if they be registered. Such men I regard as not only hindrances to the progress of art (for who likes paying a high price for a well-considered design if immediately it is issued others copy the idea, if not the actual design, and by saving the cost of the pattern are enabled to undersell the original producer), but as nothing more nor less than thieves, who should be engaged on the tread-wheel with others of their kind. This detestable piracy of new patterns, which is constantly carried on by those who are truly little men, is one of the great hindrances to art progress. Did it ever strike these detestable rogues, I wonder, that by every piracy they commit they not only degrade themselves but exalt both the manufacturer and the designer of the pattern which is stolen; the very theft acknowledges the want of power to produce what is of equal merit. To those noble men who continue to produce what is new and what is beautiful, while they constantly suffer from theft, I would say persevere, for the tribute which the mean pay to your nobleness and enterprise is sufficient in itself to build up in time your worthy reputation.

Much has been said respecting the unwillingness of manufacturers to issue designs of an art character, and to pay such prices for patterns as will fairly compensate the designer for producing a carefully considered work. I have had as much to do with manufacturers, I think, as most artists, and perhaps more, and I am bound to say that I have found most of them both willing to try new things and to pay handsomely for well-considered designs, but as the object of business is, in a sense, money making, the manufacturer cannot be expected to produce many patterns such as will not sell when placed on the manufactured article. Some men I could name who nobly contribute towards the education of the people by yearly producing a few works in good art which do not command a large sale, owing to their being too advanced for the public taste, but these men are few in number, yet they do exist amongst us. However, with the exception of a few mean hounds, such as we find in every class of society, I exonerate manufacturers from the charge of being hindrances to the progress of a true decorative art.

But I cannot regard those whom I may describe as *middle men* as free from blame, for no class of persons in our country so thoroughly obstruct the progress of applied art as these middle men, such as the "buyers," as they are called, in our large retail houses. For the most part these are men utterly ignorant of even the first principles of art, and yet they are as proud and self-opinionated as they well can be. If you talk to them of a pattern being good, or just, or right, you are often met with the remark, "Do I not know what sells?" haughtily expressed. My candid opinion is that these men very imperfectly know what the public wants, and that they in many cases fail to let the people have what they really desire, through standing between them and the manufacturer. Scarcely a week passes in which I am not asked, "Where can I get good artistic things?" and scarcely a week goes by without my applying direct to a manufacturer for art works, or fabrics, of some kind; but I do give these middle men credit for being good salesmen. If they like a thing they buy it, and they sell it, however bad it may be; and if they don't like a thing they won't sell it, however good it is. The salesman introduces a pattern to a customer, and says, "this is just in. Within the last week I have looked through the patterns of the best manufacturers in England, and this was the best pattern that I anywhere found" (perhaps it really was the worst, but his want of taste led him to regard it as the best). This, if said to a weak-minded lady of title, secures its sale, and then, when the future customers are told the same tale, and, also, that Lady Weakmind purchased it, its sale is certain. It is only a few days since that I was told by one of these middle men, as he spread before me the most miserable carpet I ever saw, that Lady So-and-so had purchased it. I looked at it, and then felt constrained to remark that her ladyship's art knowledge gave her no more claim to her title than "the claimant's" education gave him to the Tichborne baronetcy. What we should do in order to check the baneful influence of these ignorant middle men, I do not know. Some few of our art manufacturers have opened retail shops, in order that they may come in immediate contact with the people! Where would our great works in silver, and gold, and jewellery have een, if our leading manufacturers had not shown their works direct to the public? If middle men had stood between the manufacturer and the public in these cases, the chief works would never have been produced, for the first made would still be left in the manufacturers' hands.

There are a few of these middle men whom I know to be exceptions to the rule, and who have some art taste; hence we find in a few shop windows a certain proportion of things of good pattern. We must look to their conversion to the cause of art by their getting art knowledge in some way, and by the pressure which the public may put upon them on the one side, and the enterprising manufacturer on the other; thus they shall no longer remain as hindrances to the progress of decorative art.

The public, in some instances, impedes the progress of art. The public is of two classes—the educated and the uneducated. The educated, in many instances, seeks better art than is to be found on the goods procurable at most of our shops; but the utterly ignorant, having no art knowledge, are pleased with whatever is "loud" and showy. These latter undoubtedly hinder the progress of art, as some manufacturers will cater for the patronage of the most vulgar, but this hindrance will disappear with the increase of art knowledge.

Whatever is bad in art tends to vitiate taste. If a person whose taste is highly cultivated, and who is sensitive to every deformity both in colour and form, is obliged to contemplate what is ugly, he, after a time, ceases to feel the hideousness of what he views; thus, if he takes lodgings by the seaside, and the walls of the room in which he sits are covered by a hideous paper, and the floor by an obtrusive carpet, and if every piece of furniture is uncomely, and every so-called ornament in the room a mere offence to good taste, however repulsive all this may be when first seen, it will become less and less offensive as he dwells upon it, until finally it ceases to impress the sense as that which is uncomely at all; and in order that its true nature be understood the judgment has to be appealed to; thus the sense which leads us to discriminate between the beautiful and the uncomely becomes deadened. This leads us to perceive the necessity for surrounding ourselves with beautiful objects if we would keep alive within us a quick perception of the beautiful; and to see that whatever is presented before us which is beautiful tends to exalt our taste, and sharpen our perception of the beautiful. But we also perceive that whatever around us is not excellent tends to degrade our taste and to deaden our perception of the refined and graceful. This brings me to consider the effect which museum objects have upon the taste of the country.

The museum the action of which upon public taste I have chiefly to consider is that of South Kensington, for the objects collected in the British Museum are gathered together chiefly on account of their antiquarian interest. The Indian Museum at Whitehall is small, and, I am sorry to say, is visited by the few only; and the Kew Museum is of a botanical character. On the two former of these museums—the British and the Indian—I may have a word to say incidentally; but as the South Kensington Museum is intended to furnish art-instruction to the people, we must especially look to its teachings, and consider their effect on the large mass of people who visit it.

This I must say, that of all the museums that I have visited, and they are many, that of South Kensington contains the largest number of well-decorated objects, and of worthy examples of applied art, fitted to lead public taste in a right direction; and, almost without exception, these objects are well displayed and carefully preserved; but there are also examples of indifferent art in this museum, which it is not desirable that we take as examples, and the museum is not free from illustrations of even bad art, for such, I am sorry to say, are numerous. I take it as granted by all, whether friends or enemies of the museum system, that the collections of which I speak embrace much that is good, that they afford many examples of excellent applied art, and that, taken as a whole, they are a credit and not a disgrace to us as a nation. But if I discern anything in them, or anything connected with them, that appears to me to retard the progress of applied art, it is my duty to point it out; and should all agree that the museum is not as useful as it might be, we should then be justified in asking that whatever is wrong be set right, or that whatever can be improved be altered for the better.

The South Kensington Museum is too fully an historical or antiquarian collection, yet in this respect it is far from complete. Egyptian art is well represented in the British Museum, but it is scarcely, if at all, illustrated in the Kensington collections; and the same may be said of Babelonian art; while the specimens of Greek and Roman manufactures illustrative of the applied art of these peoples are so meagre as to be unworthy of consideration, while they are numerous in the British Museum.

It is to be expected that such branches of art as are fully illustrated in the one collection should be sparingly illustrated in the other, and I cannot help feeling regret that the contents of each museum should not, as far as possible, be made subservient to the purposes of the other. If some of the fine art examples now in the British Museum could be transferred to the Kensington collection, and some of the merely antiquarian specimens of the Kensington Museum be transferred to the British Museum, I cannot but think that both would thereby be benefited.

I say that the South Kensington Musum is too antiquarian in its character. It must ever be borne in mind that, however interesting things may be, owing to their age, it does not follow that because a thing is old it is necessarily beautiful; and yet many—yea, very many—are so enamoured with what is old, that however ugly it may be, or inconvenient to use, they prefer it to that which is new and good. Such blind worship of the old can only totally retard the growth of a true art-judgment in all who indulge in it. A clumsy and ugly utensil, even if formed of the roughest material, and wrought in the rudest manner, may yet be an object of great interest if it illustrates a manufacture in its infancy, or even reveals certain customs connected with the domestic life of the people that produced it; but this is the interest which an antiquarian would attach to it; the artist, however, would feel no interest in this vessel; it is not a thing to be copied, nor even to be studied as suggestive of what we should do. We must be careful to discriminate between what is merely old, and what is beautiful as well as old.

Mr. Redgrave, in his report on design, says, "The ornament of past ages is the tradition of the ornamentist, and tradition ever hands down to us things good and bad, both equally consecrated to most minds by the authority of time. But a moment's reflection will show how necessary it is to discriminate before receiving anything on such authority. A church or temple built in a rude age remains undisturbed by some happy chance. . . . . The ornamental details found therein are copied and illustrated by the notes of antiquarians, or published in the proceedings of learned societies, and are at once regarded as authorities for imitation, it being forgotten that they were, perhaps, the works of obscure provincial artists, or of a barbarous age perchance, or of a people with whom art, no longer studied for its principles, had ceased to progress, or had rapidly declined."

If all who visit the South Kensengton Museum would first read Redgrave's report on design, as prepared for the Commissioners of the 1851 Exhibition, from which I have just made an extract, there would be little danger of their confounding the good with the bad in art. Redgrave's report is an excellent work, but, unfortunately, the people who visit the museum do not first read this book, hence it appears to me necessary that some other means of instructing them be resorted to. I say that the museum contains many examples of really bad art, such as if regarded as examples to be copied must hinder the progress of ornamentation. As illustrations, I may name the two large pulpits in the inner open court near the fernery; one by Giovanni Pisano, and the other by Nicola Pisano; both from Pisa. In the first the weight of the platform on which the priest stands rests, to a great extent, on the backs of three naturalistically treated figures, who are bent, almost to deformity, by the weight of the superposed mass, and appear as though they must be in great pain; three such figures and three columns bear the entire weight of the upper portion of the pulpit. In the case of the other pulpit, every second column (three out of six) rests on the centre of the back of a lion, which, like the figures just spoken of, are naturally rendered. The wooden-looking lions bearing the fountain in the Alhambra Court, which we are familiar with at the Crystal Palace at Sydenham, do not appear to be susceptible of pain; hence a weight may rest upon them without our feeling troubled. But even with such wooden-looking lions as these, a column standing on the back would appear to have a weak and insecure foundation; but in the case of the pulpit both the lions and the figures are in every way offensive as supports, and can only serve as illustrations of the worst form of art.

I have given two illustrations of bad art from the South Kensington collections, but I might give many, for scores of works there preserved illustrate what should be carefully avoided in all decorated objects; but setting aside the debased character of some of the old examples, which we may regard as of antiquarian interest, we cannot help noticing that a large proportion of the comparatively recent purchases of modern works are bad, and embrace just such as Mr. Redgrave, in common with all true artists, condemn. This is the more strange as the prizes offered to the students of the government schools of art, throughout the country, are offered on the condition that the works sent in competition be in accordance with the principles enunciated in Mr. Redgrave's report, and Mr. Redgrave is named in all the papers issued from South Kensington as the art superintendent of the museum and schools. Hear what Mr. Redgrave says:—"The Renaissance itself arose mainly from the study of Roman remains, and those often of the worst period of the empire, when Greek science, skill, and pure taste had fallen before Roman magnificence and barbarism, and before modern discoveries had opened up the Athenian treasures of Greek art. It was introduced, however, by men of enlarged minds, most of them great constructive architects, and by them it was constructively adapted; they embodied in it many of the first principles of the ancient styles; and if the stream of tradition had brought down much rubbish as well as treasure, still, the master minds of the fifteenth century gradually separated them, and applied with unrivalled skill and a fertile fancy what was beautiful and good. It was, however, essentially pagan in its details, and its ornament conveyed no symbolic truths to the hearts of men."

This is Mr. Redgrave's description of the Renaissance, and I ask you to notice it, for the South Kensington Museum contains much more numerous illustrations of Renaissance art than of any other. My opinion of the Renaissance is not so favourable, even, as that of Mr. Redgrave, for I fail to see in its best works more than a recast of the Roman spirit, with which I have no sympathy; its forms utter no sentiment—they are cold and dead. The best forms produced in the time of the Renaissance are graceless when compared with Greek ornaments, and poor in both colour and form when contrasted with the rich Eastern styles, or our own Gothic.

But Mr. Redgrave goes on to say, "In the hands of less skilful masters, it soon became decoration without a pervading spirit, ornament merely used as ornament, without propriety as without meaning; and thus, as the Tudor style, it succeeded in this country to the Gothic, that style dying out partly from the causes above stated and partly from the change of feeling consequent on the reformed opinions which then prevailed. This debased form of the Renaissance, in its decoration, had already cast off all constructive truth and consistency; much that was bad in the late style was retained and mixed with it; whatever was good was as certainly forgotten. Columns were reversed, the heavy and broad part being upwards, the small part below; they swelled alternately into enormous bands, and were contracted into severing rings, and sometimes they stood upon balls to give a further sense of insecurity. Terminal figures were introduced which had the weight of their entablatures borne on baskets of imitative fruits or flowers. The covering pediments were broken, contrary to all constructive application, or were placed successively one within another; entablatures were enlarged out of all proportion to the supporting columns; and the useful was superseded by the ornamental."

Let me make a few other extracts from the same source, and then let us consider the recent works added to the Museum. "Design," says Redgrave, "has reference to the construction of any work both for use and beauty, and therefore includes its ornamentation also. Ornament is merely the decoration of a thing constructed. Ornament is thus necessarily limited, for, so defined, it cannot be other than secondary, and must not usurp a principal place; if it do so, the object is no longer a work ornamented, but is degraded into a mere ornament. . . . . . When commencing a design, designers are too apt to think of ornament before construction, and, as has been said in connection with the nobler art of architecture, rather to construct ornament than to ornament construction. . . . The primary consideration of construction is so necessary to pure design that it almost always follows that, wherever style and ornament are debased, construction will be found to have been first disregarded; and that those styles which are considered the purest, and the best periods of those styles, are just those wherein constructive utility has been rightly understood and most thoroughly attended to."

In speaking of furniture, Mr. Redgrave says:—"It will without difficulty be conceded that, in every kind of furniture having a specific purpose, the first consideration of the designer should be *perfect adaptation to intended use*. . . . Another consideration to be attended to is stability of construction, *apparent* as well as *real*; the first being necessary to satisfy the eye, the last being indispensable to excellence and durability. . . . The constructive forms, moreover, should not be obscured by the ornament, but, rather, brought out by it. . . . Over enrichment, indeed, destroys itself, and it would not be difficult to point out works of the greatest pretension, and the most costly workmanship, which are completely spoilt by this fault." I might go on giving you quotations wherein Mr. Redgrave denounces the pediment broken in the manner of the Renaissance; the arch when used constructively in woodwork, floor coverings bearing a pattern pointing in one direction only, earthenware plates and dishes covered entirely with ornament, and wherein he extols the works of India, Arabia, and the east generally.

Yet how is it that all these principles are violated by the recent purchases of modern works, and by the very decorations themselves of the South Kensington Museum.

If we look at the cabinet of Fourdinois, which was purchased at the Paris Exhibition of 1867 for the large sum of £2,750, and apply to it the test of Mr. Redgrave's principles, which are undeniably correct, we find it wanting in every particular. Thus the structural lines are broken or concealed; the arch, which Mr. Redgrave justly terms a true method when employed in stone construction, but a false structural feature for works formed of wood, is a leading constructive element; the drawers and cupboards are disguised; mouldings are divided; and instead of construction being ornamented, ornament has been constructed, for decorative children in low relief pass from the panels of the spandrils over mouldings till they in part cover the styles of the panels, and yet this work cost the nation nearly £3,000. If this cabinet be compared with the simple, yet beautifully constructed, sideboard, which now stands near it, designed by Mr. B. J. Tallert, and executed by Messrs. Gillow and Co., of Oxford-street (which could, undoubtedly, be purchased for a fourth of the money), the justness of the latter will be at once apparent; but, unfortunately, this good work is not purchased for the museum, but is only on loan there.

It is strange, indeed, that so many works which have been added to the museum during the last few years, if not the majority of such works, should be of a character at variance with the written opinions of the Art Superintendent, and that all the decorations of the building, save the Oriental courts by Mr. Owen Jones, are of a character contrary to his expressed views of art.

It is strange, also, that nearly all the objects purchased for the museum, save the few Eastern things derived from the International Exhibition of 1851, are in the Renaissance style of art, while Mr. Redgrave justly prefers Eastern works to these—the beautiful Chinese and Japanese objects now exhibited being chiefly on loan; but what is the cause of this, we ask? and this question we have a right to ask if we consider that the inconsistency which we observe between the preaching and the practice of the South Kensington Museum is a hindrance to the progress of applied art, and I certainly do think that it is.

The answer will be found in the fact that those of the authorities of the South Kensington Museum that have art knowledge have knowledge of pictorial art only, and the Renaissance has the greatest amount of the pictorial element, while it has least of those true structural qualities which have always accompanied good design, as Mr. Redgrave justly says, and of pure ornamental principles.

The cabinet by Fourdenois while badly designed, and structurally false, bears upon it some beautifully carved figure groups, and these, embracing as they do the pictorial spirit, would naturally be chosen by a pictorial artist; and if we examine the purchases for the museum generally we find that they are such as have parts which pictorial artists admire, while but few can be regarded as examples of a true style of decorative art.

I consider that while there are many objects in the South Kensington Museum which are of great interest as worthy examples of a true applied art, the whole teaching of the museum is not as beneficial as it might be, and that some of the objects therein stored are hindrances to the progress of a true form of ornamentation. How can these hindrances be removed? This is a question with which we are much concerned. It appears to me that the first step was taken in the right direction when a collection of articles of bad taste was formed at Marlborough-house at the time when the museum was first instituted, which collection was arranged in a vestibule that become known as the "room of horrors." It will be remembered that to each article here exhibited a label was attached, stating why the article was in bad taste. This "room of horrors" did more, in my judgment, to advance taste in this country than any institution that we have yet established, and I am pleased to see a revival of the same idea, although it is on a very small scale, at the Kensington Museum, where a case may be seen in the entrance-hall containing some of the very things that were exhibited in the old room of horrors. I sincerely hope that this idea will have extensive illustration, for the public should see what is bad as well as what is good; and especially should they be told why each article is bad, and why, or in what respect, it is good.

I submit to you the suggestion that it is desirable that every article in the South Kensington Museum should be furnished with a label stating why it is there; whether it is a thing of mere antiquarian interest; whether it is altogether a successful work; or whether some of its features only are to be commended while others are to be avoided. If this were carefully done by competent architects and ornamentists the museum would at once cease to be in any way a hindrance to the progress of applied and decorative art.

But more still might be done. In connection with the interesting food collection at the South Kensington Museum, Drs. Lyon Playfair and Edwin Lankester prepared enlarged labels, setting forth general physiological principles, smaller labels relating to special groups of substances, and individual labels having reference to particular specimens, and the result is, that from visiting this collection you may gain a fair amount of physiological knowledge. Why, I ask, could not the same thing be done with the art collection? For as things now are, you might visit the museum for years without gaining much knowledge of applied art. I should suggest that large labels be prepared, explanatory of the general principles of utilitarian or applied art, such as might be condensed from Mr. Redgrave's report, and that a secondary label be prepared, treating of each group of things generally. Thus, one might relate to Persian art, another to Indian art, another to that of the Renaissance period, and so on; while each individual object should be furnished with a label which should point out both its excellencies and defects. And even short explanatory remarks might, at stated times, be offered by competent persons on the objects most worthy of being regarded as fit examples for us to follow; but the opinions given must not be those of men merely learned in literature and antiquarian lore, or even those of pictorial artists only, but the views of educated practical architects and ornamentists.

I come, in the last place, to notice the effect of the South Kensington Museum School teaching upon the public, for here, it appears to me, we experience such a want of efficiency, or rather completeness, in some departments, that if these schools are not in some respects an actual hindrance to the advancement of applied art, they fail to do much that they might accomplish.

These schools were originally commenced as Schools of Design, and their purpose then was that of aiding our commerce by producing designers such as could draw good patterns, and thus give increased value to our manufactures, while only the same expenditure of material was involved; but since then they have become mere drawing schools, as it was found that art works were not appreciated by an ignorant public. I submit for your consideration that the time has now arrived when schools of design should be re-established such as shall concern themselves with the furnishing of advanced or high-class education in all that pertains to the production of true works of art fitted for application to our industrial manufactures.

Designing, it will be said, is taught both in the South Kensington Museum Schools in London and in its various branch schools throughout the country. But how is it taught, and by whom? Without an exception, the masters at the South Kensington schools are more pictorial artists than ornamentists, and, without any discredit to them, I say that there is not one amongst them who even professes to have a thorough knowledge of ornamental art; and how can a man have great knowledge of two branches of art so utterly opposed to each other in spirit as are ornamental and pictorial art; for the one in its highest forms, as I pointed out to you last year, is in part at least imitative, while the other is wholly creative.

The South Kensington masters, being pictorial artists, naturally infuse the ideas of a pictorial artist into the minds of the pupils, and the result is, if the student acquires a reasonable power of painting, he strives to become a pictorial artist, and often passes to the Royal Academy of Arts with that view. As there is no one in connection with the schools who, being devoted to applied art, and having knowledge of ornament, infuses into the students of the schools a feeling of its nobleness and greatness, it is but natural that these schools should rather hinder than foster the development of true ornamentists such as the vast manufacturing interests of this country require. There is scarcely a week in which I do not visit some of our large manufactories where art is applied to the fabrics, or works, made, and although I have intimate intercourse with the designers employed at most of these works, I yet rarely meet with such as have been students at the South Kensington, or branch schools, and if I do I am frequently informed that these men are the least useful designers that they have; and I could name repeated instances in which students from the schools have been tried in the designing-rooms of factories, and found of so little value that their services have been dispensed with. There are, of course, honourable exceptions to this rule; but I fear the rule is what I have portrayed.

I blame no one for this state of things; I offer no censures; but I do say that the time has come when this state of things should be altered, and when every facility should be offered to our young people for becoming great ornamentists, and to our manufacturers for endowing their goods with an ennobling art.

My suggestion is this. Let our drawing schools remain, and let all who will learn to draw there be taught. Let these schools furnish the Royal Academy with pupils, if any of their students desire to become pictorial artists, but institute a Royal Academy of decorative or applied art, wherein the highest knowledge of design in all its branches, as required by our various manufactures, be fully given. Let ornament be treated as a fine art, and as that which is ennobling and refining in its influence upon those who view it, if it is truthfully rendered; and let all technical knowledge necessary to the understanding of the application of pattern to fabrics, and various wares, be given, and let such instruction in science be afforded as is necessary to the understanding of the processes by which ornament is applied to manufactured articles. One great want of our designers is general knowledge. As a class, they are as ignorant upon science, and even upon the history of art, as they well can be; indeed, their hands are informed while the intellect remains uncultivated. The very knowledge necessary to the understanding of technical art processes would lead to thought, and thought would lead to knowledge, so in two ways would the student be gaining an advantage through this technical education.

This institution should have the power of conferring degrees equal with the membership and associateship of the Royal Academy, for without encouragement no art will prosper. It was only the other day that one of our best known sculptors said, "We do the work, but it often happens that the man who unveils the statue gets the honour." It is thus; and it is equally true that through law, which settles men's quarrels, through the cruel art of war, and through statesmanship, men can rise to the peerage, but to the ornamentist, however great or learned he may be, no title nor post of honourable distinction is open; but if we institute a Royal Academy of decorative art which has the power of conferring degrees in applied art, as our universities do in science and literature, a stimulus will even thereby be given to applied art which, in my opinion, would soon place us at the head of the world as manufacturers of art objects and art fabrics. To this Royal Academy of applied arts the drawing school should also contribute pupils. If, combined with this academy, we could have an art-workman's institution, in which the mechanic could learn to use the metal-chaser's tool in a truly artistic manner, and the china painter his metallic oxides in the manner of an artist (Messrs. Minton and Co. have now a class in connection with the South Kensington Museum schools for this purpose), and where the wood carver could pick up the true spirit of his art, and, indeed, where knowledge of all art-handicrafts could be gained, we should then have removed from us the chief hindrances to the progress of applied art and impediments in the way of our manufacturing prosperity.

Upon the occasion of the reading of this paper, Dr. Dresser exhibited a number of valuable oriental art objects and a series of manufactured articles of his own designing.

DISCUSSION.

Mr. Edward Hall, F.S.A., said the main points to which attention should be directed were those referred to in the first part of the paper, namely, the importance of attending to the utility of the object which was the subject of decorative design. He was sorry to say, however, that this had been too much disregarded. The use of the object was very frequently entirely neglected, and the first aim of the designer had been to produce an effect which he conceived was ornamental, but which was not always so. Some time ago he visited the establishment of a silversmith, and took objection to a particular design, as not being according to correct principles of art; but he was told that that article was painted by the duchess of so-and-so, as a very beautiful work. Dr. Dresser had referred to this particular hindrance, viz., the undue deference paid to titled persons, without taste or knowledge, to the progress of art, and he entirely agreed with him in his remarks. There was nothing so scarce as a well-designed handle. Every handle should be, as had been said, "responsive to the grasp," but one was scarcely ever found, either to a tea-pot, poker, or anything else, which at all answered that description, but which was rather calculated to hurt the hand. Anything which did not fulfil its use was bad art, and the prevalence of such articles was one of the hindrances to the establishment of good art. Furniture should not be too elaborately carved, but should only be ornamented so much as would enable it to be readily cleaned without injury. He knew there was considerable difficulty with regard to the treatment of colour, and probably there was no department of the field of designers so difficult; but manufacturers had been in the habit of taking a very wrong course in regard to the production of carpets and calico prints; for, having produced a good design in a certain combination of colours, they attempted to exhibit the same design in every colour they could think of, under the idea that, having a great variety of combinations, some would hit the taste of the buyer. Dr. Dresser had not said so much as might have been said as to the surroundings in the open air as well as in museums. He considered the prevalence of smoke was a serious hindrance to the appreciation of art, and that we should never have good architecture until durable art was to be seen in buildings which could be seen without the obscuring medium which prevailed almost constantly in London. The press in London was another cause of the slow progress of art in public estimation; and he considered the manner in which the press was conducted with reference to art matters was very much to its disgrace. The art department of the press was under the care of some one who had had no training in art matters. The same hand which was employed to report upon the drama and to "do" the musical criticism was also employed upon the criticism of buildings and other art matters. This was an erroneous system, and he did not believe the sound progress would ever be made in this country which ought to be made until, somehow or other, that mistaken system was brought to an end.

Mr. Christian Mast said the object of the lecturer appeared to be to raise the taste for ornamental art by working downwards, and by establishing a sort of academy; but, in order that this effort should be really effective in raising the country to a higher level, they should work as much from the bottom upwards as from the top downwards, and schools ought to be the foundation of the matter. But here a great difficulty existed, that there were so few teachers who were able to instruct the public taste, and this arose in a great measure from its being forgotten that ornamental art stood in close connection with mathematics and geometry. The connection between these two branches of education was very rarely pointed out, and unless masters could be found to grasp this idea, they would always work to a great extent in vain. Ornamental art must rest on mathematics, and he would say that in Germany most art teaching was really founded upon mathematics, and boys in German schools were taught drawing at the same time as they were geometry.

Mr. George Wallis said he would not refer to what had been said as to the South Kensington Museum, as far as regarded the description of the objects contained there, because, being an official of that institution, the attempt to excuse would be to accuse. As to whether those objects might be made more educationally valuable to the public, he would say a few words. Dr. Dresser had made a remark that it would be very valuable if, by the side of certain specimens, a description were given why the object was considered good, or why it was considered bad or defective, why it should be studied, or why avoided. He thought there was labelling enough in the museum already, and if they did as was suggested the student would complain that they gave him more table-cloth than dinner. Still, the question of a catalogue, in which this kind of criticism might be placed before the art student, and carried home by him to study, was fairly open to consideration, and indeed such catalogues might be said to be more or less in the course of preparation. From some cause or other the art student had an invincible dislike to read a description or history of what he was studying. He had found it so himself; and so convinced was he of the importance of the student reading the descriptions before he began to draw, that when he got up an elementary drawing-book for the benefit of students, in 1854-55, he not only put a description on the copies with a definition of what was to be done, but also put upon it, "Read this before beginning to draw." From his experience as keeper of the Museum at South Kensington, he knew not one in ten read the labels; and they said they could not afford time to do so. With regard to the Chamber of Horrors, he had always denounced it. It was not right to put ugly objects before the public to show them what was ugly, and it was as absurd to attempt to teach good art by putting bad art before the public, as it would be to teach spelling in the same way. With regard to any good that might arise from the foundation of any institution or academy for the encouragement of applied or decorative art, he had very great doubt about it: for, if such an institution were established, it would be sure to get into the hands of a clique or party. He had said for years that use was the first point to be looked to to study how the object was to be constructed, and how it was to be afterwards decorated, so that the ornamentation should not interfere with the use. The next thing to study was the character of the material of which it should be made, so that objects might be made in such forms as should not easily be broken. Lastly should be considered, how far the means by which the object was to be manufactured could be applied to the design in hand. These three criteria afforded a ready means of testing any object, and ascertaining whether or not it was what it professed to be. One of the great complaints of architects some time ago was that carvers attempted to carve, and designs were made for them to carve, decorations in stone which really were only adapted for wood, and *vice versa*. The old designers were very careful on this point, taking care to adapt their designs to the material in which they were to be constructed. The same thing was true with regard to iron-work. Designs well-adapted for wrought-iron would not be adapted to cast-iron, but it was not at all an uncommon thing to find objects in cast-iron, originally intended for stone or wood, which a little consideration showed were totally improper for such treatment. That which was perfectly adapted for wrought-iron when executed in cast-iron presented points which were easily broken off, and therefore the design was radically bad. There was no doubt that the one great obstacle was that to which Dr. Dresser had alluded—viz., the character of the buyers, or middlemen, who stood between the manufacturer and the consumer. In too many instances these gentlemen really knew nothing whatever about art. They should therefore endeavour to impress upon tradesmen and buyers the necessity of looking well to this question of art; and those who had distinct ideas on this subject should take care to incessantly enforce them upon this class of persons whenever they had an opportunity. Their sole object was to sell a thing, whether it was good, bad, or indifferent; and if they only came in contact with people who could not answer them, when showing them any particular design that was wrong in principle, they would still go on selling. Whenever they were told that a thing was ugly, or radically wrong in design, and the reason was given for it, they would be convinced, and each one who took the trouble to exert his influence in this way might do a great deal of good, and extend the knowledge and practice of art. During the last thirty years considerable progress had been made in this respect, though it was another question whether all had been done which might have been done. But looking back to 1837, when he first visited the Staffordshire potteries, and remembering the wilderness of ugliness which then met his view, and contrasting that with the present productions of those same potteries, he could not but feel that at all events the little he had been able to do as an art teacher and writer, and in connection with South Kensington, had not been entirely thrown away, and he had reason to congratulate himself on having seen some little reward for the labour he had bestowed.

Mr. Yarley desired to bear testimony to the great value of Dr. Dresser's paper, and also called attention to the great hypocrisy which was often manifested in architecture, houses intended for one purpose being built to look like something else, and the rules of proportion being too often neglected. There were many things in the South Kensington Museum which he was glad to pass by, as being not worthy of notice or attention. Bad taste was very commonly shown in china and crockery ware very unnecessarily, for it was as cheap to print beauty as ugliness, and rational patterns as absurdities.

Mr. Locke said he had been engaged for thirty years in artistic designing, but he did not know that he could throw much light on the question. He must, however, congratulate the authorities connected with the South Kensington Museum, also, to some extent, those of the British Museum, on the great services they had rendered in educating the public mind upon art matters. His own view was that the great end to be aimed at was the education, not so much of the artist, as of the public for if that were attained that of the artist must necessarily follow. On this account he considered that the opposition which had been raised to the situation of the South Kensington Museum was misplaced, inasmuch as it was placed where it was best fitted to educate the taste of the upper classes, who were the principal patrons of art. At the same time, such institutions should be multiplied, so that the public generally, as well as the upper classes, might have an opportunity of studying fine examples of art, without having to make such great sacrifices of time as the majority of people had to do at present in visiting South Kensington. He had no doubt that such papers as they had heard that evening would be of great benefit; and it was very important that children in art schools should know, as they had been told, that, no matter how humble their present position, by perseverance and conscientious study they might attain to a good position and eminence. He quite agreed with the remarks about middlemen, for most buyers for wholesale houses were utterly destitute of any knowledge of art whatever.

The Chairman, while desiring to give to Dr. Dresser the highest credit for his valuable paper, said he must break a lance with him on the point of pictorial and imitative art, on which he seemed entirely to turn his back. He acknowledged most heartily the wisdom and logic of the earlier part of the paper; indeed, the whole of it seemed to be correct, except the point to which he had alluded. The importance of this was illustrated in the case of France, which in certain classes of goods, such as bronzes, the best class of furniture, jewellery, &c., had the command of the market, and this arose from the fact that the workmen who produced those beautiful objects had been taught form and figure drawing, and to imitate all kinds of natural objects. The great complaint with regard to the ordinary English workman was, that if he had to produce anything beyond straight lines, or very simple scrolls, which got tiresome by repetition, he produced something which was repugnant to the eye. The fact was he could not draw the human figure, or animals, in fact he had never learnt to imitate the natural objects representations of which he wished to introduce into his design. He admitted that objects of a negative character might be perfectly pleasing; for instance, one of the vases before him was perfectly agreeable, both in form and colour, but it was strictly negative—there was no design in it. Many examples of Indian work were very beautiful, both in form and colour, but there was no imitation in them, and therefore there was nothing on which the eye delighted to dwell; and if such a pattern had to be produced in relief, it would be impossible to do so unless the workman had spent some years in imitating natural objects and in learning how to conventionalise them so as to fit them for decorative purposes. The basis of his education must be to a great extent to give him the power of imitating the objects which he had to make the leading feature in his design. Schools of all kinds, art or otherwise, were intended for the period of youth, and the time requisite to train a young man in the imitative branch of his art, precluded of necessity in great measure his study of its principles. But the two should be concurrent; imitative art should not be repudiated, only kept within just bounds. With regard to labels in museums, as a general principle the more completely specimens were labelled the better and the more instructive, but labelling them dogmatically was very different to labelling them historically. To make any dogmatic assertion at all about an article in a museum was especially dangerous, for all authorities had a natural tendency to dogmatise, and the more this was checked, and the articles left with a full historical description to tell their own tale, the better. With regard to articles purchased for South Kensington they were of a very mixed nature, and various reasons might be assigned for different purchases. The very same outlay that bought the Fourdinois cabinet purchased another collection, consisting of a quantity of beautiful Arabian work, which contained the most valuable information for the designer. He had nothing whatever to do with the purchase of the cabinet, but those who recommended it wished to show a specimen of the perfection to which French cabinet-making had been brought. At that time marquetrie was very little practised in England, but since then it had been considerably adopted. The method of forming marquetrie, partly on a flat and partly on a curved surface, was then quite a novelty, and M. Fourdinois was led to it, partly by a study of old French work, and partly by seeing some old Spanish wood-work. The process was then revived for the first time, and that alone constituted the cabinet in question a fair historical sample of the revival of a most interesting process in connection with cabinet-making. Purchases were constantly made with regard to which it could not be said that the specimens as a whole were held up as models for imitation; but there might be certain parts of them of great merit, or they might show the perfection to which certain processes had been carried in former times. Success in certain technical directions was of the utmost consequence, and, to a great extent, the museums which had been most useful in foreign countries in instructing the workmen, were those in which elegance of design was the first consideration, and the illustration of the historical arts of the country the second. He was far from desiring to see an academy for applied design in one place, and one for imitative design in another. The proper thing would be to amalgamate the two, and make one great central institute, and then some good might be done. He should like to see more attention paid to applied art in the Royal Academy, and considered it a disgrace that Mr. Owen Jones was not an associate of it. With regard to schools, it must be remembered that the first essential was to teach a person to see with his eyes, and to work or imitate with his hands, to make those two organs so tractable that the student might, in the first place, so distinguish tints as to imitate colours accurately. Until he had learned the whole gamut of colour he could not produce a pattern or design, however clever he might be. The reason why, as Dr. Dresser had said, students from South Kensington were not found to be of much use in designing-rooms in manufactories was that, the student becoming learned, imitative art went where it was not required. A manufacturer might send for a student, thinking he would be a treasure, and find when he came that he could not design the branch of manufacture which he wanted, though no doubt he could do something else very well. In truth, he wanted that practical element in education which should really be the life's labour of every man. The common error with regard to education was to suppose that, having been taught up to the age of twenty, we are then to cease learning, and only practice what we know. Education was then in reality only beginning. When a student had been thoroughly taught form and colour, and was then set to master the practical requirements which he had to meet, he would become a much more valuable artist than one who had been simply dragged up, step by step, in the manufacturers' designing-room. Elementary knowledge and correct principles should be taught in schools, but the same results must not be expected from a youth as from a man with life-long experience. In conclusion, he desired to move a hearty vote of thanks to Dr. Dresser, who earnestly desired to do good, and if he (Sir Digby Wyatt) did not think every remedy he proposed was exactly adapted to the case, still he gave him credit for honestly and earnestly endeavouring to discover the hindrances to the progress of decorative art, and to apply a remedy, and those who endeavoured were always those who succeeded. Certainly Dr. Dresser did not belong to one class of those whom he said hindered the good cause, viz., the uneducated. He had spoken of two classes, the educated and the uneducated, but in his opinion there was a third class, which did more harm than either, namely, the half-educated, for they came before the world with a pretence to knowledge which they did not really possess, and thus the ignorant and those who relied on them were deceived and led astray.

The vote of thanks having been unanimously carried,

Dr. Dresser, in reply, said he was much obliged to the Chairman for his remarks, but he was sorry to say his opinion remained unaltered. The great advantage of these discussions was that everyone could express his opinion freely, and that whatever was said wrong might be corrected; and if all were sufficiently wise to test the opinions put forward by others, to adopt what was right and acknowledge what was wrong, all would be benefited. He had not arrived at the opinions he had enunciated without considerable thought. He must apologise to some kind friends, who had written to him suggesting topics upon which he might speak, for having apparently neglected them, but the fact was his paper was written before those letters reached him, and, having been out of town, he had had no opportunity of adding anything to it. He could not agree with the first speaker, who thought that the public could judge whether a design was good or bad. He did not consider anyone was able to give a competent judgment without considerable knowledge, and as he should not think of treating himself if he were ill, or conducting a law-suit on his own account, but should consult a physician or a lawyer, and trust to their better judgment, so he believed artists ought to demand of the public the same deference, having devoted their whole life-time to the study of a particular matter. It was not reasonable to suppose that the public at large should be able to discriminate between what was beautiful and what was not, so well as those who had studied the subject for years. With regard to press criticism, he quite agreed that it was very often simply absurd; but he was glad to say that Mr. Wallis had joined him in an effort to overcome that difficulty, for both of them had written a great deal for the press, and had contributed many scores of articles on art matters. He agreed with Mr. Mast that it was most important that science should be taught in schools, though he was not quite sure that the Germans did not sometimes get wrong in their mathematical proportions. With regard to the labels at South Kensington, he agreed with Mr. Wallis that there were sufficient labels, but not that they said all that they might say. Why did students dislike reading descriptions? Mr. Wallis said no one would read the remarks he made on his drawing copies, but what was the result? Not one in ten that he or anyone else had trained in art schools had ever become an artist at all, let alone a successful one. If a student would not read labels he would never become successful. Men did not become successful artists because they did not study art intelligently. He was sorry to say that very few art students obtained anything like popularity; and he believed that was greatly due to the fact that although they were taught to use their hands, their intellect was not trained. They never became intellectual men, and therefore they never rose to the position of successful ornamentists. As to the Chamber of Horrors, he contended they had a perfect right to warn the public against danger; ugly things would be produced, and they ought to be held out as warnings at an institution like the Museum. He believed amongst the old Greeks there was a tribunal to which all manufactured articles had to be submitted, and if a thing was so utterly bad in itself that it would degrade the public taste, it was condemned, and not allowed to be manufactured. It was not reasonable that any manufacturer should be allowed to cater for the most ignorant and depraved taste and produce whatever abortions he thought fit. All things of this sort ought to be checked in the same way as debasing literature. If, however, articles were not very bad, he should not put them in the room of horrors at first, but should give the manufacturer due notice that, if he continued producing the like, they would be placed there; and after this system had been continued for some time he should then place them there the instant they appeared. How were students to know what was good and what was bad in a museum, unless there was a label explaining them. Sir Digby Wyatt said there ought to be nothing like dogmatic teaching, with which he perfectly agreed. He held views contrary to those of Sir Digby on some points, and Mr. Owen Jones also held contrary views on other points. But if there were three or four opinions by competent persons about the same article, they might all be affixed, giving the authorities, and then the public might decide between them. But without some guide of this sort the public had no means of judging of art subjects at all. For instance, in the Fourdinois Cabinet the arch was used as a structural feature in wood whilst it was only legitimate in stone, the object of an arch being to enable a large space to be spanned with a number of small pieces of stone. In wood work, however, the use of an arch weakened the wood essentially, because it had to be cut across the grain. Still not one in ten thousand of the public would understand that. With regard to the buyers, or middlemen, he must say they had had a hard time of it that evening, but as he never liked to strike a man behind his back he had requested the secretary to send an invitation to the buyers of all the large houses of London, and if any were present he hoped they would be benefited by what they had heard. If they felt they had been in error he was quite sure they were sufficient men of business to alter this state of things. South Kensington had done very much for the advancement of art, though not so much as he believed it might have done. Sir Digby Wyatt thought he turned his back on pictorial art, but this was not so; on the contrary, only last year he had been the means of a considerable number of valuable pictures being purchased, and within the last month a picture which he believed would form a striking feature at the Royal Academy had been purchased by a friend on his recommendation. He did not, however, believe in pictorial art usurping the place of decorative art, or *vice versa*. The Chairman had alluded to one of the specimens of Indian work before him, and had remarked that the design could not be executed in relief by a man who had not studied figure drawing.

The Chairman—No; by one who had not regularly studied the imitation of natural forms.

Dr. Dresser said he could not quite agree with that, because it so happened that he had another specimen of similar work, carved in relief by an Indian, who certainly never had studied natural forms. He always advocated art students studying nature, and had been engaged himself for seven years almost exclusively in drawing plants, so that he was not likely to undervalue natural beauty. What he objected to was pictorial usurping the place of purely decorative art. The question of one or two academies was of very little moment; and if, as the Chairman suggested, the two schools could be united in one building, he should be very glad. Indeed, if the Royal Academy would appoint Mr. Owen Jones their professor of applied art, the difficulty would be, to a great extent, met.

CHANNEL PASSAGE.

The committee met on Monday, March 11, at three o'clock. Present Lord Henry G. Lennox, M.P., in the chair, Mr. F. A. Abel, F.R.S., Mr. E. Chadwick, C.B., Major-General Eardley Wilmot, F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. E. J. Reed, C.B., Admiral A. P. Ryder, Captain Scott, R.N., and Mr. Seymour Teulon.

The following letters from Admiral Schomberg, Harbour Master at Holyhead, and Capt. Dent, Superintendent of Packet-boats there, were read:—

Holyhead, March 4th, 1872.

Dear Sir,—I beg to acknowledge the receipt of your letter of the 2nd March, enclosing a circular. I much regret I have not seen the boats that run the traffic to France from Folkestone, nor have I been in the French ports alluded to. But I should think a vessel something resembling those that work the London and North-Western Railway traffic would be suitable, say, 250 feet long; paddle-wheels in a draught of ten feet, a good beam, flat floor, sharp ends (covered in), steered from the bridge amidships, a deck saloon aft, as long as possible, with good sleeping accommodation underneath—a ladies' cabin at the fore-end of after-cabin. I should think sofas better than bed-places for such a short passage. If two decks, there should be a separate ventilation for each compartment, by deck sky-lights shafted up and by tubing. I have described this minutely to Admiral Ommanney, from a plan I adopted in emigrant ships, which was most successful:—

(a.) Steadiness. Not easily achieved; but the boats above described are not unsafe; and, as I know Captain Dent has described them, it is needless to repeat it.

(b.) Ventilation by sky-lights, side-lights, and air-tubes, pierced behind with bell-mouth, head to wind, and air-pipe aft.

(c.) Covered decks quite necessary.

(d.) Bed-places.—Prefer sofas for such a short voyage.

(e.) Luggage.—This depends on the spot selected for embarking and disembarking. A movable crane might be applied if the train comes near the vessel.

In Holyhead it would not suit, and luggage is carried by hand.

I will now briefly describe our mail boats:—350 feet long; 30 feet beam; 14 feet draught; 750 horse-power (nominal); paddle-wheels; covered in forward; a bridge (very large). They are steered from it. The after-hatchways are also covered in, and some small deck-cabins are included; they are open (*i.e.*, no covered deck) aft. The main cabin is aft; very lofty. Sofas round the stern; side cabin around it; large sliding table; stewards' berths; lavatories, water-closets, &c., at the extreme end. A (gentleman's) hatchway (ascend); bulkhead (ladies') hatchway. A ladies' cabin right athwart the ship; very lofty and elegant. Some sleeping berths separated off; sofas around the cabin. Some small deck cabins above. The fore end is covered in; the crew are in the bows below. Then come the mail-rooms, two in number, large; a bulkhead; three gentlemen's sleeping berths; water-closets, lavatories, &c. The engines amidships; they consume very rough coal, but they drive the ship in gales of wind; and, take the ships for all in all, I have never seen finer ships. I enclose you a card of their averages for last year (the eleventh year). I have no experience of a compound engine. I see no objection to making the ship double-ended for turning, should the limited space require it. We wind here round the end of jetty with ropes, using the engines as well. If I came to London, I could explain in minutes what it takes hours to write.

I beg to remain, yours faithfully,

Charles F. Schomberg.

P. Le Neve Foster, Esq.

London and North Western Railway,
Steam Boat Department, Holyhead,
Superintendent's Office,
March 2nd, 1872.

Sir,—In reply to your letter of the 27th ult., I fear I shall not be able to be in London during the ensuing week, and therefore will endeavour to put in writing my views on the questions put to me therein, and shall be very glad if my experience while in charge of this company's sea service may prove useful to the committee. I have crossed between Dover and Calais, Ostend and Dover, and Newhaven and Dieppe, but have not made the passage between Folkestone and Boulogne. In taking passage by these and other lines, I have naturally taken as much notice as circumstances would admit, of the manner of conducting the services with the view of improving the line of steamers under my charge; and of course, in so doing, have formed my own opinion as to the possibility of improvement in those I was travelling by. The conclusion I have come to with respect especially to the service between Dover and Calais is that, under existing circumstances, a far superior class of vessel could without difficulty be introduced on this line, on the same plan that I have found beneficial on the service between Holyhead and Dublin. The same difficulties to be overcome, viz., light draught of water and limited dimensions, appear to be common to both, and although these may be greater between Dover and Calais than on this line, it is to a certain extent counterbalanced by the necessity in our case of providing for a heavy goods and live stock traffic; whereas, on the Dover line, the passenger traffic has alone to be considered. To illustrate my meaning and belief, I will compare the *Maid of Kent*, in which vessel I lately crossed, with the *Duchess of Sutherland*, one of the new steamers built under my supervision, and now running on this line:—

	Length.	Breadth.	Depth.	H.P.
Maid of Kent	146·5	24·6	11·4	160
Duchess of Sutherland ..	256·	30·	16·	270

The *Duchess* conveyed a battalion of the Guards (726 in number) between Dublin and Holyhead, with their marching baggage, all protected from the weather, in a heavy gale of wind, during which no other steamer, except the mail boat, put to sea; her draught of water on this occasion was 9 ft. 4 in. aft, and 8 ft. 11 in. forward I noticed that the *Maid of Kent*, in Calais harbour, drew, when light, over 8 ft. 6 in.; it appears to me, therefore, that a vessel of our type, even if the dimensions had to be reduced, could easily be constructed so as to afford very superior accommodation, as the interior can be fitted up according to circumstances, and does not affect the hull of the vessel. The harbour of Calais does not admit of vessels beyond a certain length being swung therein, but if the elbow that I noticed there, and which appeared to me to admit of a vessel much over 200 feet swinging, is not available, owing to being occasionally crowded with fishing boats, there would be no difficulty in making the vessel double-ended, so as to do away with the necessity of swinging at all. I am not aware of the limit of beam necessary to enable the vessels to enter the docks at Dover, or the difficulties in the way of widening them if desirable. In dealing categorically with the questions put me, I may observe that, with respect to 1, *a*, *b*, *c*, *d*, it will be gathered from my foregoing remarks that I do not think the present vessels, as typified in the *Maid of Kent*, could be altered advantageously to suit the requirements of the service according to my ideas, being altogether too small, and in my experience it is the truest economy to build a vessel to suit the service rather than alter any existing type. With respect to the cabin accommodation, I have found nothing is so difficult as to please the general public. What is regarded by some as a great improvement is denounced by others as a mistake, because it departs from what they have been accustomed to. In the new boats now being built under my supervision, I am making the sleeping berths much wider, than the ordinary allowance, whereas in the saloon I am compelled to keep to the ordinary two feet, as, if wider, they are uncomfortable seats when used as sofas. The ventilation is provided for by mean of skylights, ports, common cowl ventilators, and Shiel's patent fan, which, in connection with trunks placed all along the cabins, admits either the foul air being carried away or fresh air forced down at will. No. 2, *a* and *b*, are, I think, answered in my foregoing observations. *c.* I have lately introduced boxes, in which the luggage is packed and hoisted in and out by means of the steam cranes, and, being on wheels, are capable of being run along a wharf, and on board the vessel these, according to the requirements of our service, are loaded from the vans in shipping and unloaded into them in unshipping, but arrangements might easily be made, where the train goes close alongside the steamer, to make them fit into the luggage vans and be removed direct, and *vice versa*.

3. Answered in my foregoing remarks.

4. I have no doubt Messrs. Leslie and Co. will gladly afford you any information if applied to.

5. I went carefully into the question of compound engines with the makers, themselves great advocates of the principle, and we came to the conclusion that for our service it would not be advisable; the advantages, viz., economy of space and coal, not being counterbalanced by the extra expense in first cost, and more careful supervision required. I fancy this would equally apply to the Dover service.

In submitting the foregoing I regret that, having much to occupy me at the present moment, I have been obliged to reply hastily to the queries addressed to me. I shall, however, be happy to attend personally before the committee when I am in London, to give any further explanation they may desire, also to show them the drawings of our boats in my possession if they wish it.

Your obedient servant,
Charles C. Dent.

P.S.—I find that although I have alluded to our type of steamer I have omitted to state what it is. They are paddle vessels with a lower deck, main deck (part of which aft is taken up by the lower or sleeping saloon, and forward by the fore-cabin, seamen, and firemen) and upper deck, the after part of which for about 60 feet is formed into a saloon by carrying the bulwarks up. The top forms a promenade deck. The bridge is also formed into a promenade deck, by being carried to the outside of the paddle-boxes, its fore and aft length being about 60 feet. The captain's cabin and steering wheel, are on this deck, and the fore-deck is covered in by a hurricane-deck reaching aft to the hatchway. As cattle-carrying is not a desideratum between Dover and Calais, I should be inclined to dispense with the 3rd deck, which ought to enable a further reduction in the draught of water. Our boats average from 12 to 13 knots all the year round, under all circumstances, and are excellent sea-boats, no weather stopping them. C. C. D.

Mr. John White, of Cowes, attended and gave evidence as follows:—He said he had not crossed the Channel for the last ten years, and was, therefore, not much acquainted with the present accommodation and fittings on board the boats between Dover and Calais.

Mr. Teulon asked Mr. White to look at a plan showing the details of the present boats with the fittings.

Mr. White said it would take some time to examine the plans minutely, and come to any conclusion upon them, but in his opinion there was greater difficulty in fitting the cabin than in building the ship. Some time ago he had built two steamers for the West India Royal Mail Company, the drawings for which originally provided for vessels 27 feet deep, but previously to their being built they were raised upon, and a spar deck put upon them, and from this alteration it was supposed there would be great difficulty in obtaining ventilation to the lower cabins. They had, therefore, to resort to artificial ventilation.

Mr. Reed said the Holyhead boats, which Admiral Schomberg advocated, had hurricane decks.

Mr. White, in reply to Lord Clarence Paget, said he had built small steamers for the Guernsey and Jersey line which were fitted with one set of cabins under the deck. There was no ventilation to the cabins beyond the hatchways, sky-lights, and companions, with a port or two at the side. That was all the ventilation considered necessary in former days.

Admiral Ryder—Do you think it quite impossible to get artificial ventilation as good as natural ventilation?—I should think not. The saloon boats appear to be the right thing, if you can only get the cabin roof 4 feet or 5 feet above the deck, so that you can have ventilation all along the side. That is the present arrangement of the boats running between Southampton and Cowes. They are about 150 feet long.

Lord Clarence Paget said the great complaint with these boats was that the wind caught them, and there was a difficulty in turning them. Would it not be possible to make a sort of compromise between the deck cabins and the old plan, and to sink the midship part so as to keep it down much lower than the regular saloon deck would be?

Mr. White—That is the plan on which the boats I referred to were built. You go down about 4 feet to the cabin, and the roof rises 3 feet or 4 feet above the deck, allowing for ventilation around the sides. They do not complain of their catching the wind. The top of the deck is about 18 inches above the bulwarks, the cabins are about 7 feet high, and you go down two or three steps, so that they do not rise much above the deck.

Mr. Teulon—Are you aware of any mode of fitting up your cabin which would neutralise the effect of motion in a vessel?

Mr. White—I remember when I was a boy that the Duke of Norfolk had the whole of his cabin floor made to swing like a swing table. I do not know what the result was, except that great caution was necessary in order to avoid jamming your toes as the yacht rolled.

Admiral Ryder—Is a saloon (in a vessel the size we are talking of) consistent with having a covered deck over it, so as to keep the passengers dry?—I think so.

Captain Scott said there was no way of getting good ventilation except by throwing up the central portion of the deck, and cutting port-holes in the raised sides of the structure within the bulwark, and therefore clear of the wash of the sea.

Admiral Ryder—Have you had any experience of artificial ventilation in vessels?—I remember in building revenue cutters, about thirty-five years ago, they introduced an air pump into some of them, made by Maudslay, to pump the foul air out from between the skins, and of course the fresh air would then rush down. It was a little air pump, of about 15 inches in diameter. It was on the deck, and was worked every morning; it was supposed to prevent dry rot in the timbers.

Mr. Reed said there was a fan applied, not long ago, in one of the small sloops in the navy, for a similar purpose, and the furnaces were worked from this fan alone, and the result was, that the vessel went only about a knot less than she went without; showing that you could get a very large body of air through an artificial ventilator. Again, only a few weeks ago, he had been over the *Glatton*, which was in a very excellent condition with regard to ventilation, but it was almost entirely artificial.

Admiral Ryder said it was the same in the *Hotspur* when he visited her. They went right down to the lower decks, and found the air came through holes all round the timbers. Artificial ventilation was not by any means to be despised.

Mr. Reed said that, recently, Mr. Silber, of Wood-street, Cheapside, had shown him a ventilator which allowed a considerable amount of escape of air without the possibility of water passing through; he said it was impossible to get water down it, even by throwing pails of water over it, but yet it allowed the air to pass only.

Mr. Teulon said that was a most important point. He remembered, on one occasion, coming from Scotland to a port on the Lancashire coast, where the cabin was ventilated by a fan, there being perforated zinc in the different parts under the deck, just round the sides of the cabin under the beam, forming a tube, through which the air was carried away by the action of the fan. It seemed to work very well.

Admiral Ryder thought the French plan of ventilation was the best, sucking the foul air downwards, and carrying it off, so as to allow the fresh air to enter above.

Mr. Edwin Chadwick said he believed that was the principle on which the French had succeeded in ventilating vessels for the carriage of horses.

Admiral Ryder said he was a juror on ventilation at the Paris Exhibition, and he found that M. Hamlincourt was the great authority on this question there. He had to ventilate the Louvre, and many other large buildings in Paris, and he did it all upon this system, exhausting the bad air downwards.

Captain Scott said a steam-vessel was most admirably adapted for such a system, inasmuch as the foul air could be drawn at once into the fire-place.

Mr. Teulon asked Mr. White if he knew of any method by which the interior of the cabin could be fitted up in a superior manner to that at present in use; if he knew of any method by which the sofas could be kept in equilibrium? At a previous meeting of the Committee, it was said that the sick bays in men-of-war were so fitted up that the patient lying in his berth remained almost in a state of rest, and it occured to the committee that if that principle could be applied to sofas in steam-vessels, it would add greatly to the comfort of passengers.

Mr. White said perhaps the principle of a swing-table might be applied, but he had had no past experience in the matter.

Mr. Henry Bessemer then explained to the Committee his idea for preventing sea-sickness by keeping the cabin in equilibrium. He showed a model of a circular saloon cabin, so constructed as to preserve its level by the force of gravity. He added—This is not the principle I am really trying to work out, but it is only illustrative of the first idea I entertained with regard to the steadiness of a ship's cabin. In this form of apparatus there is this, a disadvantage, viz., if the passengers walk from side to side in a body, their weight would at once produce a tipping motion, and if nine or ten people were to perpetually walk backwards or forwards they would get up a considerable amount of oscillation; but I shall have a model ready in a few weeks time, twenty feet long and twenty feet beam, by which I hope to show practically how this may be kept under control by hydraulic force. I propose now to make a much flatter top to the saloon, and make an upper deck upon it, because, if the lower platform remains horizontal, of course the upper deck will remain in the same position, and therefore, instead of being confined, as usual, to the paddle-boxes, there will be a large area on the top for a promenade. There is another risk in trusting simply to the force of gravity, that, if the ship should make tolerably regular pulsations, they might accord with the length of the pendulum, and thus set up a pendulous motion, which would be very inconvenient, even if the motion so set up were not so great as that resulting from the motion of the vessel itself. As a means of keeping the floor horizontal, I propose to suspend the cabin on axes in both directions, but in other cases allowing play in only one direction. For instance, if we have a ship of 300 or 400 feet long, and occupy the central part of it with the cabin, the amount of pitch would not be great; and if we descend to that point in the ship about which it really oscillates, the motion there is almost *nil*, as far as pitch is concerned, although there might be a great roll. Therefore, I propose to make the cabin on two axes in the direction of its length, allowing the floor of the cabin to partake of the motion of the central part of the vessel, at the same time entirely preventing the roll, which will simplify the matter to a great extent. We then have the cabin on axes in one direction only. And I may now illustrate, by the application of hydraulic power to other purposes, how I propose to keep the cabin steady. I refer to my converting apparatus for making steel. We have there a vessel containing about five tons of fluid metal which has occupied a vertical position, but has to assume a horizontal position in order to pour out the metal. The vessel holds about five tons. It is suspended on axes, and at a certain point the fluid distributes itself all along the vessel in such a way that a very slight motion will cause it to flow out. The surface of the fluid is about 10 feet in length and five feet in width, and when it comes nearly to the level of the opening a dip of one-eight of an inch, or a mean of one-sixteenth over the whole area, would be equal to about 5 lbs. per foot, or 200lbs. over the whole surface. If, therefore, the mouth of the vessel is altered one-eighth of an inch, 200 lbs. of the fluid will run out by that alteration of the level, and this can be effected with the greatest ease by a boy or man at a distance of 60 feet from the vessel, having handles before him communicating with the hydraulic apparatus. So accurately can he regulate it that not only can he pour out 200 cwt., but he can even pour out 20 lbs., or whatever quantity he likes, and stop it immediately, so that, practically, the elevation or depression of one of these converting vessels of the weight of 16 tons, can be effected with the greatest ease to less than the sixteenth of an inch, by a boy at some 60 feet distance. I propose to apply the same principle to keeping the floor of the ships' cabin level. Of course, if the level of a fluid can be kept to so great a nicety, a solid floor acted upon by the same mechanical force can be controlled in like manner. I therefore propose to have a man attending to an apparatus of this kind, which raises or lowers any point required by means of an equilibrium valve. It works with the greatest possible nicety. This equilibrium valve is made so absolutely in equilibrium that it works with the greatest possible ease, and a power of five or six pounds' weight exerted at the handle would administer a power of some 30 or 40 tons if necessary to the floor of the chamber. Therefore, if from any cause the passengers all walked to one side of the vessel, and thus threw a weight of 10 or 12 tons on that side, the effect would be simply to throw no more work on the handle, but it would be entirely controllable by means of this apparatus. The man would have a spirit level in front of him, or rather three levels. One an absolute level, another bent at a very minute angle, and the third bent at a larger angle. He will watch the bubble in level No. 1, and his object would be to see that that does not move to either end, and he would vary the handle as he saw necessary. If it moves more than No. 1 level will indicate, then No. 2 comes in; and if he should be a little more careless, and the equilibrium is still more disturbed, then level No. 3 shows him how to set it right. In this way he can judge not only whether it is absolutely level or not, but that it varies by certain increments by these two other guages. His whole duty will be simply to stand on the still floor and move the handle as the vessel rolls or pitches this way or that. Mr. Bessemer then went on to explain, by the aid of diagrams, the construction of the valves by which the hydraulic pressure was proposed to be applied, and which prevented any play in the apparatus.

Lord Clarence Paget asked if this plan would affect both the rolling and the pitching?

Mr. Bessemer said he could do so if necessary, but it would be simpler to control the rolling only. In that case the cabin might be 150 feet in length, and the only tendency that such a suspended cabin would have to move with the ship would be the friction of the axes on which it rested. And all that the man would have to do would be to administer a power so great that the friction of the axes did not allow it to be carried with it, and also to provide against the motion caused by the passengers moving about.

Admiral Ryder asked what would be the result supposing anything happened, such as a pipe bursting.

Mr. Bessemer—It might be fixed anywhere by a stop or break, and then it would at once partake of the ordinary motion of a ship, and would cease to have any advantage for that voyage.

Admiral Ryder said one of the most disagreeable effects was not the pitching, but the sensation of the vessel falling from beneath you.

Mr. Bessemer said he believed it had been observed by Mr. Reed that although the end of a ship went up and down very much, and a person in that position felt as if his body was falling away from his stomach, yet if you went down to the centre of the vessel, to the point on which it oscillated, there was none of that motion. It was very much like a see-saw, there was a deal of motion at each end of the plank, but little or none at the fulcrum. He hoped, in the course of a few weeks, to have the model he had spoken of so far completed that half-a-dozen passengers might try the effect. The cabin floor is 16 feet by 10 feet, and he hoped to keep the level within one or two inches of horizontal play throughout. That he could ascertain exactly, as he had constructed a very simple little instrument for ascertaining the amount of roll of vessels, which consists simply of a spirit level in a curve divided into degrees. This being fastened to the deck, as the ship rolled the little bubble would always keep the highest point in the curve, and show the angle of depression.

Admiral Ryder said he had tried that plan at sea the other day and found it did not quite answer, as the fluid swam backwards and forwards in the tube, and the bubble did not always keep its place. The French had gone into this subject very closely, and they had satisfied themselves that there was no constant axis of motion in a ship, but that, as she moved about, the axis was constantly shifting, so that there was no fixed point at which the level could be placed.

Mr. Bessemer said he agreed that it was impossible to ascertain the roll quite accurately; he had seen a pendulum tried for this purpose, but it did not answer, for the pendulum might get a swinging motion of its own. A great deal of the difficulty in the case of spirit levels might be got over by having a very small bubble of air. Of course, if there were a small quantity of spirit in the gauge and a large air-bubble, the fluid would wash backwards and forwards, but if you took a two-inch tube and filled it with spirit, only leaving room for a globule of air, $\frac{1}{8}$ or $\frac{1}{4}$ of an inch in diameter, practically there was no room for the spirit to move in.

Captain Scott said he had gone into this question minutely; if the tube were nearly filled it would not go from end to end, but with a large tube with a large space of air, there was no doubt it would wash backwards and forwards.

Lord Clarence Paget asked if the hydraulic apparatus could be worked as quickly as the waves acted on a small vessel?

Mr. Bessemer—I have observed the sleight of hand that men acquire in various mechanical arts where they have a certain thing to do and that only; and it is really marvellous how, in three or four weeks, a man will do with ease what would have been pronounced an utter impossibility. Take, for example, the forging of steel; a man will take a bar of steel, which has to be forged into an octagon shape, and he will pass it under a heavy hammer, striking about 300 blows a minute, and will turn it exactly $\frac{1}{8}$ of a revolution at each stroke, and the whole of the bar is forged with the greatest exactitude, though he has to alter the angle every 300th part of a minute. The action of a steam-hammer is very similar, a man may either crack a nut or smash a large piece of iron, although in that case he has an elastic fluid to deal with, and has to calculate with a much greater nicety when he has to let it on and off, than in the case of hydraulic apparatus where there is no elasticity.

Admiral Ryder said the same thing was illustrated by a man balancing a pole on his chin with a boy on the top of it.

Mr. Bessemer said he did not think there would be any difficulty as far as the dexterity of management was concerned, but at the same time he thought eventually a self-acting apparatus might be devised. He had already devised one, but would not speak of it with any confidence until he had made further experiments. His simple opinion was that it could be done, and if he did not succeed in doing it, he had no doubt some one else would. If the system were established that hydraulic power was to be used for keeping a cabin-floor horizontal in a pitching or rolling vessel, there was no doubt that that would soon be made self-acting either by himself or some other inventor.

Lord Clarence Paget said it would act itself if it were hung on pivots. He understood the hydraulic power was only to regulate it.

Mr. Bessemer said he intended to get rid of the weight altogether, because, if you depended upon that, there was always the possibility of oscillation being produced like any other pendulum; he intended, therefore, to depend entirely upon hydraulic power.

Lord Clarence Paget said, in that case, if the man left the valve for a moment, the cabin would follow the motion of the vessel.

Mr. Bessemer said that was the case, therefore he should propose to have two sets of valves and two men, in order to avoid any chance of neglect.

Lord Clarence Paget—Have you contemplated how many degrees a vessel will roll? Sometimes she would roll 15 or 20 degrees, would the apparatus work up to that extreme?—I should allow for a greater amount of rolling than could possibly be anticipated, in order to avoid any danger of a sudden jar.

Mr. E. Chadwick—Would not this principle that you have described on a large scale, be applicable on a small scale to sofas or couches when suspended on jimbals, especially if the suspension were effected by means of an elastic substance?—I see no difficulty in applying the hydraulic principle to sofas or to any similar fixtures about the vessel as well as to the cabin. I have not turned my attention to that part of the subject; but at present I see no difficulty in accomplishing it.

Admiral Ryder—As I understand, Mr. Bessemer would undertake to have one hundred sofas all kept level by one man.

Mr. Bessemer said he thought that could be done, though he had not directed his attention to it. It must, however, be understood that all sofas or couches whose axes are far removed from the centres about which the vessel pitches or rolls, will partake of the upward and downward motion due to their relative distance from such centres, notwithstanding that each such sofa may be made to preserve a horizontal position, and hence such suspended sofas can, under any circumstances, add but very little to the chances of avoiding sea-sickness. He added that, when the model he was engaged upon was completed, which would be in the course of four or five weeks, he should be happy to show it to any of the Committee.

Mr. Teulon asked Mr. White if he would kindly furnish the Committee with any information as to the fittings of vessels, which, it appeared to the Committee must remain of a draught not greater than 7ft. 6in. until the harbours on the French coast were increased in depth. One of the points mentioned to the Committee was with regard to the deficiency of water-closet accommodation. In the event of sea-sickness, it was a great desideratum to get rid of it as soon as possible.

Mr. White said it is well known that water-closets were a great nuisance everywhere, especially on board yachts and other vessels. It had been usual to have closets which forced the soil under the water, but they were constantly getting out of order, and always took a week or two in repairing. If possible the water-closets should be placed above the water-level, so as to work in the ordinary way.

Admiral Ryder asked Mr. White whether, for very short passages, such as from Dover to Calais, it might not be well to introduce earth-closets, and thus, while preventing bad smells, avoid all necessity for "forcing the soil under the water," as described by Mr. White, a troublesome and difficult process almost impossible for ladies, and which passengers unaccustomed to ships do not understand; their ignorance and inexperience frequently making the closets quite unusable a few minutes after leaving harbour.

Mr. White saw no difficulty in the application of earth-closets for these short passages. Mr. White then showed the committee a rough sketch of the boats plying between Southampton and Cowes, showing the manner in which the roof of the cabin came above the deck; there was a promenade on the top; and in answer to Lord Clarence Paget he said it was not found to interfere with the stowage of the boats, as they could be swung on davits high enough to allow of the passengers walking underneath.

Lord Clarence Paget asked if this construction would not reduce the number of passengers?

Mr. White said he thought not, as there was one tier of cabins under the deck; it was thought that the saloon-decked vessels would not answer between Southamton and Cowes, on account of the rolling motion, which was much the same there as between Dover and Calais, but it was found in practice that they answered every expectation.

Lord Clarence Paget asked where the beams went across to strengthen the vessel?

Mr. White said they went under the saloon deck floor; there were only one set of beams.

Mr. Teulon asked how the cabins would be ventilated?

Mr. White said there might be a tube coming down the centre, divided in half, so as to make a down-cast and an up-cast, and if this were made of glass it would also give light. At the same time he did not think an air-pump was at all a bad thing. There was a deal of carbonic acid gas about the cabin of a vessel which required a great deal of kicking out.

Captain Scott said the same kind of thing had recently been applied to houses, as he had been recently informed by builders. A pipe ran up near the fire-place with an opening near the top of the room, down which the heat and foul air came, the draught of the fire drawing it downwards. He understood this worked admirably. The same kind of thing might be carried out under the floor of a cabin, and thus the whole of the foul air might be drawn off.

Mr. E. Chadwick said that Captain Douglas Galton's ventilating chimney acted very much in the same way, and changed the air in a room with great regularity.

Admiral Ryder said there was a plan now coming into use a good deal in schools, by which the fresh-air chamber was placed behind the fire-place, so that the air was warm before entering the room.

Mr. Teulon—The new buildings of the London Orphan Asylum at Watford are so ventilated.

A lady, the daughter of a distinguished statesman deceased, sends the following:—

There is one branch of the arrangements for transit between England and this Continent that urgently demands—and, at the same time, readily admits of—improvement—the conveyance of baggage.

At present every single package is wheeled on a barrow down the railway platform, and packed in a waggon for conveyance to the coast. On arrival there, each one is separately taken out of the waggon, conveyed to the steamer, and either lowered into the hold or piled on deck, the converse operation being performed on disembarkation on the opposite coast previous to continuing the journey.

The results are:—

1. Great loss of time. I have myself been detained at Folkestone above an hour whilst the baggage of an unusually large party of travellers was thus landed and repacked in the railway waggons.

2. Great damage to the luggage. Every traveller can testify to the covers torn, straps pulled off, light cases crushed, heavy boxes dinted and otherwise injured, by the hasty removals, the articles being often actually thrown down, without the least consideration as to the consequences to them and on those upon which they may fall.

3. Unnecessary confusion and delay in reclaiming the baggage. A traveller (or a party) may see all his property safely deposited in one pile on starting, but before arrival the chances are that the several "pieces" (to borrow a French term) are scattered far and wide. I have myself known our four boxes come out of three different waggons—one quite in front of the train, the two others near the end of it. Every one can perceive the amount of extra labour, vexation, and loss of time that must result from such disorder.

All these evils might be diminished to a very great degree by a simple and immediately practicable change of management. On some of the railway platforms (perhaps on the Continent) I have seen some large crates—on small, low wheels—used for the removal of baggage from one part of the platform to another. There could be no difficulty in so constructing them and the railway waggons that the crates should be wheeled into the waggons, out of them into the vessel, and again out of the vessel into railway waggons, with their contents undisturbed, so that they would reach their final destination exactly as first packed. Of course there must be separate crates for different destinations, as there now are, in some cases, separate waggons; and on stopping at the several stations nothing need be touched save what is addressed to that station. If necessary, a crate might be shared between three or four adjoining stations; or, where there was much for delivery at one station, the entire crate might be wheeled out and left behind, without waiting to unpack it. For the long journeys of registered baggage, as from London to Paris, or for Marseilles, or for Brussels, where there would be several crates required, it would be desirable to number them, and to issue luggage-tickets bearing corresponding numbers. Thus a party, having seen their boxes consigned to the crate, "Paris, 5," at the Victoria-station, would, on arrival at the Paris gare, look out for the same, and keep close to it till the proper official came to unpack it, receiving then all their property together, with only the fair wear and tear of the journey, instead of running about from one waggon to another, finding one bag here and another there, one scratched and another broken, with great risk of losing some of those first recovered before all the rest have been found.

There might, probably, be some still better mode devised; this is recommended merely as immediately practicable with very little alteration of the present steamers and railway rolling-stock.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The various committees appointed to select, from the large number of objects sent in in answer to the invitation of the Commissioners, for exhibition in the various classes of Fine Arts and Manufactures included in this year's exhibition, have now finished their labours, and it is a matter for congratulation by the general public, that the committees have been extremely rigid in their selection, and that consequently all articles exhibited will be of the very highest standard and class possible. So careful have they been that in one instance. out of sixteen hundred articles sent in, over a thousand have been rejected. From this may be gathered the fact that the object of the commissioners is not to cover their walls and fill their cases only, but that every article exhibited, whether in the department of Fine Arts, in the Industrial, or in that of the Scientific department will possess that merit, whether of art, or manufacture, or design, as shall be of value to the public, either as showing the progress that is being made in any particular branch of manufacture, or as illustrative of new ideas and new principles as developed in scientific instruments. It is also a guarantee that mediocrity will find no home in the exhibition buildings, but that the members of the committees, according to the light that is within them, will do their best in the interests of the public to submit only such articles for their consideration and study as shall possess sufficient merit to deserve that consideration and study. It is possible that the number of articles exhibited may not be so great as last year, but at least they will be up to the character that befits those that should find a place in such an exhibition.

Official Reception on the 27th inst.—The following are the details of the official reception by his Royal Highness the Duke of Edinburgh:—The Royal Albert Hall and the Orchard entrances of the Exhibition will be opened at 8 p.m. His Royal Highness the Duke of Edinburgh, K.G., will arrive by the royal entrance of the Albert Hall, where he will be met by her Majesty's Commissioners, who will accompany him to the Arena. Foreign ambassadors, her Majesty's Ministers, and other distinguished personages, will assemble in the Arena. His Royal Highness the Duke of Edinburgh, after passing through the Hall, will visit the foreign and British picture galleries, and will then return through the arena of the Hall to the royal entrance. Only those persons whose invitation cards bear the words "Pass to Arena," will be admitted to that part of the Hall, until after his Royal Highness the Duke of Edinburgh has proceeded to the picture galleries. All other invitation cards will admit to the gallery and balcony of the Hall, and to the picture galleries of the Exhibition, seat-holders in the Hall proceeding, if they see fit, to their own stalls and boxes. The most convenient entrances for those persons who wish to be present in the Hall will therefore be the East and West Gallery Entrances, and the East and West Balcony Entrances. The nearest entrance to the foreign picture gallery is that in Exhibition road; that in Prince Albert's-road is nearest to the British picture gallery. The band of the Royal Artillery will perform in the Royal Albert Hall, the Grenadier Guards, &c., in the Conservatory and picture galleries. Performances will also be given on the great organ in the Royal Albert Hall. All persons must produce their cards of invitation upon entering, as the presentation of the season ticket without an invitation card will not insure admission. Holders of season tickets should therefore as soon as possible obtain these special invitations, which they can do by applying to the agent who supplied them. Those who obtained their season tickets from the Society of Arts, should at once apply to the Financial Officer, Mr. S. T. Davenport.

People's Concerts at the Albert-hall.—These concerts have been uniformly successful, both as to the attendance and the character of the music performed. Next Thursday his Royal Highness the Duke of Edinburgh has signified his intention of being present at a concert of English ballad music, under the direction of Mr. Land.

Photography.—The Heliotype Company have been granted the exclusive right of supplying the public with photographs of the buildings and objects exhibited. These photographs will be printed by what is known as the Heliotype process, which consists of printing in carbon, by which permanence is secured. A separate portrait department has been established, which will be under the charge of Dr. Wallich, of Kensington, and the printing of these in carbon will be a new feature in portrait photography.

French Fine Art.—Among the pictures that will be exhibited are several incidents in the late war and siege of Paris.

CORRESPONDENCE.

TRINKETS AND THEIR MANUFACTURE.

Sir,—The paper read by Mr. Larkins on "Trinkets and their Manufacture" brings to our notice the important fact that, in consequence of the low quality of gold used in the manufacture of jewellery in this country, our export trade is far below what it should be.

Two things are necessary to place the English manufacturers in a position to compete successfully with their French neighbours:—

1. To have no article of jewellery hall-marked below 18 or 15 carats.

2. That such new regulations should be introduced by the Goldsmiths'-hall as would give manufacturers the opportunity of having any article marked, however light or delicate its construction. The present rules in force, which are old and unsuited to modern work, will only allow of such articles being stamped as are of a plain and solid make; while those that are light and fashionable and have any artistic merit cannot be.

In view of the forthcoming Exhibition, when public attention will be drawn to the manufacture of jewellery, the Society of Arts might, by using its powerful influence, so reform the present system as to confer a benefit on the public, give satisfaction to the retail houses of the trade, and place manufacturers in a position to greatly extend their present limited foreign trade.—I am, &c., B. H. T.

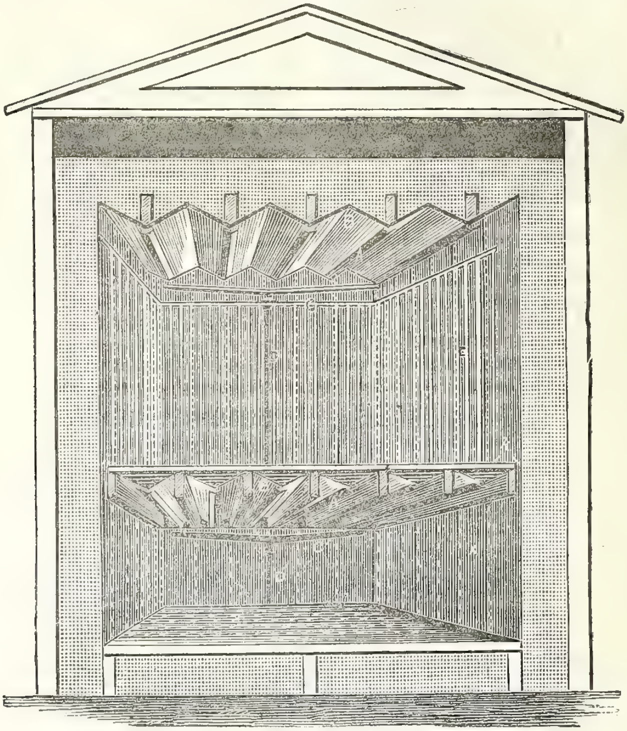
March 20, 1872.

BRAINARD'S REFRIGERATORS.

Messrs. L. de Fontainemoreau and Co., patent agents, of 4, South-place, Finsbury, have forwarded a drawing and description of Mr. E. D. Brainard's improvements in ice-houses, store-rooms, and refrigerators. This invention has been patented in the United States, England, and the Continent.

Mr. Brainard employs metallic surfaces within the chamber, upon which the vapour of the atmosphere is deposited by condensation, and then conducted from the chamber, without coming in contact with the ice. By these means he claims that he is enabled to keep his ice-chamber at the lowest practical temperature, both dry and sweet, producing no mould or fermentation of any character or degree. This circulation, occasioned by the discharge of the moisture arising from the ice and other substances within the chamber, serves to remove from the chamber the heat or caloric set free, thereby tending to keep down the temperature as near freezing point as possible.

The drawing represents a vertical section of Mr. Brainard's improved ice-house and storage-chamber, in which E represents the ice-chamber, and X represents the storage-chamber, each of which is enclosed by air-tight walls, to avoid the admission of external air. The ice is placed in the upper chamber, which constitutes the ice-house proper, and receives the caloric, which is imparted to the atmosphere by articles placed in the storage-chamber, and conveys it from the chamber by means of the water formed by it, and deposited upon the metallic floor of the ice-chamber. The mode of its operation is as follows:—The caloric and moisture escaping from the substance placed in the storage-chamber are taken up by the atmosphere and conveyed to the corrugated metallic ceiling of the storage-chamber, when the moisture is deposited by condensation, and the caloric passes into the ice-chamber, and is taken up by the liquifaction of the requisite quantity of ice, and the water thus produced passes off by means of the troughs or gutters A, as seen in the drawing, carrying with it the moisture arising from the substances within the storage-chamber, and deposited on such corrugated ceiling. By these means the ice and storage-chambers are kept dry without resorting to atmospheric ventilation.



The construction of these ice and storage chambers is as follows:—

BB represent sheet metal, forming the corrugated ceiling of the said chambers; AA represent the discharge gutters placed under the angle of each corrugation; CC represent the main discharge gutters into which those marked AA discharge; DD is the discharge pipe, conveying the water from these chambers.

In the construction of ice-houses for supplying the public during the season, they should be constructed with separate compartments, not communicating with each other, so as not to expose an unnecessary quantity of ice to the atmosphere while using from it.

If twenty thousand tons of ice are to be stored in a house of one compartment only, whenever that compartment is opened, the whole quantity is subject to waste from the heat admitted while taking ice from the house. But if stored in three separate compartments, and one compartment only is opened at a time, then only one-third part of the quantity is thus exposed, and two-thirds are free from waste, and the expense of recovering with straw, saw-dust, &c., avoided.

In employing an ice-house thus constructed, the ice is packed in the upper chamber E, and the beer, meat, fish, fruit, vegetables, or other articles to be stored, are placed in the lower or storage-chamber X, and, as the temperature in these ice-houses remains low and uniform (about 34° Fahrenheit), the articles stored therein may be preserved in warm weather for a considerable time, and at a very low cost, thus rendering these ice-houses of great value in meat, fish, and fruit markets, and to brewers, butchers, fishmongers, keepers of hotels, &c., &c.

ON THE PROFITABLE CULTIVATION OF TEA IN INDIA.

By Frederick Campbell, Esq.

(*Continued from page* 427.)

About Christmas-time the plants must be very carefully pruned with an ordinary sharp pruning-knife, care being taken to give every encouragement to the plant to spread as much as possible, by clearing the wood from the centre. The natural tendency of the plant is to run up in the centre; but in order to obtain the greatest space for the production of leaf, the lateral shoots must have every opportunity given them to become strong and vigorous. A deep hoeing may also be given, and the land left as rough as possible, for the purpose of securing thorough ventilation and purification by sun and air, from which it has been so long excluded by the jungles. During the cold weather, the weeds will give no trouble.

The preparation of the second section of 35 acres will of course be also going on.

For deep hoeing, the koodalie is used. It is a heavy hoe, of considerable size, which the natives use for all purposes, and with some skill, but it is an unwieldy, antiquated affair, and should be replaced by the sharp, light, steel spade, such as is used in Lincolnshire. There being no stones in the soil, this implement is well adapted to this country; the work would be more efficiently done, and at less expense, and the tea less liable to injury. The deep hoeing or digging should not be carried near enough to the tea bush to disturb the roots, but, at the same time, it is necessary that the soil round the trees should be stirred, to admit air to the soil, and this can be best effected by the use of a small light, iron pick, and done by the women and children, going in advance of the deep hoers, who will, at the same time, carfully remove all weeds from the vicinity of the plant.

In the month of July, that is, nearly two years after the seed was first sown, it is probable, if the plants are very vigorous, that a few maunds of tea may be gathered with advantage from the first section planted; it will check the tendency of the plant to run up, and induce it to grow more bushy, and the tea so gathered from young trees is of great value; this requires, however, caution and judgment.

The general routine of the third year will resemble the first and second, except that a crop of tea will be gathered from the older bushes, and regular manufacturing will commence.

The process of manufacturing and leaf-plucking is now so generally understood, that only general instructions are necessary, and the overseers whom the planter has engaged, with his own opportunities of observation, will be able to carry on the work with success; but as my system is somewhat different to that in general use, I shall endeavour to make it as distinct as possible.

In leaf-plucking, the only precaution necessary is to gather only such leaves as will become soft and flaccid by withering, so as to receive a good curl in rolling. When the young shoots have sufficiently grown, and the bark begins to turn brown next the stem, the top may be plucked off, with about three leaves, the lower leaf and stem being cut through with the finger-nail, so as not to injure the lower eye or germ under that leaf, the object being to leave as many germs as possible to form in turn shoots for plucking. Great care must be taken not to pluck any leaf which will not become soft, and roll properly. By not strictly enforcing this on the pluckers, they are very apt to pluck the old leaf in order to increase the weight of their leaf, and so complete their allotted tasks quicker; but this kind of leaf gives great trouble to the tea rollers, who are obliged to pick it out of the mass; and any which may not be so picked out become red, and have to be removed by the tea sorters, as it greatly injures the appearance of the bulk of the tea prepared for market. The leaf is conveyed to the tea-house twice a day for weighing, oftener if the leaf is very plentiful. It is spread out thinly on mats for withering, and will be fit for rolling the next morning. The rolling is performed by a regular staff of tea-makers. The process is very simple, and easily learned by the ordinary coolies. A machine has been invented which, I believe, executes this work with great success, but it is expensive, and only adapted to large concerns, where the quantity of leaf is very great. In point of cost there is little saving. After the leaf is rolled it is left in a mass, to undergo a certain amount of fermentation, to give it uniformity of colour; this will occupy three or four hours, accordingly as the weather is hot or otherwise. When it acquires a rich salmon colour, and is rather warm, it is fit for drying. For this process charcoal is generally supposed to be essential. It is thought that the fumes of charcoal have a certain influence in imparting strength and aroma to the tea. To this I can, from practical experience, give an emphatic denial. Tea may be dried without the aid of charcoal with the greatest success, and will realise a higher price.

Mr. Craw, of Kumâon, has constructed a very simple, but efficient apparatus for tea-drying, which I can recommend. It consists of a 9-inch cast-iron gas-pipe, leading horizontally from a furnace to an outlet at the opposite end. This pipe is enclosed in a brick-chamber, and over it are placed a succession of trays, to contain the tea, like a chest of shallow drawers, the lower tray being covered with canvas, to prevent the dust from falling on the hot pipe and creating smoke. The advantages, besides the enhanced price of the tea, are several.

The use of charcoal requires a very large drying-house. Small holes are dug in the floor, called chulas or butties, and the charcoal is lighted in these till a clear red-heat is obtained. A large round iron or bamboo-frame is placed over it, on which a small tray containing the tea is placed. The danger, therefore, is great; any dust falling on the fire, which is quite unprotected, produces smoke, and the tea is greatly injured. The danger of fire to the house is also very imminent. The use of charcoal is a source of great expense in labour for its preparation, and in some places difficult to obtain. In the furnace recommended, any wood or rubbish which comes to hand can be used.

It has also been usual, after fermentation, to put the tea into iron pans nearly red-hot, and again give it a slight rolling; this also is not only unnecessary, but positively injurious, and may be altogether dispensed with. One pan of this kind must, however, be kept, as during cold and wet weather it sometimes happens that the leaf will not become sufficiently soft to receive the neccessary curl, and by placing it in the hot pan a few seconds softens it. I, therefore, advise that the tea be taken at once from fermentation to the drying apparatus.

After drying, the next process is sorting and packing. It is customary to do this with sieves of various sizes of mesh, and subdivide it into six or eight different sorts of different names. Various machines have, from time to time, been sent out for this work, but they have not been successful. Of the system of subdivision I entirely disapprove, as injurious to the tea and a waste of labour. All that is necessary is as follows:—After the tea is dried, let it be carefully hand-picked, to take out any red leaf or foreign matter; then placed on a No. 4 sieve, which is of open mesh, and carefully sifted; this will take out the large, coarse leaves, and give to the bulk uniformity, which may be called pekoe souchong. The coarse leaves remaining on the sieves may then be rubbed through the sieve with the hand, and called broken black, thus making only two sorts.

The great complaint amongst brokers is, that they can get no large breaks (that is, a large number of chests of one kind of tea), but that the tea is sent to market in such small lots of different sorts; and there is no doubt that one hundred chests sent to market on my system would realise a higher price than if it were divided into eight or ten lots with different names. In addition to this, also, a large amount of labour would be saved, and much waste, caused by the repeated handling of the tea, avoided.

Before sorting, it is usual to store the tea in large bins, sort, re-dry, and pack at some future time. It is possible that this course may, in some cases, be unavoidable, but it is most objectionable. The tea is exceedingly susceptible of damp, and in a moist climate like Assam is almost certain to receive injury. I have repeatedly seen large stores of this kind perfectly mouldy and rotten, even on well-managed estates.

No time should, therefore, be lost in packing the tea, and, if possible, I would have it done daily. After sorting as described, the tea should be again taken to the drying machine, and allowed to remain some hours till thoroughly dried, and then packed hot into the tea chests prepared for it, and soldered down before it has had time to cool and the aroma to escape. In packing, no more force or pressure should be applied than can be given by well-shaking the box and pressing on a thick cloth, many times doubled, with the hands.

The tea chests are generally made of mango wood, but any light, strong wood will answer, provided it has no scent in it, as the tea, even through the tea lead-lining, is easily tainted. These boxes are lined with lead, carefully soldered at the seams, and are made to contain a fixed quantity, one maund (80 lbs.) or 100 pounds each; the 80 lb. boxes are most convenient for transport.

No time should be lost in sending the tea to market, and it would be well to send regular breaks of fifty or a hundred boxes as soon as they are ready, and thus realise a fair average price of the season.

The main features which my simple system of the manufacture and manipulation of tea are, first, the great saving of labour; in a country where all labour must be brought from a distance, it is manifest that it should be encouraged by every means, and it will be found that this will be done in a most important degree by avoiding the sub-division of the tea into more than two sorts, by discarding the use of charcoal and the hot pan, and by not storing the tea in bins in large quantities. It is impossible to attach too much importance to this matter, as it is during the most busy time of the year that these operations are carried on, and success or loss of money depends on the necessary amount of labour and its application, and when it is remembered that, in addition to the saving in labour, better tea is turned out than by the existing systems, nothing more can be said to recommend it to the planter.

Having prepared the tea for market, it is an important question what market to send it to. Both Calcutta and London are available. Calcutta is annually becoming of greater importance, and I have no doubt will contrive to do so, and prices are quite equal in Calcutta to those realised in London. When it is considered, therefore, that the time saved in realising the value of the tea, which will be at least two months, probably three, and the saving of freight; &c., there is no doubt Calcutta presents the greatest advantages for the sale of the tea.

Details of expenditure and receipts for the first six years are approximately given in the appendix; in this statement 400 lbs. of tea is given as the yield of tea six years old. I consider this estimate as very low, and have no doubt that if my instructions are strictly adhered to, in planting out the garden, 700 lbs, to 800 lbs. will be obtained. A few days ago a small tea-garden was advertised for sale, on which 800 lbs. of tea per acre were guaranteed. A large company, occupying 4,000 acres, reports that last year they obtained an average of 320 lbs. of tea per acre, and these gardens I know to be only second-rate, and the management far from being equal to that which would be bestowed on a garden by a private planter. It is an interesting question how long a tea-garden will exist profitably after it has been once formed. There has not yet been time enough, since the first foundation of tea-gardens, to ascertain this, but I have seen experimental gardens which have been tea-bearing for 30 years, which showed no signs of decrease of vigour or productivenes. I have also seen indigenous tea-trees cut down when the forest was being cleared for planting, which could not have been less than 150 or 200 years old, and these stumps which were left in the ground produced bushes of a luxuriance and productiveness quite astonishing, there is no reason to doubt that, by occasionally cutting down the old trees on the appearance of decay (which I have seen practised with perfect success), that a tea-garden will last 100 years; and as the old stumps of the tea-bushes throw out far better bushes than the orginal ones, it is probable that they will last much longer.

The statement of account shows a very large profit, and it will naturally give rise to the question, if my figures are to be relied on—How is it that there has been so little success, and so much failure? This I shall be able to thoroughly account for.

It is a fact that, throughout all the tea-growing districts of India, there are not half-a-dozen gardens which were opened out as a means of livelihood and permanent settlement, as already stated; a mania for tea-planting was created by the profits made by the first public company, which was called into existence by the sale of the Cachar gardens of the Assam Company. At that time extravagant reports were spread as to the profits to be made by tea-growing, and great excitement prevailed, both in India and England; but strange to say, extravagant as these reports were, they did not exceed the truth, and the failures to realise these brilliant prospects arose—not from any defect in the tea—but from the circumstances under which it was attempted to be grown; circumstances caused by ignorance in most cases—dishonesty in others.

In consequence of the general excitement, a vast number of companies were formed for the purpose of opening out tea-gardens, or for purchasing gardens already opened out. The avidity with which gardens were purchased, at high rates, induced also private individuals to rush to those districts where, it was supposed, tea would grow. This led to vast tracts of land being cleared, and planted throughout the Punjaub, north-western provinces, Assam, Cachar, and Darjeeling, in an incredibly short space of time, the only thing aimed at being to clear, or partially clear, a piece of land, stick in a few worthless plants, call it a garden, and sell it at an enormous price to a company. It is a fact that these companies, being generally formed more for the sake of jobbing in the shares than cultivating tea, no inquiry was made as to what the gardens so bought were like; and I know of thousands of acres which were bought which were absolutely worthless, and thousands of acres were sold which never had any existence.

When this rush to the tea districts occurred there were not ten tea-planters in all India, and the sudden demand for European tea managers was so great, that people of all classes were sent up to open out tea-gardens, at enormous cost, in a country they had never been in before, with labourers whose language they did not understand, and who would not have known which end of a goosberry-bush to put in the ground in an English garden. Were it not for the disastrous results which arose from it, it would be amusing to know the kind of people who were suddenly turned into tea-planters; in my own experience I met with lawyer's clerks, soldiers, and soldier officers, sailors, clerks from mercantile houses, waiters from hotels, magistrates, parsons, coffin-makers, boys from the public schools, and, in fact, every trade and profession was represented. It is little wonder that the tea-gardens were failures.

The sites, soil, and climate necessary for profitable growth of tea were also little understood. An impression prevailed that a certain elevation was necessary for the health of the tea, and this gave rise to the enormous gardens opened in Darjeeling and Kumaon. Experience has proved this impression to be quite groundless, as the Himalayan gardens are, without exception, failures, and the millions of money expended there thrown away; but even in those countries like Assam, which have proved to be of the highest rank for the production of tea, great mistakes were made, and much land was opened out quite unsuited for the growth of tea, and was afterwards abandoned, but not till vast sums had been expended. The vast sums of money expended on worthless gardens, and wasted by dishonesty and want of experience, were not the only causes of heavy expenditure. A new interest like tea planting called for the supply of material in the shape of implements, &c., necessary to tea-gardens, and the rates were extravagantly high, at least double what they are at present. This also applies to the supply of labour. Such was the demand for coolies, that the price rose to 80 rupees (£8) per head delivered on the gardens; they can now be obtained for 30 rupees (£3) per head. But the price was the smallest mischief. In consequence of the excessive demand, 25 per cent. died almost immediately, and of the rest 25 per cent. were probably worthless; this arose from the contractors' sending anything they could lay their hands on—the diseased, old, idiotic, and maimed, were sent off, in order to obtain the high rates paid by the planters.

Nor did the causes of excessive expenditure end here. Government regulations were brought into force with regard to payment and treatment of coolies. I may mention one which entailed great loss on the planters. It was compulsory on the planter to supply his labourers imported with rice at one rupee per maund, no matter what it might have cost him. The consequence was that, on account of the extensive demand for rice, which was necessarily imported from Bengal, the price, delivered on the garden, reached as high as 6 rupees per maund, entailing a loss of 5 rupees per maund on the planter. This and other obnoxious regulations no longer exist; it is not necessary, therefore, to notice them further than to quote them as adding to the already severe difficulties under which the tea-planting interest at first laboured. With reference to these regulations, however, it may be not out of place to remark, that the most stringent of them were called into existence by the alleged harsh treatment and cruelty of the planters; that any such treatment of coolies, calling for especial legislation, ever existed I am able most emphatically to deny. I have seen much of the treatment of coolies in all departments, and I have no hesitation in saying that, for one case of severity witnessed on the tea-gardens, I have seen fifty on public works and in government employ. The tea-planters are, as a body, most indulgent and kind to their coolies, giving them every indulgence consistent with their duty to their employers.

The foregoing are only a few of the causes which led to disaster. I could, if necessary, state many others; those quoted relate principally to the first formation of tea-gardens, but the after management was little less free from defects. The money paid by companies to secretaries, directors, managing directors, and tea-garden managers was out of all proportion to the work they were called upon to perform; this would have been the case even if they had well understood the work they were supposed to supervise, but as, in fact, each was more ignorant of the affairs of a tea-garden and its management than the other, it was so much money wasted. This ignorance led to reckless expenditure in the cultivation of the tea-gardens, as well as in their supervision. I may mention one or two cases, amongst many, which came under my own observation.

A company in Cachar, cultivating 900 acres of tea, expended 16,000 rupees (£1,600) per mensem on their expenses; and, as no dividend could be paid, inquiry was called for. I was deputed to investigate the affairs of the management, and I found no difficulty in cutting down the expenditure from 16,000 rupees to 8,000 rupees per mensem; and yet the work was better done, and the yield of tea superior after the reduction than before it. This fact will surprise no one who has had to deal largely with matters relating to labour in connection with the cultivation of the land. In another case, I reduced the expenditure on an Assam tea estate from 9,000 rupees per mensem to 5,000 rupees, with like result.

These two instances will serve as a fair example of the way in which estates generally were managed. Much improvement has now taken place, and many companies, who formerly could not pay their expenses, are now by judicious economy and good management paying handsome dividends.

I have, I think, said enough on this subject to convince every business man, not to say agriculturist, that there is more to be surprised at in the fact that any gardens brought into existence under such circumstances should pay a dividend, than that there should have been so much failure.

(*To be continued.*)

MEETINGS.

Aeronautical Society of Great Britain.—A general meeting of members will be held, by permission of the Council, at the House of the Society, on the evening of Thursday, the 18th April, for the reading and discussion of papers. The chair will be taken at 8 p.m.

NOTES ON ART.

The fourth day's sale of M. Péreire's pictures produced £16,120, making up a total of upwards of £68,000. Want of space confines the following list to the most important works:—Rembrandt's "Portrait of Juste Lipse," sold for 38,000 fr.; Rubens' "Apollo and Midas," for 40,000 fr.; two landscapes, by Ruysdaël, for 47,000 fr. and 40,000 fr. respectively; Teniers' "The Tric-trac Player,' 17,500 fr.; the "Players at Bowls," 6,900 fr., "Tabagie," 9,100 fr.; Terburg, "Portrait of a Man," said to have been bought in, 31,500 fr.; G. Van der Velde, two marine pieces, 14,200 fr. and 28,500 fr.; A. Van der Velde, the "Sheep Farm," 10,000 fr., and landscape, 12,650 fr.; Wouvermans, the "Horse Market," 15,000 fr., "The Kennel," 13,000 fr., and "The Halt," 7,100 fr.

The value of provincial exhibitions of modern works of art is again exemplified in the case of that which was closed the other day at Pau, in the Pyrenées. Three pictures were bought for the museum of the town, and forty-seven by the Society of the Friends of Art, to whom the exhibition was due, and private purchasers. Amongst the forty artists who benefit by these sales are such names as Pils, De Cock, Chaplin, Daubigny, and Morin, but the majority, consisting of less known painters, to whom such encouragement is of great benefit; and there are three or more ladies' names in the list.

Important changes are being made in the Louvre, and autumnal visitors to Paris will find on the walls a mass of pictures which have been hidden away for years. The whole of the newly-built portion of the great gallery, which had been taken from the Louvre and devoted to State purposes, is to be restored to its original destination. The new, unfinished Salle des États and all its dependencies—which were used for the inspection, conversion, and repair of small arms during the siege and the Commune—will now form part of the great picture gallery, and will supply wall-space for about eight hundred works. These are to consist almost entirely of pictures by old masters. The appropriation of the former Salle des États to the exhibition of works of the Flemish and Dutch schools, which took place two or three years since, is to be continued, and another large compartment is likely to be devoted to the same schools by the suppression of the Musée des Souverains. This latter collection of antiquities and souvenirs of the sovereigns of France it is proposed to remove to the Cluny Museum, where they will certainly be more appropriately placed than amongst pure works of art, although some few of the objects forming the present musée belong properly to that section. Of these is the silver statue of Henri IV., which now stands alone in the Musée des Souverains. The contents of this latter museum will form a highly interesting addition to the already admirable museum of the Hôtel Cluny. In 1870 a commission was appointed to examine all the hidden stores of the Louvre, and select such works as could be spared for the provincial galleries. The commission set aside about twelve hundred pictures for this purpose, but the war interfered, and they still remain in the private depositories of the Louvre. Another commission is now appointed to complete the work. Another important work undertaken by the Beaux Arts administration is the complete revision of the Louvre catalogue, which is expected to be ready in a few weeks for the printer. This revision has long been wanted, and now the new changes and additions referred to above render it absolutely necessary.

Notwithstanding the sad events of the last twenty months and the comparatively restricted space allotted to the Paris *Salon* this year, the number of works of art sent in for exhibition amounts to about 4,500. There is little doubt that the collection will reflect many of the phases of the war, and of the communal insurrection; in fact, many subjects are known to have reference to the conflicts, and to depict the ruin and desolation that these deplorable events have produced; and there is a considerable collection of portraits of heroes who fell, and of others who made themselves a name during the events of 1870-71; but there are also many compositions of a different character, and a fair proportion of landscapes, some of which also represent the sites or the ravages of war and insurrection. Views of the many ruins of monumental buildings destroyed by the enemy, within as well as without, will doubtless be numerous, and will present a sad interest. The present directors of the Beaux Arts have departed, in many respects, from the regulations of the time of the empire, as already stated in the columns of the *Journal;* but, amongst others, they have retained the popular mode of election by the exhibiting artists themselves, each in his own class, of the juries who are entrusted with the selection of works for exhibition, and also with the award of the medals. There is one change, however, made in this regulation; of late years every artist who had previously been admitted as an exhibitor, and sent in works again to the *Salon*, had a vote for the jury in his class; now, those who had previously gained a medal or other award have that privilege. The juries have all been elected, and the official lists are published, and the result proves that under either system artists of high standing are invariably elected. The juries of 1870 and of the present year are in the main the same; and the following names of the elected will prove that there is nothing erratic, very little, if any, ostracism, in the votes of the great body of artists. MM. Baudry, Bonnat, Pils, Brion, Meissonier, Breton, Delaunay, Robert Fleury, Cabat, P. Rousseau, Fromentin, Jalabert, Dubufe, G. Boulanger, Vollon, Millet, Puvis de Chavannes, Worms, Magerolles, and Protais from the elected jury in the section of painting; MM. Guillaume, Dubois, Barye, Perraud, Cabet, Falguiére, Cavelier, Carpeaux, Jouffroy, Soitoux, Dumont, and Hiolle, that for sculpture and gem engraving; and MM. Labrousse, Duc, Viollet le Duc, Baltard, Lefuel, and Questel in architecture. That these form a large proportion of the *élite* of French artists is beyond question, and it may be added that the absence of the names of Cabanel and other eminent men is to be accounted for by their own absence from France or Paris. The jury for the section of engraving and lithography is of the same high character, including the names of the first etchers and engravers of the day. The small proportion of the jurors—about one quarter—nominated officially, in addition to the above, consists of well-known art critics and connoisseurs and a few officials connected with the fine arts. The introduction of the non-artistic element is considered, and with reason, to be in favour of liberalism, and opposed to the dominancy of any special school or clique.

Art and Archæology have suffered seriously by fire at Erfurth and Dusseldorf. At the former place the famous cell of Luther has been destroyed. It formed part of the ancient Augustine Monastery, which had been converted into an asylum for Protestant orphans. Luther entered the monastery as a mendicant friar in the year 1505, when he was 21 years of age, and ever since the Reformation this chamber or cell has been the resort of incalculable numbers of visitors. The fire raged so violently that nothing could be saved. The famous Bible, with Luther's marginal notes, the autographs of many of the great Reformers, the Book of Honour, in which were the names and inscriptions of Göethe, Schiller, and nearly all the great men of the last three centuries, are reduced to ashes, and with them the museum of the orphan asylum, the Bellermin Museum, a famous Dance of Death, and a number of other precious or unique objects. The walls of the famous cell or oratory were simply whitewashed, and were covered with religious verses and Bibical extracts, traced by the hands of the Protestant pilgrims. On one side hung a portrait of the Reformer, and amongst the relics were a small travelling-case, which contained his money and writing materials, and a number of letters from his family, which were forgotten by Luther at Halle, in the house of the director of the saltworks, in 1546. Luther died at Eisleben, and war having broken out, the articles remained in the hands of the family at Halle for some time, then passed into others, and finally, in 1754, were presented to the cell at Erfurth, where they were guarded with reverential care. Of the ancient Augustine Monastery, erected about the year 1266, nothing remains but the outer walls.

The other fire, which occurred at Dusseldorf, is serious in an artistic point of view, and might have been one of the greatest calamities of its kind had not the efforts of the officials and inhabitants been, to a certain extent, successful. The States Chambers and the Academy of the Beaux Arts, adjoining each other, formed not only one great depository, but contained a perfect hive of artists who had their studios in the buildings. The fire broke out in that portion of the States Chambers which adjoined the Academy of the Beaux Arts, and finally consumed the whole of the former building except the tower, and all that part of the Academy which connected the former with the great exhibition gallery. The ateliers of the painters Molitor, Massen, J. Heabach, Deger, André Muller, Professors Keller and Roeting, Bendemann, Wissicenus, are destroyed, with nearly all their contents, the cherished productions and collections of all these eminent artists. The loss of M. André Muller is very serious; the grand altar-piece for the Church of Zifflich, on which he has been at work for four years, and which was all but completed and highly spoken of, could not be rescued. In five hours, besides the ateliers, the fire destroyed the whole of the MSS., archives, drawings, plates, and prints of the Artistic Club of Rhenish Westphalia, which were housed in the building, the School of Engraving, and the Landscape School, with all their contents. Fortunately the list of what is saved is still more important. In the first place, the Great Exhibition Gallery, in which had been placed a number of important pictures requiring repair, is uninjured, as are also the ateliers situated beneath the gallery, the library, and the Ramboux collection. The remaining portion of the famous historical gallery of the ancient prince-electors—in which, amongst many other highly-important works, is the Assumption of the Virgin, by Rubens—is uninjured; as well as a collection of modern pictures, worth about six thousand pounds, belonging to the Society for the Assistance of Distressed Artists, which were in the same part of the building. Another fortunate escape is that of the collection of prints, one of the finest in the world. It is a terrible accident, but it might have been much worse.

The great work of "The Suez Canal" is about to be illustrated in that profuse and artistic manner to which the Parisian publishers have of late years made us accustomed. This work, which is by M. Monteil, the engineer of the Canal Company, will vie in extent, if it do not exceed, that of M. Alphand's history of the parks and promenades of Paris. The work is to be divided into ten series, commencing with the plans of the canal, the geology of the isthmus, the working establishments, the distribution of fresh water, with full details of the dredging machines and their numerous accessories, the dry excavators, of the various constructions, jetties and sluice-gates, and ending with the workshops, the arrangements for working and lighting the canal, and, finally, the lighthouses at its entrance. The illustrations will consist of three hundred folio engravings on copper. The work, like many of its predecessors, is published by subscription.

GENERAL NOTES.

Irrigation.—A prize of 2,000 francs and a medal are offered by the Agricultural Society of France for the best memoir "On the Theory and Practice of Irrigation." The documents are to be sent to the secretary of the society before the end of the year 1872.

Peruvian Antiquities.—King Victor Emmanuel has presented to the Geological Museum of the University of Rome a collection of Peruvian antiquities—silver vases, curious musical instruments, a coloured garment made from the bark of trees, and arrows and lances. The articles were discovered in a guano bed, and are antiques. The lances are notched, ornamented with feathers, and have wooden heads, showing that they were made before iron was used.

British Association for the Advancement of Science.—The forty-second annual meeting of this Association will commence on Wednesday, August 14, 1872, at Brighton. The first general meeting will be held on Wednesday, August 14th, at 8 p.m., precisely, when Professor Sir William Thomson, LL.D., F.R.S., &c., will resign the chair, and Dr. W. B. Carpenter, LL.D., F.R.S., F.G.S., F.L.S., &c., will assume the presidency, and deliver an address. On Thursday evening, August 15, at 8 p.m., a soirée; on Friday evening, August 16, at 8·30 p.m., a discourse; on Monday evening, August 19, at 8·30 p.m., a discourse; on Tuesday evening, August 20, at 8 p.m., a soirée; on Wednesday, August 21, the concluding general meeting will be held at 2·30 p.m. Authors are reminded that, under an arrangement dating from 1871, the acceptance of memoirs, and the days on which they are to be read, are now as far as possible determined by Organising Committees for the several sections before the beginning of the meeting. It has therefore become necessary, in order to give an opportunity to the committees of doing justice to the several communications, that each author should prepare an abstract of his memoir, of a length suitable for insertion in the published transactions of the Association, and that he should send it, together with the original memoir, by book-post on or before August 1, addressed thus—"General Secretaries, British Association, 22, Albemarle-street, London. W. For Section . . . . ." If it should be inconvenient to the author that his paper should be read on any particular days, he is requested to send information thereof to the secretaries in a separate note. Reports on the Progress of Science, and of researches intrusted to individuals or committees, must be forwarded to the Assistant General Secretary, for presentation to the Organising Committees, accompanied by a statement whether the author will be present at the annual meeting. Excursions to places of interest in the neighbourhood of Brighton will be made on Thursday, August 21.

Water Supply.—The daily London supply is now 107,000,000 gallons.

Naphtha.—In Russia it has been used as fuel for locomotives and steam vessels with decided success as to economy and otherwise.

The French Educational Budget.—The Assembly has, after considerable discussion, passed the budget of the Minister of Education, Fine Arts, and Religion, amounting to upwards of £3,771.800. The following are the chief items of the first section, that of public instruction, science, and letters:—Salaries of the Minister and officials of the central administration, £23,796; expenses of the same, £5,116; salaries and expenses of inspectors-general of public instruction, £13,120; general expenses of the department of public instruction, £10,000; the academic administration, £45,600; superior normal school, £12,852; the faculties, £176,117. An amendment was proposed to add a sum of £960 for the creation of four travelling fellowships for young doctors of law and medicine to complete their studies in England and Germany, but the question was deferred; the establishment of a faculty of medicine at Lyons, at a cost of £3,640, was also deferred till next year. The library of the University, £12,000; the Ecoles des Hautes Etudes, and encouragement to its professors, £12,000. This vote was objected to, but warmly and successfully supported by M. Waddington, of the Institute, who praised the new school highly, as preparatory to the courses at the Sorbonne and the College de France; it is a free evening school, and to it are annexed the laboratories at the Sorbonne and the Jardin des Plantes for the higher branches of scientific research. The professors and directors are taken from the College de France and the faculties, and the maximum honorarium is £80 per annum. The pupils are from the chief normal school, the Ecole des Chartes, the College de France, and other high educational establishments. The pupils in letters amount at present to 75, but in the sciences they are far more numerous. This school is the most important feature added of late to the means of instruction of the highest class, and it is entirely independent of the faculties and university. The Institute of France, £26,688; the Academy of Sciences, £1,820; the College of France, £11,600; the Museum of Natural History (Jardin des Plantes.) £27,127; astronomical establishments, £22,124; instruction in Oriental languages, and the Library and Museum of Algiers, £4,712; Ecole des Chartes (records and archæology), £1,840; Ecole d'Athènes (archæology, inscriptions, &c.), the Minister proposed a vote of £8,560 for building a new school, but the committee on the budget reduced the amount to £4,580. The Bibliothèque Nationale, £19,830; the catalogues of the public libraries, £2,000; staffs of other public libraries, £8,380; learned and scientific societies, £2,800; *Journal des Savants*, £600; subscriptions to scientific and literary publications, £5,600; encouragement and aid to men of letters and sciences, £8,000; for scientific voyages and missions, £4,000; collection and publication of documents relating to the history of France, £4,400; preparation and publication of the chart of the Gauls, £800; general expenses on account of secondary instruction, £4,800; communal lyceums and colleges, £166,000; national scholarships, £40,000. Primary instruction—Inspectors of schools, £56,305; expenses of the schools, £157,600; expenses of special schools of Algeria, £2,860. The small salaries of the assistant teachers, pupils who have passed the normal school, which range from £20 to £24 per annum, gave rise to discussion, but the proposal to increase the amount by fifty francs was negatived. Governmental subscription to works of art, £5,440 per annum; encouragement and assistance to artists, £10,160; historical monuments, £44,000; national museums, £24,400; an additional sum is promised in aid of provincial museums; public libraries of Paris, £1,596 (this must be a misprint); the Luxembourg Palace, £4,587; national manufactories, £32,328.

Sugar Used in Breweries.—It appears from official returns that in the year ending the 30th September, 1871, the quantity of sugar consumed in breweries in London was 11,991,690 lbs.; in the English provinces, 17,288,599 lbs.; in Scotland, 508,472 lbs.; in Ireland, 2,712,102 lbs.; making a total of 32,500,763 lbs., being more by 3,483,592 lbs. than in the preceding year. The increase in the English provinces exceeded 2,800,000lbs.

Music and Drawing in the City of Paris Schools.—The municipal council of Paris has voted a sum equal to £4,800 for the teaching of singing in the city schools and the expenses of the Orpheonic meetings. It has also awarded a subsidy of £3,420 to the schools of design. It is pleasing to note that, amidst all the difficulties and demands that press upon the city authorities, there is an evident desire not only to maintain but to improve the various means of education and civilisation.

The Doomsday Book of France.—The boundaries not only of the communes, but also of each parcel of land belonging to a private individual, are laid down in what is called the "Cadastre," which was commenced in 1807, and occupied the government surveyors nearly forty years. The *parcelle* in French administrative nomenclature means a piece of land belonging to one proprietor, and applied to one purpose; thus, each piece of meadow, vineyard, arable land, ozier ground, &c., is given, with its boundaries, with great exactitude, the maximum error allowed in the daily rectifications being one in five hundred. In connection with the *cadastre* is a register, in which each parcel of land bears the same number as on the chart, and also the exact measure of its sides, and the kind of cultivation to which it is devoted. When any change is made, either in the boundaries of the land or its ownership, this is also registered. When we remember the extraordinary subdivision of land in France, and the consequently large number of proprietors and parcels, the labour of producing such a chart and register must be enormous. Moreover, the moment the cadastre is completed corrections commence, and the number of entries or changes which have been made, or should have been made, during a term of twenty-five years, must be almost incalculable. Complaints have been made for years that the cadastre is incomplete, that the land-tax, which is graduated according to the class of land, is not accurately charged, one owner being rated too high, and another too low. It was said not long since that a new cadastre was about to be taken, but this was a premature announcement. On inquiry, it appears that the cost of a new cadastre would be about £9,600,000 (240,000,000 francs), and would occupy from twenty-five to thirty years, with the number of surveyors now available. It is not surprising, then, that the new Doomsday-book and chart is deferred for the moment.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

April 17th.—"On the Great Central Gas Company's Works." By A. Angus Croll, Esq. On this evening Lord Alfred Churchill will preside.

April 24th.—"On Nuts: their Produce and Uses." By P. L. Simmonds, Esq.

INDIA CONFERENCE.

This Friday evening, at 8 o'clock, the adjourned conference upon Mr. Frederick Campbell's paper, "On India as a Field for Private Enterprise," will be held. The chair will be taken by Sir Donald McLeod, C.B., K.C.S.I., late Lieut.-Governor of the Punjaub.

CANTOR LECTURES.

The First Lecture, on "Silicates, Silicides, Glass, and Glass Painting," by Professor Barff, was delivered on Monday evening, April 8th. The remaining lectures will be given as follows:—

Lecture II.—Monday, 15th April.

Solvents of Silicic Acid—Silicates—Glass (composition of)—Different Kinds of Glass—Methods of Making Glass.

Lecture III.—Monday, 22nd April.

Manufacture of Glass (continued)—Coloured Glasses—Glass Staining—Glass as a Decorative Material—Glass Painting.

Lecture IV.—Monday, 29th April.

Glass Painting (continued)—Mosaics—Enamels.

Lecture V.—Monday, 6th May.

Styles of Glass Painting—Illustrations with the Electric Light, illustrative of the Nature of Colour.

Lecture VI.—Monday, 13th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose have been issued.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lectures. Prof. Barff, "Silicates, Silicides, Glass, and Glass Painting."
Social Science Association, 8. Mr. Joseph Brown, Q.C., on "The Bill to Amend the Law of Evidence."
London Institution, 4. Prof. John Ella, "Elementary Music."
Royal United Service Institution, 8½. Commander W. Dawson, "The Mounting and Working Heavy Guns at Sea."
Medical, 8.
Asiatic, 3.
Victoria Institute, 8.

Tues. ...Civil Engineers, 8. Mr. Leveson Francis Vernon-Harcourt, "Description of the New South Dock in the Isle of Dogs, forming part of the West India Dock."
Statistical, 8. Mr. Hammond Chubb, "On the Bank Act and the Crisis of 1866."
Royal Institution, 3. Dr. Guy, on "Statistics, Social Science, and Political Economy."
Zoological, 9.
Pathological, 8.

Wed.....**SOCIETY OF ARTS, 8.** Mr. A. Angus Croll, "On the Great Central Gas Company's Works."
Meteorological, 7.
Royal Society of Literature, 8¼.

Thurs...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. 1. Prof. Oliver, on "*Begoniella*, a new genus of Begoniaceæ." 2. Prof. Oliver, on "Three New Genera of Malayan Plants." 3. Prof. Dyer, on "*Camellia Scottiana* and *Ternstrœmia coriacea.*"
Aeronautical Society, 8. (At the House of the Society of Arts.)
Chemical, 8. Notes from the Laboratory of the Andersonian University. Mr. E. A. Letts, "On a Compound of Sodium and Glycerine," and "On Benzylisocyanate and Isocyanurate."
Numismatic, 7.
Royal Society Club, 6.
Royal Institution, 3. Prof. Tyndall, "Light and Heat."

Fri.......Philological, 8¼.
Royal Institution, 9. Mr. A. Vernon Harcourt, "On the Sulphurous Impurity in Coal Gas, and the means of removing it."

Sat.......Royal Institution, 3. Mr. Proctor, "On the Star Depths."
Royal School of Mines, 8. Dr. Cobbold, "On Geology."

Journal of the Society of Arts.

No. 1,013. Vol. XX.

FRIDAY, APRIL 19, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 17th, 1872; Lord Alfred S. Churchill in the chair.

The following candidates were proposed for election as members of the Society:—

Armitage, Benjamin, Halton-bank, Pendleton, Manchester.
Beeton, Henry Coppinger, 108, Adelaide-road, N.W.
Campbell, Rev. William, 30, Westbourne-park, W.
Cole, Walter B., St. John's-terrace, Weymouth
Harvey, Augustus John, 1, South-bank, Regent's-park, W.
Mappin, John Newton, jun., Conduit-lodge, Blackheath-park.
McLaurin, Peter, 324, Camden-road, N.W.
Sheppard, William John, 7, Addison-gardens, South Kensington, W.
Swan, Patrick Don, Provost of Kirkcaldy.
Williamson, George, 2, East India-avenue, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Clark, Adolphus, 1, Chandos-street, Strand, W.C.
Haig, Major R. W., R.A., Royal Artillery Institution, Woolwich, S.E.
Jellicoe, Charles, jun., 20, Kildare-terrace, Westbourne-park, W.
Oppert, Emil, 180, Piccadilly, W.
Pulman, G. P. R., the Hermitage, Crewkerne, Somerset.
Scammell, Samuel, B.A., 217, Caledonian-road, N.
Scott, Robert, C.E., Blackhill, Durham.
Stevens, C., Foulden-house, Foulden-road, West Hackney.
Stewart, Charles, West-hall, High Leigh, Knutsford.

The paper read was:—

THE GREAT CENTRAL GAS COMPANY, ITS ORIGIN AND HISTORY.

By A. Angus Croll.

Up to the year 1848 the supply of gas to the City of London was practically a monopoly, in the hands of two companies—the Chartered and the City Gas Companies, and many complaints had arisen amongst the customers, both as to the illuminating power of the gas supplied, and the price charged for it. That these complaints were not without foundation may be inferred from the fact that the citizens of London were charged 7s. per 1,000 feet for gas of an inferior quality. The dissatisfaction which was felt led to several meetings being held, in order to secure, if possible, an improvement in quality and a reduction in price. Those meetings had the result of deepening the conviction that a reform was needed, and was possible. The positive declaration to the contrary by the existing companies failed to convince the public mind, or to allay the wide-spread and increasing discontent.

Urgent appeals were addressed to the Corporation, requesting them to take action in the matter. Accordingly, in 1848, that body appointed a sub-committee to act in concert with the City solicitor, Mr. Charles Pearson, instructing them to investigate and report upon the facts of the case. In entering upon the task assigned them, Mr. Pearson had the advantage of having already devoted much attention to the subject. About this time, meeting the late Alderman Wire at the judges' dinner in the Old Bailey, I was introduced by him to Mr. Pearson as having had a long and thorough knowledge of the manufacture and supply of gas. He said that my acquaintance with the subject was practical as well as theoretical, and that my experience in various gas works, especially at Coventry and Tottenham—being at that time sole proprietor of the works at the latter place—had led me to the conclusion that improvements could be effected both in quality and price, equally advantageous to the producer and the customer. Many conferences were held with Mr. Pearson; views were freely exchanged. The conclusion at which I had arrived, and the grounds of these conclusions, were laid before him and his coadjutors. The result may be stated by Mr. Pearson in his own words.

In a pamphlet, "Are the Citizens of London to have better Gas?" he says: "I encouraged Mr. Croll to part with his other gas properties that he might concentrate his energies to wage war with the monopoly in the more extended field for his spirit and enterprise, the City of London." He also requested the writer to furnish the Corporation's Committee, through him, with estimates as to the price at which good gas might be supplied at a fair but not undue profit. Statements derived from experience were accordingly placed in Mr. Pearson's hands, showing that pure gas, of a high illuminating power, could be supplied to the citizens at a maximum rate of 4s. per 1,000 feet.

The data upon which the estimate was based were derived from experiments and observations extending over a long series of years, from the time when I first became interested in the manufacture of gas by joining the Chartered Gas Company.

The process of manufacture was then in a very imperfect and rudimentary state. No attempts were made to purify the gas, beyond cooling it as it came from the retorts, and then passing it through lime. The need for a more perfect system of purification became strongly impressed upon my mind. In addition to the low illuminating power of the gas so supplied, and the deleterious fumes exhaled by it in combustion, there was a further mechanical injury to the meters, which, as less obvious, may be briefly adverted to in passing. The impure gas, highly charged with ammonia, in combination with sulphur in various forms, has to pass through meters containing a complicated system of toothed wheels. The result was, that the brass work of the interior was constantly found to be corroded, and the teeth of the index wheel broken off. Such was the condition of the gas at this time that I have known the brass teeth in the index of a meter dissolved in three months. The gas in consequence passed through the meter unregistered, to the serious loss of the companies. Besides which there was a constant and troublesome tightening of the taps. A staff of men had to be employed to attend to the repairs which were thus required, involving constant expense annoyance. This, together with the injurious effects of the products of combustion, caused a prejudice against the use of gas, which greatly checked its introduction, especially into private houses.

The chief cause of this mischief was the retention of ammonia in the gas—a source of inconvenience the writer set himself to remove, and in which attempt, after many experiments, he at length completely succeeded, by making the gas, in its way from the condensers to the lime, pass through a purifier charged with a solution of chloride of manganese, or diluted sulphuric acid, and at the same time adapted the works to this improvement, which produced an almost entire cessation of the injuries to the meters and fittings previously complained of.

This method had the yet further advantage of utilizing the gas products, which, previously deleterious, now became a highly valuable manure, extensively used for agricultural purposes. The Telford medal was awarded to the writer, now more than a quarter of a century ago, for a paper on this subject, read June 11th, 1844, at the Institution of Civil Engineers.

This process was by degrees followed and adopted in a large number of gas works throughout the kingdom, to the great advantage alike of the producers and consumers.

The writer carried out at the Chartered Gas works other economical appliances, the chief of which were as follows:—An arrangement of supplemented flues, by which the amount of air supplied to each furnace was so regulated as to secure the adequate but not excessive draught for each. The lessening of the bar surfaces—an arrangement by which each furnace could be clinkered from beneath, instead of from above; and the charging the furnaces with red-hot coke as it was drawn out from the retorts. These and the alteration of the setting of the retorts and other improvements, reduced the consumption of fuel from 50 to 17 per cent.

It was shown that by all these improvements, good and pure gas might be produced, which would not destroy the instruments that measured it, whilst affording to the companies the means of proportioning the payment for all the gas supplied, whilst the necessary result of these things would be not only to satisfy the public, but also to enable the companies, by increased profits, to reduce the price, and by so doing to add further to their business, and consequently to their profits.

These proposals, were, however, received very coldly and incredulously at the time by the directors, and, indeed, generally by the persons professionally or pecuniarialy interested in the manufacture. When the writer now looks back on that period, and remembers that what he stated was not not only unsupported but contradicted by every one then considered as a competent authority, he is inclined frankly to forgive all the hostility that was displayed. He can do this the more readily because that very hostility rendered him the more determined to make every exertion, even at the risk of a considerable and increasing fortune, to accomplish all that he had predicted, and thus to prove that, so far from being the enemy he was the true friend both of the officers and shareholders of gas companies, and of the consumers also.

The agitation for cheaper and better gas, which assumed so decided a form in London in 1847, was destined to lead to the ultimate realization of the above-mentioned proposals; for the committee appointed by the City Commissioners of Sewers, having clearly ascertained from the statements communicated by the writer to their chairman (Mr. Pearson) that the desired improvements ought to be and could be secured, recommended to the commissioners that efforts should be instituted for obtaining a supply of gas in the city at a maximum rate of 4s. per 1000 feet.

Meanwhile the two old-established Gas Companies (the "City" and the "Chartered") reduced their tariff from 7s. to 6s. per 1,000 feet. But it was generally felt by the consumers that this was a very insufficient reduction, and as there appeared to be no prospect of any further compliance with their wishes, the establishment of a new and independent gas company began to be discussed, and recommended in many quarters. Nevertheless the old companies decidedly refused to supply their gas at a lower price than 6s. per 1,000 feet, although urged to do so by meetings and deputations of the consumers. The representatives of both companies also announced in the Court of Sewers their decision to make no further concession to the public demands.

From these and other circumstances it had become evident that the foundation of a new gas company was the only way by which the urgently desired advantages to the consumers could be obtained. Accordingly, in November, 1848, the prospectus of such a company, to be named "The Great Central Gas Consumers' Company" was issued. It proposed that three-fourths of the shares should be allotted to consumers, that the maximum charge should be 4s. per 1,000 feet, and that all surplus profits above 10 per cent. should be divided amongst the Company's consumers, whether shareholders or not. At the same time the requisite notices were given of application to Parliament for full incorporation.

The very liberal and unusual terms thus offered to the consumers and to the public excited general interest and satisfaction; and at an influential meeting of citizens, held at the London Tavern early in 1849, a unanimous resolution was passed in approval of the proposed scheme and the formation of the new company.

It was at this meeting that I, for the first time, announced that I would agree to manufacture gas at the Company's works at 1s. 4½d. per 1,000 feet, a price lower than I had previously stated; but it ought to be known that it was never my intention to manufacture gas at 1s. 4½d., and pay certain charges other than those connected with the manufacture. The price I had estimated for the supply of gas at the Company's works was 1s. 6d.; but I do not desire to give any further explanation.

A considerable number of shares in the undertaking were at once applied for; nevertheless, so great and immediate was the opposition manifested by the two old companies, that it became evident that the new one would require very large pecuniary support to introduce itself into practical operation, and that heavy liabilities must be at once incurred by the promoters or first shareholders; so heavy, indeed, were these liabilities likely to become, in prospect of the violent and powerful hostility which we must encounter, that the whole undertaking was imperilled at the outset.

Those who desired to obtain the advantages offered shrank from the responsibilities attendant upon the costly and arduous task of clearing its way, and bringing its extensive operations into working order.

So great at this period was the hesitation of wealthy and influential men, who had been invited to assume the direction and first responsibilities of the new company, that, in order to secure their continued cooperation, it became necessary for the writer to allay their apprehensions and establish their confidence, by taking upon himself the whole risk of the preliminary expenses. He therefore signed a bond of agreement to pay all the expenses of the company up to the time of its obtaining Parliamentary sanction, or, failing that, up to the time of its registration under the Joint-Stock Companies Act. He further engaged to guarantee the return of all deposits on shares if half of the whole number of shares were not taken and paid for within a period of five months from the commencement of the company, that is to say by the 25th of March, 1849.*

All the liabilities and all possibilities of loss being thrown upon one person, whilst a prospect of great eventual advantage was offered to all other parties concerned and to the public, as consumers, some of the most respected men in the City of London now took part in the company. But meanwhile the single promoter was bearing the entire cost of drawings, surveys, specifications, clerks, canvassers, offices, counsel, solicitors, and other sources of expense. He also had to devote to these engagements his almost exclusive attention, to the serious detriment of his other business. The preparation and circulation (by thousands) of prospectuses, addresses, pamphlets, and appeals, his constant examination of contracts and agreements, his frequent consultations with counsel or solicitors, and attendances on public bodies, as the Commissioners of Sewers, the Common Council. and the parish vestries, so absorbed his time, that he was obliged to remove from his country residence and establish himself over the offices of the company, in Moorgate-street, where his presence was often necessitated from early morning until midnight.

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* Extract from the subscribers' contract deed:—"And whereas the whole of the expenses of forming the company and promoting the Bill in Parliament has been hitherto borne and paid by the said Alexander Angus Croll, and he is willing to continue to find funds for those purposes until the company shall be completely registered, or until the Act of Parliament shall be obtained, whichever shall first happen; and he has agreed to indemnify the said directors, and the several other parties hereto, &c."

It might be presumed that the guarantees and indemnifications already entered into by the promoter were abundantly sufficient to meet the wishes of the most exacting and suspicious; but, in order to satisfy to the very utmost some further objections brought forward by certain very timid persons, the writer entered into an additional contract, whereby he engaged (and furnished sureties for the performance of his engagement) to supply the company, for a term of years, with meters at a present fixed price, and to manufacture its gas of good and pure quality; also to keep the premises, retorts, and gasholders in repair, at a rate of 1s. 4½d. per 1,000 cubic feet (subject to an addition of 1d. per 1,000 feet should the price of coals exceed 16s. per ton).

Thus far the preliminary difficulties arising from the timidity of directors and shareholders were met and surmounted. But still greater and more numerous were the external obstacles placed in the way of the new undertaking by the old companies.

Immediately on the announcement of the formation of the Great Central Company these instituted every possible means of hindering its establishment, and barring its progress. Not only did they prepare for the most vigorous and costly parliamentary opposition, but they had immediate resort to all manner of expedients for publicly and privately disparaging the claims and prospects of their rival. One of their first steps was to circulate amongst gas shareholders throughout the kingdom a pamphlet directed against the Great Central, attempting to prove that it was an impossibility to manufacture gas at a lower price than 6s. per 1,000, with any reasonable regard to the shareholders' profits and the quality of the article itself.

Not only did the two opposition companies circulate this pamphlet universally, but their solicitor accompanied it with a letter by himself, in which he informed gas shareholders everywhere that their interests were endangered, because the result of the successful establishment of the new company would be to cheapen gas throughout the country. He therefore added:—"I am sure you will be anxious to give your support and assistance in opposing the bill to incorporate the Great Central Company, and therefore request that you will be so good as to put your local members in possession of the real facts of the case, and either request their assistance, or permit me to communicate with them under the sanction of your authority." Thus, not only was the powerful opposition of two wealthy City companies directed against the new undertaking, but strenuous efforts were made to excite against it the prejudices of vested interests all over the kingdom, and to concentrate their influence in obstructing it.

In April, 1849, the bill to incorporate the Great Central Company was brought into the House of Commons. This bill was the first that was submitted to Parliament with clauses for testing the accuracy of the meters, and the illuminating power and purity of the gas by public officers. Similar clauses have been insisted upon by the legislature in every bill that has been passed since that period, a matter on which I may justly feel some pride. In connection with this subject I may be allowed to explain, in passing, the reason why I adopted the wax candle, instead of sperm, as the standard of comparison in testing the illuminating power. First, wax is of a more certain and uniform material that what is called sperm. Secondly, the colour and the penetrating power of the light emitted from the combustion of wax more nearly approaches that emitted from the combustion of London gas than is afforded by any other substance; but of course the candle ought to be kept trimmed, and used as a standard when at its best.

Thirteen days were occupied by the Select Committee of the House in hearing counsel for and against the bill, and in the examination of witnesses, the writer himself having been under examination and cross-examination for four entire days. The two old companies meanwhile were straining every nerve to upset the bill. In this object they at length succeeded by detecting a slight legal flaw in the preamble, which the company's solicitors had so worded as to ask for power to "manufacture and distribute gas within the City," whereas the word manufacture should have been omitted, as the gas-works were intended to be erected without the City precincts. This single verbal inaccuracy of the lawyers was fatal to the bill, so far as that session was concerned, and it was therefore thrown out. This result occasioned great jubilation amongst its adversaries, and corresponding depression amongst many of its friends. The heaviest part of the blow, however, fell entirely on one individual, the promoter, who, according to previous agreement, had paid all expenses incurred in this defeat and the preceding stages of the company's progress. But it was at once determined that the disaster should not be fatal; the defeat should not become a rout—it should be merely a temporary check, and not a final stoppage. Notice was immediately given of the intention of the company to apply to Parliament a second time, in the ensuing year, 1860, for incorporation. This announcement was at once followed by another from the two companies, reducing the price of their gas from 6s. per thousand feet to 5s. (June, 1849). But the Great Central Company, although for a time failing to obtain parliamentary incorporation, was not thereby precluded from active and effectual progress. Steps were forthwith taken to register it as a joint stock company, with limited liability (at that period the present Limited Liability Act had not been passed, and the difficulties of such companies were much greater than subsequently). By September, 1849, the company was thus completely registered, and thereby obtained most of the advantages that a special Act could furnish, except the power of compulsorily carrying their operations or mains through any property whose owners were unwilling to consent.

At this stage of the company's history, the directors issued an address to the shareholders, stating that—"Mr. Croll has fulfilled, with the most scrupulous exactitude, every engagement into which he entered;" and that he had paid all the promotion expenses, amounting to £4,000. And further, "that, except the 1s. per share deposit (on 5,000 shares), neither the directors nor the shareholders have been called upon to bear any portion of the burden."

It now became necessary that that burden should be still further increased by making due preparation for the commencement of working operations. To secure the promoter's ability to perform the remainder of the engagements which still devolved upon him, he disposed of some of his private property, relinquished some of his other business undertakings, took a partner into one of his works, and, in fact, staked his prospects for life on the Great Central Company. Meanwhile, the profits of his business in the manufacture of his patent dry-meter, of his profession as consulting gas engineer, and as manufacturing chemist, were in a great degree suspended, owing to the industrious and systematic circulation of false reports and rumours by hostile parties. Happily, these attempts eventually failed, but at the time they were very trying.

The company having succeeded in becoming completely registered under the Companies Act, the next step was to obtain the consent of the City Commissioners of Sewers for the breaking up of the streets and pavement, in order to lay down the gas pipes.

Every gas company that had been established in

London since the formation of the Chartered, had endeavoured to obtain a share of the valuable gas preserves of the city of London, and had failed. Believing that the permission requisite was most likely to be obtained when under the guidance of one individual only, the writer made the following proposition to the company:—That he would, at his own entire cost and charge, make the application to the Commissioners of Sewers for liberty to lay down the mains and services of the company in the city. That if he succeeded in obtaining their consent, the company should pay the sum so expended, or any part thereof; if he did not succeed he would himself bear the whole cost and expense so incurred.

As a preliminary step it was necessary to institute a thorough and complete canvas of the whole of the inhabitants and householders of the city of London. For this purpose I decided to avail myself of the existing political organizations which are already in efficient working. The parties known as Conservatives, Liberals and Advanced Liberals, had each of them its own agency, consisting of a secretary, with a staff of men working under him, who knew and had access to every individual belonging to their party. I therefore saw the three secretaries, and engaged them and their staff in the work for a period of three months; their remuneration was made partly to depend upon the success of the enterprise. One of these gentlemen was to receive £75, another £100, the third £150, and this amount was to be doubled in each case if we succeeded.

Having, at a meeting between these three gentlemen, decided upon the policy to be pursued, offices were taken, distinct from the Central Company, on the west side of Moorgate-street. The whole of their staff were set to work, and obtained petitions to the Board of Sewers from the gas consumers of 111 City parishes. A large proportion of these petitioners, 4677, further entered into a contract to take the gas of the Great Central Company for five years, at a maximum rate of 4s. per 1000 feet. Before the decision of the commissioners was given, they were advised, evidently through the pressure of parties who desired to embarass the new company, to require as a preliminary step that proof should be given that at least £75,000 of the capital had been paid up. By means of vigorous exertions on the part of the promoter and a few friends, this difficulty also was overcome, by providing the needful securities and taking up the requisite number of shares.

In November, 1849, a general meeting of gas consumers was held at the London Tavern, when a resolution was unanimously passed requesting the Commissioners of Sewers to grant the requisite permission. On the 3rd of December the Board of Sewers met. Of 51 members present, 38 voted in favour of the application, and 13 against it. A majority of 25 therefore placed the Great Central Company in a position to go forward with vigour after all its delays and struggles for very existence. The three gentlemen who had undertaken and superintended the canvas, thus became entitled to the additional sums promised if successful. These were therefore handed over to them, and, with other expenses amounting to £1,100, was repaid by the company.

But another very heavy blow, which almost proved fatal, was to fall upon it immediately. The next day after this favourable decision of the Court of Sewers, the old City Gas Company announced that its price would be reduced to 4s. per 1,000 feet. This was intended to swamp the new company, which had not as yet a foot of pipe laid down in the City, and had only just obtained a provisional site for its works at several miles' distance, and which was still threatened by powerful opposition in various forms. The announcement, as might be expected, occasioned great consternation and bewilderment amongst the directors and shareholders of the Great Central. At the same time, overtures for a compromise were made to the new company by the old ones, but conditional on the suspension of all operations by the former. So adroitly were these overtures managed, that at a meeting of the directors of the Great Central a resolution was agreed to for winding-up the undertaking. This was, indeed, the crisis of the company. The promoter succeeded in getting the entry of this resolution on the minute book delayed. In the evening, after the board had separated, he took a cab and waited on each of the directors individually, in order to induce them to re-consider their decision. This attempt was successful. At the next meeting the previous determination was rescinded, and it was concluded still to persevere.

Shortly afterwards another attempt was made to conciliate the new company into a cessation of its operations. The two old companies now offered the sum of £10,000 to the promoter, directors, and shareholders of the Great Central, on condition of their consenting to withdraw from the field. They further agreed to continue permanently their recently reduced charges to the consumers. The sum offered would have more than covered all the expenses hitherto incurred by the new company and its promoter. Its acceptance was urged by Mr. Pearson (the chairman of directors) and other leading members of the Great Central management. It was now, however, too late to entertain such proposals, because the new company had entered into obligations, both with the Commissioners of Sewers and with the contracting gas consumers, to prosecute the engagements recently agreed to on both sides; and it was greatly to the eventual advantage of the public that such was the case, for not only were the citizens of London at once benefited to the extent of £40,000 per annum by the reduction in the price of gas to 4s. per 1,000 feet already granted by the old companies, but they were ultimately enabled to participate in further reductions by means of the new company. Still more important in its aggregate amount was the gain which now and subsequently ensued to the gas consumers throughout the country, in consequence of the persevering competition of the Central Gas Company, for the reduction of charges in the metropolis was speedily followed by a similar reduction in the provinces.

The early part of the year 1850 found the Great Central Company about to commence its real working operations. More than a year of time, and many thousands of pounds had been consumed in its struggles to obtain the necessary sanction for beginning to exist. But at length it had victoriously surmounted the colossal opposition which the persevering ingenuity of wealthy vested interests had so long arrayed against its establishment. The battle was even now by no means ended—many a sharp encounter was still to follow; but the crisis was passed, and the final issue of success began to loom in the future with increasing clearness.

Arrangements had been entered into for securing a site for the company's gas works in the parish of St. Pancras, a position which had many advantages, on account of its nearness to the City and its proximity to the principal railways and to a populous neighbourhood; but, owing to various influences (the source of which it was not difficult to conjecture), the company failed to secure the requisite permission from the parish authorities.

It was eventually concluded to erect the new gasworks at Bow, on a site which had the disadvantages of being two-and-a-half miles from the City precincts, thus involving very heavy expenses in laying down the connecting mains. At that time there were very few roads or inhabitants at Bow. The Commercial Gas Company's works were already established in that direction, but a mile nearer the City than the new company. There were also numerous other drawbacks, one of which was the difficulty of disposing profitably of the coke in that vicinity, involving a very heavy loss to myself, as compared with the facilities afforded by the vicinity of St. Pancras.

Towards the latter end of 1849, after much negotiation, contractors were engaged to erect the works upon a scale of prices agreed upon; the drawings and specifications and the land at Bow were handed over to them.

But it soon became evident that the company was to be involved in new difficulties by the reluctance of these contractors to proceed with the work. And the blow appeared to fall with disastrous weight, when, early in 1850, the company received an intimation that they refused to carry out the contract. The seriousness of this position may be estimated when it is considered that the promoter had contracted with 4,900 consumers to supply gas in September of the same year. Fortunately, however, other contractors were found, who agreed to take 25 per cent. of their payment in fully paid-up shares of the company, and, the contracts having been settled, the land at Bow was placed in their hands, and work commenced in the beginning of March, 1850. The new contractors, Messrs. Rigby, possessed great energy and ability, and carried the works forward most vigorously.

The important work of laying down the mains was now entered upon under circumstances of great difficulty. Parliamentary powers had not yet been obtained; it was therefore necessary to obtain the sanction of the authorities and the parishes lying between Bow-common and the City before their streets and pavements could be opened by the new company, and amongst these parochial authorities were some notoriously under the influence of the hostile companies. Nevertheless, the permission of the two principal parishes—viz., that of Whitechapel, next to the City boundaries, and that of Mile-end Old Town, adjoining the Bow Gas Works, was obtained with comparative ease, especially as the new company offered to supply the inhabitants of these districts with gas at City prices, a boon which was highly valued by them.

The Great Central Company was now in possession of most of the powers needful to enable the undertaking to be carried on to completion; but, inasmuch as it was also of importance to obtain parliamentary sanction in order to give greater confidence to shareholders, and to place the company in an indisputable position in case of certain contingencies, a bill was introduced a second time into the House of Commons for its incorporation by special act. A Committee of the House (of which the Right Hon. E. Cardwell was chairman), who evidently took a deep interest in the bill, and analysed the various clauses and the evidence with great ability, passed it unanimously in June, 1850, and it was sent on to the House of Lords with every prospect of success. But the Lord's Committee (to the astonishment of everybody) rejected it, after the most hasty consideration. Its eventual enactment was, however, a mere question of time. But these vexatious and useless delays, occasioned by the jealousy of the old companies, had already cost the Great Central Company and its promoter the sum of £15,000.

The laying of the mains commenced on the 24th of June, 1850. These had to be laid over sixty miles of streets during the next three months, as the company had contracted to supply gas to the consumers from and after the 29th of September in that year. The difficulty of completing so great a work in so short a time was considerably increased by the necessity imposed upon the engineer to carry on the work in the principal thoroughfares only at night, so as not to impede the traffic.

The principle of distribution adopted was somewhat novel, and was certainly at the outset more expensive than the ordinary mode; but it had the great advantage of reducing to a minimum the interruption to the street-traffic after the pipes had once been laid down, and the distribution of gas had commenced. Of the value and importance of this I had become convinced from long experience. In all the wider streets a secondary pipe, of smaller diameter than the main, was laid down under each footway, to be connected where needful with the larger main, which ran along the centre of the roadway. In the narrower streets the carrying main was laid under one footway, and a smaller pipe under the opposite footway. The advantage of this method will be obvious. For thus, when a service-pipe to a customer had to be laid it only interfered with one or two stones in the footway. These could be taken up in the early morning, and replaced before the time for opening the shops. Besides this, the service-pipes could hereby be made of the shortest possible length, which obviated many objections and difficulties well known to every one practically conversant with the supply of gas.

This system, however, caused no little disturbance of the streets at first. *Punch* characterised it as an invasion of the Picts (picks). The company sometimes had as many as twenty different gangs of pipe-layers working away in as many localities. The whole of Upper and Lower Thames-street, from Blackfriars-bridge to the Tower, about a mile in length, was laid in one night. With so many men working at once, in various places, and under the pressure of unavoidable haste, it is not to be wondered that some portions of the laying were very ineffectually secured; unexpected difficulties also arose, on the spur of the moment, requiring bends or syphons, when these were not on the spot. In such cases spaces were left, and the laying was urged forward without waiting to complete the omissions at the time, as no delay could be permitted. The ground was therefore filled in before morning, and hence it happened in some instances that these unfinished connections were forgotten.

It is not to be wondered at that work thus carried forward under cover of the darkness of night, and in the hurry of the final arrangements, was left so imperfect that during the first few days after the earliest supply of gas from the new works, nearly nine-tenths of the whole escaped at these uncompleted points. In one case, the gas was discovered discharging at full bore "from an eight-inch main."

Throughout August and September, 1850, the operations were pushed on with unintermitting vigour by day and night, that the company might be able to perform its contract to supply the consumers by the 29th of September. Beyond the small circle of those acquainted with the real progress of the work, it was generally believed that it would be impossible to fulfil these engagements. But by the middle of September the great advance that was being made could no longer be concealed from the eyes of opponents; for by that time the pulling up of the streets had become excessive, and there was scarcely a street or alley in the company's district that had not been torn up from end to end. At length, on the 14th of September, the Chartered Gas Company applied to the Court of Chancery for an injunction to prevent the laying down of pipes by the side of or across their mains; but this step was taken too late, for whilst the lawyers were discussing the question on both sides, the work was so far completed, by means of additional energy, that further proceedings were dropped, as being useless. But a more practical form of impediment was now offered to the new company's progress outside the City precincts. A portion of the line of route along which it was wished to lay the mains from the works to the Whitechapel-road, lay through a district under the control of the Middlesex and Essex Road Trustees, who (owing to the pressure of certain influences) refused their permission for the needful opening of the thoroughfares. The company was thereby necessitated to take a somewhat circuitous route along back streets and narrow bye-ways, in some of which it was necessary to lay the mains seventeen feet below the surface. It was also necessary to cross a canal over which there was a narrow bridge, along which a three-inch main had previously been laid by the Commercial Gas Company.

At this time that company proceeded to lay an additional ten-inch main up the bridge on one side, across it at right angles and down the opposite side, connecting it also with the smaller main at each end. Although the Commercial Company possessed the right to lay gas pipes upon this bridge for the supply of the district, they had no right to open the ground for that purpose without giving three days' notice of their intentions to the local authorities. They failed to give this notice until they commenced the work, so that the opening of the ground and giving the notice were simultaneous. Inasmuch as the only way in which the works at Bow could be connected with the City for the supply of gas was over that bridge, this serious obstructive action on the part of the Commercial Company was immediately known to the writer, whose eye rested upon that bridge as he passed it day by day with considerable anxiety.

A meeting of the local authorities was called for the following evening, when Mr. Pearson made a powerful appeal to the parish board. The board, having previously given permission to the Great Central Company to lay down their mains in every street and lane of the parish, were indignant at this attempt to frustrate their previous decision. A special committee was appointed to meet the writer the following morning, at 5.30 a.m., with power to do all that was necessary to aid in removing the obstruction, and give the company possession of the bridge, so to enable them to lay their mains. The writer was at the appointed place of meeting a little before the time named. This special committee, who were full of ardour and patriotism on the previous night, were on the spot before him, and, to the writer's utter consternation, were unwilling to do any one single act to aid him beyond going through the very quiet and respectable farce of ordering their beadle to remove the mains, which he proceeded to do by taking up a shovel in his hand. The secretary of the Commercial Gas Company placed his hand upon the beadle's shoulder—this was considered an assault. Summonses were then to be applied for for this assault, and the whole matter argued out in the highly proper way before a judicial tribunal. It was vain for the writer to argue with these gentlemen; therefore, mentally deciding upon another course, he quietly left the ground.

The Commercial Gas Company now blocked up the bridge at each end by thick 3-inch planks, 10-feet high, with strongly-guarded wicket entrances, and posted a party of 200 men, well supplied with food and liquor, inside the barriers, and in possession of the bridge.

It was absolutely necessary for the Great Company's main to cross this bridge before another day passed, for the three days' notice which the Commercial Company had given for the opening of the ground would have expired, and they would, at the expiration of the notice, have had legal possession of the bridge, which at that time they did not possess. It was resolved to carry it by a sudden onslaught at whatever cost. Accordingly a number of waggons were quietly loaded with pipes, chains, slings, crowbars, planks, picks, and shovels. Four powerful horses were then harnessed to each of the waggons, which were forthwith started at full speed, with a large body of picked navvies in each. Fortunately, these arrived at the bridge at an unexpected moment, when a number of its defenders were scattered in neighbouring beer-houses. The advanced guard having removed the strong hoardings previously erected, the whips were vigorously applied to the horses, and, with a loud hurrah, the bridge was taken. Hammers and crowbars were speedily in operation, chains were looped on, horses attached, and the whole of the obstructions were dragged over the bridge and thrown into an adjoining field. The waggons were placed across the bridge at each end, and strongly barricaded, and the whole vigilantly guarded.

The outposts, who penetrated into the enemy's camp, learnt that it was determined to retake the bridge that afternoon, and for that purpose to employ a thousand men, dock labourers and others. This information was considered so serious, that the writer immediately went to the Thames Police-office, and made a declaration of the state of affairs, and the danger that might result to life unless the magistrate gave him the protection of a large body of police. The magistrate at once dispatched as many men as he could spare. The writer also persuaded Mr. Warren to go to Scotland-yard to make a similar statement. The small army of defence was then reinforced by a large number of police, some of them mounted, two inspectors, and a superintendent. The writer thereupon retired to his head-quarters, with feelings of perfect security, the mounted police reporting from time to time that the enemy had not shown himself in any direction. Thus ended the Battle of the Bridge.

By the middle of September the new company had a slow fire put to six "settings" of fourteen retorts each, and by the 27th of September the manufacture of gas commenced. In the meantime the leading 26-inch main had been completed from the works throughout, and connected with the mains in the City. On Saturday, the 28th of September, 1850, the valves at the works were opened, and the gas sent forward.

It ought not to have required much more than 100,000 feet to charge the mains, but after 400,000 feet had been sent out, it was found that only a pressure of a few tenths could be maintained, and during the whole of the afternoon reports were being brought in of escapes of gas, which, in some places, was being discharged through the ground in large quantities. It was at this juncture that the omissions of some of the workmen during the recent period of forced haste and hurried night-work came to light. However, Saturday evening and the next day remained to remedy these defects, and, notwithstanding all obstacles and delays, the supply of gas was duly commenced and regularly continued from the Monday following, the day which had been fixed in the contract with the consumer.

Meanwhile, although the regular supply of gas had commenced, the works were by no means complete. Only one-third of the gas-holders, retorts, and purifiers were in working order, and the paving was scarcely begun. The necessary offices and shelter for the workmen also unfinished, and for a time every comfort and convenience was sacrificed to the one object of maintaining the supply of gas. At the half-yearly meeting of the Great Central Gas Company, held October 30th, 1850, it was announced that 4,660 services had been laid on, and that 15,000 of their lights were burning on the premises of the consumers. By the end of the same year the company were already fulfilling the promise of its original prospectus, the supply of pure gas to the public at 4s. per 1,000 feet, and at a good profit also to the shareholders.

In the session of 1851, the Great Central Company, although in complete and successful operation, applied a third time to Parliament for incorporation. The Court of Common Council also petitioned in its favour, and this time the application was acceded to by both Houses. The total cost of the three applications amounted to £29,000. In the following year the directors announced that their capital account was closed, and at the same time they were pleased to record in their report the following acknowledgment of the engineer's exertions:—"Your directors feel that they cannot dismiss this important part of their subject without paying a well-merited compliment to their talented engineer, Mr. Croll; and those of the shareholders who have visited the works since their completion, and observed their extent and magnitude and the simplicity and order of their arrangement, will fully comprehend the claims he has upon them for the successful exercise of his talent as an engineer, as well as upon the public at large for the important part he has taken in reducing the price and improving the quality of gas throughout the metropolis."

Two years later, in 1855, the chairman of the Great Central informed the shareholders that he and his colleagues were "working in the most harmonious and agreeable spirit with the other companies." The latter had already learnt, to their surprise, that the principles on which the new company had been established were a great boon to the shareholders of all gas-works, as well as to the public universally. For whereas, under the high prices of 1848, the dividends of the old companies only ranged from five to six per cent., they subsequently rose to, and continued at, ten per cent., under the lower prices to consumers. And not only so, but the value of metropolitan gas shares have also risen to 60 and even 80 per cent. above par. This continuing prosperity of the companies, taken in connection with the permanent and large gain of the public, affords a striking comment upon the absurd and gloomy forebodings which were so widely propagated even by intelligent officials and shareholders in gas undertakings when the Great Central Company was started. The gas literature of that period abounded with dismal predictions of disaster, injury, and ruin, all of which have been proved to be totally unfounded by the brilliant success of gas enterprise in subsequent years—success which is fairly to be ascribed to the Great Central and its promoters.

In 1853, the chairman stated at a meeting of the directors, that "the company were mainly indebted to Mr. Croll for the success they had achieved." In 1853, the directors addressed the shareholders "on the efficient manner in which Mr. Croll has carried out his contract, notwithstanding the increased price of coal, labour, and materials during the last year."

When the Great Central Company had established itself on a working basis, the older companies commenced a vigorous competition by manufacturing gas of increased illuminating power. Hereupon the engineer of the former, in order to retain its customers, offered to increase its illuminating power also, on an agreement with the directors that he should be paid one halfpenny per "candle" above the standard of light fixed in the previous contract. It was, however, further agreed that this additional payment should be made out of the surplus profits accruing to the company beyond ten per cent.

The increased illuminating power of the Great Central Company's gas was henceforth (or at least so long as the original engineer remained with the company) raised to a high standard of superiority; and the regular official reports of Dr. Letheby, the chemical referee, appointed to test the City gas, continuously showed that the quality of the gas supplied under the contract first alluded to from the Great Central Works, was maintained at more than 25 per cent. above the Parliamentary standard.

It ought, however, to be further said, that the mode of testing at present adopted would have added a nominal and apparent increase of illuminating power amounting to 25 or 30 per cent. In other words it is pretended that the citizens of London are now receiving gas equivalent to 16 candles; but if it were tested now as it was tested then it would be found that they are receiving gas of an average illuminating power not higher than 13 candles. To supply gas of this higher quality, however, involved a heavy loss to the engineer, inasmuch as it necessitated an increased use of cannel, and shortening of the time of distillation of the coal in the retorts.

Matters continued thus for some time, the engineer losing by his efforts to promote the success of the company, and the profits of the latter so increasing that it was evident that a dividend of 10 per cent. could be fairly declared, thus showing to the engineer the right to claim the additional payment guaranteed to him in this event. But instead of so-doing the directors had now formed a depreciation fund, which absorbed that share of the profits which, according to the recent agreement, would have otherwise been disposable to compensate him for his increased outlay. Thus the dividend was maintained a little lower than 10 per cent., causing him a loss of many thousand pounds.

The contract between the engineer and the company had been for a period of 5, 7, 14, or 21 years, determinable at the option of the company at any of those dates. The directors had repeatedly and emphatically expressed their satisfaction at the mode in which he had carried out his part of the contract. Up to the end of 1855 he had, under the circumstances already stated, paid over to his co-promoter a sum little short of £7,000. He now, however refused to pay any further sums until he had been recouped for his advances.

The rental for gas had now so increased that by the end of December 1856 there remained, after paying a dividend to the shareholders of 8 per cent., the sum of £8,000. This increased rental was due mainly to the high illuminating power supplied by him. He felt, therefore, that in view of all these facts he had a claim to at least a portion of this surplus. But, in reply to his claims, the directors pleaded the strict letter of the new contract, and insisted upon appropriating £4,800 to the depreciation fund, overlooking the fact that his contract was entered into in 1852, the depreciation fund only commencing from 1853, a year later.

The first period of five years of engagement between the engineer and the company had passed over. They now gave him notice* to terminate the engagement at the end of the seventh year, that is to say, December, 1847. It subsequently appeared that the connection was terminated just then, in order that he might cease to hold his position before the 10 per cent. dividend was declared, and thus lose his claim to repayment for losses incurred in raising the illuminating power of the gas supplied by him. This statement may scarcely be credited, but it seems to be confirmed by facts which cannot be called in question. The dispute between himself and the company was subsequently referred to arbitration, when a sum of £10,200 was awarded to him, The arbitrator chosen by the company was a member of the Institution of Civil Engineers, the late Mr. Charles May, and the writer has reason to believe that he was prepared to award him a larger sum than that finally agreed upon. The progress and improved condition of the company during the years which preceded the termination of the contract may be gathered from the following statement:—

Rental for the six months ending		Dec., 1855..	£23,600
,,	,,	June, 1856..	25,800
,,	,,	Dec., 1856..	28,400
,,	,,	June, 1857..	29,500

Assuming that the rental had continued to increase in the same ratio for the next six months, the income of the company would have been £60,000. It will thus be seen that a dividend of 10 per cent. upon the whole capital of the company would have been secured, and the engineer would have been entitled to his additional payment on the high illuminating power of the gas supplied. The roads leading to the works had been greatly improved. A large and profitable trade for the sale of coke had been secured; and yet it was at this moment that the engagement was terminated. Such an action needs no comment, and the writer forbears to characterise it in such terms as he feels that it deserves.

It is with great pain and reluctance that I proceed to speak of the subsequent history of the company. It is, however, necessary to glance at it in a sentence or two. The embezzlement of £70,000 by one of the clerks of the company a few years ago, excited the astonishment of the whole empire, and the disastrous Wood-street fire involved them in a loss of £30,000. Thus from these two circumstances alone a sum of £100,000 has been lost to the supporters of the company, and yet its prosperity was laid upon so firm and sure a basis that it has paid 10 per cent. upon its capital from the commencement of the undertaking, in spite of all losses. And now the company has checked all further prosperity and development by allowing another and less thriving company to absorb their own, on condition of receiving a dividend of 10 per cent. This being the highest legal dividend, the shareholders have only suffered indirectly by losing the prospective advantages of investing additional capital at a high rate of interest in extensions of plant and works, such extensions and consequently all such further profits being reserved for the shareholders of the Chartered Company, which has absorbed them.

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* By a subsequent arrangement possession was given up, and the company entered upon the Works in June, 1857, six months before the expiration of the notice.

But if the shareholders have only lost this privilege, what have the gas consumers in the City of London lost.

The Great Central Company were paying 10 per cent. dividend, the highest permitted by the Act of Parliament, and therefore if the contract with the writer had remained, he would have realized a good profit, and the price of gas ought now to have been reduced 6d. per 1000 feet. The gas rental of the Central Company for the year ending June, 1871, must have been about £93,000 per annum, adding 10 per cent., the usual annual increase, and we have for the present time a rental of about £103,000.

Taking the quantity of gas required to supply this rental at 2s. per 1,000 feet, viz. :—1s. 9d. for the gas supplied at the company's meters for gas supplied in accordance with the New Central, and 3d. per 1,000 feet for increasing the illumination six candles in addition, it is evident that the price of gas ought now to be reduced, had it not been for this last and most improvident act of the Central Gas Company, which would not only have effected a saving of £20,000 to the consumers supplied by the Central, but the gas would have been of a purer quality and of an illuminating power of a light equal, as shown by the present mode of testing, of 20 candles.

The accompanying drawings, No. 1, is a ground plan of the works. The parts coloured show the parts built for the first year's manufacture of gas. The portion in hatched lines represent the remainder of the design as originally contemplated.

The retort house was 215 ft. long by 64 ft. wide, and was constructed for 22 double-length settings, of 14 retorts each. It was divided into three blocks, with passages between them, and was capable of manufacturing about two million feet of gas per day.

Retorts constructed on this principle, open at both ends, are now universal throughout the whole of London, and it is gratifying to find that the engineers of the various companies have followed the example thus set them.

Those represented in the drawings show clay retorts on each side and above the furnace, and the better conducting medium, iron, below the furnace; the peculiarity being placing the furnace in the centre of the retorts, whether those that were placed below the furnace were iron or clay. These settings are of the simplest kind, requiring the smallest amount of brickwork—only, in fact, that which is necessary to support the retorts. The heat generated in the furnace acts upon the lower retorts in its passage to the horizontal flues, placed under the two bottom retorts. Unhesitatingly, however, I should for many reasons prefer that the retorts under the furnace were iron, and not clay, as they are here represented.

Another building contained the purifiers, eight in number; also the steam-engines and exhausters in duplicate. In a third erection were the station-meters and governors.

A railway was constructed along the entire length of the retort-house, and on each side of it, and subsequently a siding was formed in connection with the North London Railway, which enabled the trucks to travel from the coal pits to the very mouths of the retorts.

The steam-engine was one of Wenf's high-pressure and condensing engines, and, instead of pumping water for the condensers, both the gas-holder tanks were connected at the top by a 6-inch pipe, so that the water for the condenser was drawn cold from the one tank and then pumped back by the engine out into the other. Thus an unlimited supply of out water was secured without cost, and preventing the tanks from freezing in winter.

Purifiers.—The system of purification adopted by the engineer consisted in first passing the gas through the horizontal and vertical condensers; from thence it passed through double vessels containing a solution of chlorodine of manganese, by which it was entirely freed from ammonia and a portion of its sulphuretted hydrogen; it was then passed through triple vessels containing lime water, and again passed through double vessels containing dry lime.

Such was the absolute purity of the gas, that when Dr. Letheby gave evidence before the House of Commons, the standard of purity of gas in regard to ammonia and sulphur compounds were given by him, viz. :—twenty grains of sulphur, five grains of ammonia to the 100 feet of gas, because he had on no occasion found ammonia or sulphur compounds in the Great Central gas, as then made, to a greater extent than the standard he gave.

And in referring to this subject, the writer may be pardoned for remarking that it argues little, at any rate, for the scientific and engineering progress of the directors of that company since his own connection with it, that they, having altered the apparatus he constructed for them, have since been manufacturing gas so impure as to have caused not only numerous bitter complaints from the customers, but also repeated intimations to the Court of the Commissioners of Sewers, that it might become necessary to inflict the fines against manufacturers of impure gas.

Never, during the whole period that the Great Central works were under the management of the writer as engineer, was the board of directors obliged to descend to the language of apology to the public for the quality of their gas; but ever since that period the apologetic tone has been their repeated characteristic.

Tanks.—These were formed by raising the upper portion several feet above the general level. A cone was left in the centre of each, thus much time and labour was saved in not having to cart away any of the excavated earth.

Gas-holders.—These consisted of four, and were placed within about ten feet of each other, and instead of having a pipe well to each, with a ladder for access, there was one large well common to all the tanks, with a hanging, winding stone staircase, giving complete and easy access to all the pipes and valves of the gas-holders.

The guide-framing to these holders was the lightest, and certainly the strongest that was ever erected, because, in addition to the binding of the whole by diagonal stays, the framing of all the gas-holders was connected at eight points (as shown in drawings 1 and 2), namely, at the four junctions, and at the standards next to them. These gas-holders have now stood the storms of twenty-one winters without an accident of any kind. They are each about 102 feet in circumference, by 50 feet in depth, and are of the telescopic kind. They were the first example of gas-holders of this magnitude without any internal trussing in the crowns. Their united capacity is 1,700,000 cubic feet.

The opponents of the Great Central Company raised serious objections against the absence of crown trussing to its gas-holders. A short time previously a gas-holder without trussing, built at the Western Gas-works, had collapsed, and a similar failure was now predicted of the new company's holders, especially as the cast-iron framing attached to the tanks to guide them, was so much lighter than anything of the kind previously erected, but, as the result has proved, these gas-holders were stronger than others elsewhere, because, although the whole of the crown trussing was omitted, all the other parts were of unusual thickness. Hence, when afloat, these holders effected a pressure nearly as great as if they had been trussed; and, allowing about six tons for the levity of 420,000 feet of gas, the total weight of iron was about 96 tons.

Now, it was not unusual for a gas-holder of these dimensions to have 30 tons of trussing in the roof, and yet not be heavier than one of the Great Central holders.

Hence to each of the latter there were added about 30 tons of material to strengthen the parts, which the engineer's experience had shown him to be most liable to wear and tear, namely, at the top, which, being always exposed to rain, sometimes suffers in consequence from oxidisation of the sheets; also at the side sheets, at the water-pan of the cap, where the annual painting can never be satisfactorily done, and at the last row of side-sheets, which chiefly receive the thrust of the wheels which guide the gas-holder, and to which they are in close proximity.

The guiding standards attached to the tank were about 53 feet in height. They were simple, open-leaf casts in three pieces, weighing respectively 22, 19, and 17 cwts., or about three tons each standard.

Gas holders of this size had hitherto been guided either by circular columns, or by open-leaf tripods, generally, but not always, tied horizontally at the top, and so massively constructed that the bottom bolts attaching them to the masonry were able to bear the entire thrust of the gas-holders, when acting against the upper end of the tripod. Both these kinds of construction evidently involved a great waste of material.

Now, the guiding standards of a gas-holder are simply girders acting perpendicularly as such, but receiving the thrust of the gas-holder horizontally. They had hitherto been constructed with tall columns only, tied horizontally at top and bottom, being, therefore, very weak comparatively, and also very costly, to say nothing of their absence of architectural proportion, as compared with the classic standard of columnar height, about ten diameters.

Each column has usually weighed about ten tons, and each lower casting (generally terminating at the top of the base moulding) about three tons, or as much as the weight of the whole standard at the Great Central works.

It may be mentioned, in addition to what the writer has already stated in reference to the mains, that the supply was sustained by two leading mains, conveying the gas from the works to the City. The one conveyed the supply, immediately on its reaching the City, by branches of large mains passing right and left up the centre. The other main was carried as far as the middle of Cheapside before it was connected with any of the supply mains, but the valve upon which at the works was never opened until the pressure-guage indicated a pressure below that which it was considered desirable to work; this arrangement worked exceeding well during the whole time the writer had charge of the works.

Notwithstanding the continuance of the company's operations for nearly a quarter of a century, and the greatly increased number of the gas consumers, there has been no subsequent addition made to the amount of their gas storage, a fact which cannot be stated of any other metropolitan company in the kingdom. Neither has there been any very large addition to the capacity of the mains

The whole of these extensive works were constructed, and the supply of gas commenced, within a period of little over six months from the time of commencing the works—60 miles of mains and 40 miles of services in a period of three months. The mains varied from 2 to 36 inches internal diameter. Some practical notion may be formed of the size of the leading main when it is known that two men went from the works to the City inside that main for the purpose of ascertaining if it was all sound, and also for the purpose of paying out a telegraph wire, by which instant communication was made between the works and the City, and was, it is believed, the first application of this science to the purpose of private telegraphy.

These mains were laid principally during the night in the most crowded thoroughfares known, and under circumstances of unheard difficulties. And it gives the writer great pleasure to state that no accident of any kind occurred to the men engaged in these arduous and extensive operations that were required to bring the works of the company to completion.

During the whole of these laborious undertakings I had the most anxious and earnest valuable assistance from my late highly esteemed private secretary, Mr. George Rait. I was also highly favoured by the indomitable energy, intelligence, and practical knowledge of Mr. George Anderson.

The large reduction in the price of gas was by no means the only benefit (considerable as it was) which the establishment of the Great Central Company was the means of securing to the citizens of London, and indirectly to the people of the United Kingdom. It also effected a sweeping reform in several other important departments connected with the gas supply.

Previously to the commencement of the company's operations, very little attention had been bestowed upon the subject of gas-testing, and there were no publicly-recorded observations respecting it as there are at present. In fact, the value of gas as an illuminating agent, and as affecting buyer and seller, was not at that time fixed by any determinate standard, or studied as its importance demanded. It was reserved for the Great Central Gas Company to awaken and instruct the popular mind as to correct principles in this department, and by establishing tests, based upon determined facts, as to the amount of light-giving substance contained in the article supplied to the public. That company first introduced amongst the general consumers of gas a conviction that they were entitled to be made acquainted with the real value of the article (which they could then only purchase from one or two sources of supply). And that company first placed within their reach, by means of published tests, a correct valuation of that which they received for their money; for it was one of the earliest regulations of the company that its gas should be regularly tested by competent and disinterested officers, who were to be at its request appointed by the municipal authorities, and whose testings were published for the information of the consumers.

The company also urged the adoption of a similar practice in respect to gas meters. The promoter was aware that these were accurately constructed, but he urged that it was desirable also that the consumer also should be assured of this, and not merely on the word of the company's officers, but by the testings of independent authorities, to whom at any time appeals might be made in case of disputes arising as to the supply. The directors therefore requested the City Commissoners of Sewers to appoint, in accordance with the bill, suitable inspectors, both of the meters and of the purity of the gas supplied by the company

It may be of some interest to the members of the Society to know the remuneration the writer received for the construction of the works and the vast labour and risk connected with the promotion of the company. He received the handsome remuneration of 5 per cent. upon a part of the constructive value of the works, and he regrets to say that sum was even judged and remarked upon.

The author will never cease to remember with gratitude the quiet but telling remarks which were uttered by the late Mr. Delane, when hesitancy by some of the number was expressed to pay him the sum of little over £4,000, which was the sum he received in lieu of all charges for plans, specifications, and superintendence for himself and staff And perhaps he ought here to express with deep gratitude the consistent and strong support he received from two other members of the board (in addition to Mr. Delane) throughout the whole intercourse with the company. Mr. Virtue followed him in almost every undertaking the writer was connected with; and Mr. Wyld, who gave me his constant and unvarying support, was pleased to sign and pay upon a number of shares at the commencement of the company five times greater than that of the chairman and deputy-chairman put together, these gentlemen having refused to take any shares beyond their simple qualification until such time as the company was beyond risk.

In conclusion, it may be remarked that the history of the origin and establishment of the Great Central Gas Company is not only interesting as a narrative of an enterprise which was the means of effecting great reforms in the manufacture, quality, and price of gas in this country, but also as an illustration of the struggles and eventual triumphs of more than a few of the great engineering and mechanical undertakings to which the prosperity of this and other lands is so deeply indebted. Many of these monuments of skill and perseverance convey to the ordinary speculator the conviction that numerous obstacles must have been overcome by their completion; but only those persons who have been practically and intimately conversant with those visible triumphs can be aware of the enormous extent and variety of such difficulties—difficulties, indeed, the existence of which would sometimes not be suspected even by well-informed men, and which in some instances, such as the one now narrated, might be reasonably presumed to be in no way involved by the nature of the undertaking, whose success they have nevertheless so greatly impeded and imperilled.

DISCUSSION.

Mr. Dresser Rogers said Mr. Croll was entitled to the thanks of all gas consumers for his admirable paper, particularly as it showed that his efforts on behalf of gas consumers had had at the same time a beneficial effect on shareholders' dividends, contrary to the opinions of many, who seemed to think that any advance in gas science was detrimental to shareholders. So far was this from being the case, that before the Great Central Company was established, gas property throughout the kingdom was much depreciated, whereas it was now at a higher price, and much better dividends were paid than before. Although Mr. Croll had graphically described the difficulties which he had to encounter, no one who had not taken part in the struggle could realise the intensity of feeling which it aroused and the energy which was required to conquer the obstacles which were thrown in the way. A similar agitation had taken place in South London, ending in the establishment of the Surrey Consumers Gas Company, which had been most beneficial to the gas consumers. He could not but refer to the assistance kindly rendered by Mr. Croll on one occasion when, the engineer having married and gone on a wedding tour, they found one Saturday evening that the whole district was in darkness, the gasometers having entirely collapsed. He must say he regretted the amalgamation of the Central Gas Company with the Chartered Company, though he did not wish to say anything against the latter, which he considered an admirably managed company. He might be allowed to pay a tribute to the memory of the late Mr. Livesey, engineer of the Surrey Consumers Gas Company, and considered it was a great advantage to consumers that there were two companies in the metropolis working with comparatively small capital, and he was glad that the proposal for an amalgamation between the Phœnix and South Metropolitan had fallen through, and did not think the shareholders would at all suffer. The consumers now got 14-candle gas for 3s., and if Mr. Livesey, the son and successor of the first engineer, were as successful as his father had been, he had no doubt the price would be even still further reduced at no very distant day. With regard to sulphur and other impurities, he believed it was greatly owing to Mr. Croll's exertions that these were so much reduced; and it was a very remarkable fact that, since the amalgamation of the Central with the Chartered Company, the proportion of sulphur had very much increased. It was a very lamentable fact that chemists could not devise some means of getting rid of the sulphur, for the public were deeply interested in the question of the purity of gas, and he hoped it would receive close attention until some means of remedying the evil was arrived at. Although not directly connected with any gas company, having taken great interest in gas matters, he was constantly receiving correspondence on the subject, and one main subject of grievance seemed to be that consumers had larger gas-bills than formerly, although the gas was lower in price, and they were not conscious of burning any more gas. He had told the engineer of the Chartered Company and others that some *bona-fide* answer ought to be given to this almost universal complaint. Sometimes it was said that the weather had been foggy, sometimes that the meter was out of order, or that the burners were not attended to, but he thought there was something beyond this, and it could not be for the interest of shareholders that there should be constant complaints on the part of their customers, who felt sure that they had not burnt more gas than before when their bills were less.

Mr. Botly said he quite agreed with the observations of Mr. Rogers, and thought that the thanks of the meeting were due to Mr. Croll for the admirable paper they had heard. In the seventh paragraph reference was made to the refuse gas products being extensively used as manure for agricultural purposes. He thought it had been very much doubted whether the refuse was of any service as manure, but he had used a great deal of it, and had found it very serviceable. Those who objected to the use of this article had mixed it with fresh manure, which dissipated the ammonia, and destroyed the strength, in the same way as lime did, but if it was mixed with road scrapings, the refuse of ditches, decomposed weeds and vegetables, and turned over occasionally, it made a very excellent manure for turnips.

Mr. Tallack thought that Mr. Croll was unduly modest when he claimed in his paper to have introduced some improvements and reforms in the manufacture of gas; for he considered that he had really produced a revolution. When they looked at the fact that £40,000 a year had been saved to the gas consumers of the City of London, and that the company founded by Mr. Croll had been in operation about 20 years, that alone gave something like £800,000 to the consumers; in addition to which gas shares had doubled in value, and dividends had gone up. Similar improvements had taken place all over the kingdom, and therefore it was not too much to claim, as a revolution in the manufacture and distribution of gas, the result of Mr. Croll's labours. He agreed with Mr. Rogers that the lecturer had not brought forward the real difficulties he had had to encounter. If any one looked to the pages of the *Gas and Water Times* about 1857 or 1858, they would find a very interesting series of papers on the Central Gas Company, and the arduous difficulties which Mr. Croll had overcome, but which he had not alluded to that evening. It reminded him of the icebergs which were sometimes seen in the Atlantic, whose magnificent proportions astonished all beholders, but which only displayed a very small fraction of their beauty, three-fourths or more being hidden below the surface. And so it was with some manufacturing processes. Great as was the success which was visible, the labour and pains which lay concealed in the past were still greater. He was sorry that the company had not the services of Mr. Croll still, for they were wanted on account of the deterioration of the quality of the gas, and in connection with the manner of laying the pipes without breaking up the road so as to disturb the traffic. Those who were in the habit of moving about the City must have observed how the traffic had been impeded by the long continuance of excavations, and he thought it a great pity that the plan adopted by Mr. Croll of laying one main along one side of the street, and a small pipe on the other side, leaving the middle of the street free, was not universally adopted.

Mr. Jones desired, as a consumer, to thank Mr. Croll for showing what a web was formed around them by gas companies. They seemed to do pretty much as they liked, and were to pay 10 per cent. out of a monopoly which they obtained of ground granted to them in various districts, for the use of which they paid nothing. Under the new system they were enabled to turn all their borrowed money into supplemental capital, and thus to put 10 per cent. into the pockets of their shareholders. All this was done by judicious organisation on the part of the companies, while the consumers were as helpless and unconscious as a parcel of sheep in a field. He did not object to shareholders having a reasonable profit, but thought 6 per cent. was quite sufficient. He knew, however, from experience, the difficulty there was in dealing with the matter in district boards, where the companies were always represented.

Mr. H. P. Stephenson said he was one of those unfortunate wolves referred to who fed upon the lambs. He should not have troubled the meeting with any observations, but that he thought Mr. Jones had not truly and justly represented the facts of the case. The gas companies did not receive 10 per cent.; and in the majority of cases they did borrow money. The Chartered Company's dividend was limited to 6 per cent., and a large number of companies throughout the country had their dividends limited to 7 per cent., and they did not turn their borrowed capital into share capital.

Mr. Chubb said, as secretary of the Imperial Gas Company, he was also one of the wolves, but it was not the case that gas companies received 10 per cent. universally. His own company was formed 50 years ago, when things were not so well known as at present, and for many years they paid no dividend; whilst for many more they paid a very small one. Then for some years subsequently they paid 10 per cent., but the present shareholders had mostly bought their shares at a price which only yielded them 5 per cent. Neither was it the case that the borrowed money was turned into shares; it remained at the cheapest rate at which they could borrow it. Many other things had been stated which required correction if time permitted. With regard to the success of the company described, it was very easy to commence a manufacture which had been for many years perfecting, by a new company with a more limited capital, and the gas could be sold at such a price as would pay that limited capital a very good dividend, whereas the old companies, who had had to bear the brunt, and suffer for many years, as he had mentioned, could not do so and remunerate their shareholders. With regard to sulphur, the great difficulty of chemists had been for a long time to discover what impurities there were in gas, and the apparatus for that purpose had been wonderfully improved of late years, so that now they could detect impurities which were never found before, especially compounds of sulphur, which the old apparatus did not discover, and which gas was not known to contain. Therefore, it was not that modern gas was more impure than formerly, but the reverse, only modern science was better able to discover the impurities. In Mr. Croll's early days there were no means of discovering sulphur in gas, and now he thought gas companies were rather hardly dealt with, inasmuch as chemists found out the impurities, but left the companies to find out how to get rid of them. The gas referees had had the new works of the Chartered Company in their hands, and every appliance put at their disposal for the purpose of finding out how to purify gas, and they had just issued a report, stating that their efforts had proved a complete failure, and that the gas which they had tried to improve had turned out worse than what was made before. The works which Mr. Croll erected for the Great Central produced gas containing very little sulphur, but it was quite irregular, sometimes showing 20 grains, sometimes more, sometimes less.

Mr. Croll said it was always under twenty grains per hundred cubic feet whilst he had charge of the works.

Mr. Chubb said he did not believe Mr. Croll knew at that time exactly what was in the gas. The same works continued now to give purer gas than the magnificent new works of the Chartered Company, which were designed expressly for the purpose of making pure gas; for whereas at the former it sometimes only showed 12 or 17 grains of sulphur, and then would rise to 30, at the new works, under the gas referees' management, it had shown 47, 50, and sometimes even 70 grains. The referees acknowledged they could not discover the cause of this, and yet they had issued a manifesto enjoining companies never to have more than 30 grains per 100 feet. This was rather a hardship on the companies, considering that they were under a penalty of £50 a day for issuing impure gas, which penalty had to be deducted from the dividends of innocent shareholders, who had no possible means of purifying the gas. Something had been said about the advantage of laying the gas mains under the pavements which he quite agreed with; but it could only be done in the City, for elsewhere the coal-cellars were under the pavement, and it would be impossible to lay pipes there. With regard to the consumption of gas, and people fancying that the gas companies pumped something or other through the meters to make them register more than was consumed, for that was what was implied, and he had seen it in print, it was simply impossible. The meter was not a perfect instrument, but it was so far perfect that it showed very closely what the consumption was, and the companies had no sort of control over it whatever. Thanks to Mr. Croll, who had certainly materially benefited consumers in this respect, there were persons appointed to test the meters on application, who would certify whether they were correct or not. Notwithstanding all this, the public would have it that the company did something to make them burn more gas than they wanted. Consumers ought to know that this was impossible. There was often great fault in the fittings, and the burners were so neglected that twice as much gas was consumed as was necessary. Modern gas-fiting was something shameful; in America such work was not allowed, for there nothing but iron pipes were used, and they were tested to a certain pressure before they were put up. The composition pipes used so commonly in London very often had nails driven into them, which, of course, caused a leakage.

The Chairman, in proposing a vote of thanks to Mr Croll, said it was 22 years since that gentleman had commenced operations, and his energy and enterprise had caused an entire change in the system of gas management. It had not only had the effect of breaking an existing monopoly, but had brought down the price of gas considerably. For some time the question had agitated the public mind whether it was possible to combine good dividends with improved light, and Mr. Croll had shown that it was quite possible, under proper management, to manufacture excellent gas containing a very small amout of ammonia and sulphur, and at the same time to pay largely increased dividends to shareholders. He could not help thinking that a great deal of the impurity of gas was due to the action of the Legislature in limiting the dividend to ten per cent., and sometimes less; for as soon as the company arrived at the maximum amount of profit it ceased to have any motive for improving the manufacture. By leaving the shareholders and the companies to make as much as they possibly could, they would soon find their interest would consist in giving a greatly improved article of consumption. They had heard from Mr. Croll the way the gas mains were laid at night, and he thought it would be a great advantage to the public if the streets were taken up during certain hours of night only, as by that means they would get rid of the inconvenience of having the roads continually broken up. Some few years ago, he was connected with Mr. Croll in establishing the United Kingdom Telegraph Company upon the uniform shilling principle. They had enormous difficulties to contend against at first but owing to the energy of Mr. Croll, they succeeded in overcoming them, and at length were in a fair way to pay handsome profits, when they had to sell the concern to the government. In conclusion, he begged to move that the best thanks of the meeting be given to Mr. Croll for his valuable paper.

Mr. Croll, in acknowledging the vote, said he desired to say a few words with reference to the dividend of gas companies and the registration of meters. He did not think that 10 per cent. was too great a dividend for gas companies to receive, because they were engaged in a very precarious trade, and were liable to expensive accidents. With regard to meters, in answer to Mr. Chubb, he unhesitatingly said that a meter was a silent witness which could not help witnessing correctly, and that it was utterly impossible for a meter to turn round and show a consumption which had not taken place. The reason he had advocated gas inspectors being appointed was that, in the case of any complaint or uncertainty on the part of the consumer as to his consumption, it might be referred to the inspector and at once set at rest. As regarded the general question altogether, he had no desire to say one single word in reference to gas companies generally, but only wished to put on record the connection which he had had with the promotion of the Central Gas Company, as it had now ceased to exist. The result of the paper amounted to this, that whilst the gas companies opposed it at first, saying it was impossible to sell gas for less than 7s. per 1,000, they were now selling it at 4s., and getting a dividend of 10 per cent. Mr. Chubb shook his head, but Mr. Chubb's company derived a larger amount now than it did before, and at the same time supplied gas to the public at 3s. 8d., instead of 7s. Looking at all those facts, he did not think he need be ashamed of the action he had taken in the matter.

A vote of thanks was passed to the Chairman on the motion of Mr. Alderman Carter.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts & Co., the Society's bankers, and to forward the same to the secretary or financial officer at the house of the Society of Arts, John-street, Adelphi.

DRILL COMMITTEE.

The Committee met on Monday, the 15th instant, at four o'clock; present—Major-General Eardley-Wilmot, R.A., F.R.S., in the chair, Mr. Henry Cole, C.B., Mr. E. Chadwick, C.B., Capt. Donnelly, R.E., Mr. W. S. Fitzwilliam, Sir Charles Russell, Bart., V.C., and Mr. Seymour Teulon. The Committee took into consideration the arrangements for a review of school drill to take place in the Royal Horticultural Gardens, about the latter end of June next.

ALBERT MEDAL

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

The Council invite members of the Society to forward to the Secretary, on or before the 29th of April, the names of such men of high distinction as they may think worthy of this honour.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscription paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society. Season ticket holders will be invited to a reception that will be held by his Royal Highness the Duke of Edinburgh and Her Majesty's Commissioners on April 27th. The Albert Hall, the Conservatory of the Royal Horticultural Society, and the Picture Galleries of the Exhibition, will be thrown open, and military bands will play. (See notice on page 470.)

MOSCOW POLYTECHNIC EXHIBITION. 1872.

The Committee of the above Exhibition are desirous of forming, for reference in Moscow, a collection of catalogues or price lists of makers of machines and tools of all kinds, and of mathematical instruments. Parties willing to assist are requested to send at once to the Secretaries of the London Committee for the Moscow Exhibition, now sitting at the Society of Arts, Adelphi, London, two copies of each such catalogue or list (illustrated preferred), and the same will be forwarded to Moscow, free of expense.

Members of the Society are requested to give publicity to this notice, as it is very desirable to render the collection as complete as possible.

SERIES OF 18 CONCERTS AT THE ROYAL ALBERT HALL.

Single tickets for the concerts to be given at the Royal Albert Hall on the 8th May, can now be obtained of Mr. Samuel Thomas Davenport, at the House of the Society, at the following prices :—Amphitheatre, 10s. 6d.; arena, 7s. 6d.; balcony, 5s.; ditto, 4s.

BARRY'S ETCHINGS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, have had a limited number of sets of the 29 plates etched by the late James Barry, printed. A set has been hung in the Society's meeting-room for the inspection of the members previous to its dispatch to Ireland. The impressions are taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, is £10 10s.

THE LIBRARY.

The following books have been presented to the Library :—

On Pressure Logs for Measuring the Speed of Ships. By James R. Napier, F.R.S. Presented by the author.

Drawing for Bricklayers. By Ellis A. Davidson. Presented by the author.

Du Froid Appliqué à la Production de la Bière et à sa Conservation Par Ch. Tellier. Also, l'Impôt Unique et l'Invasion de 1870. Presented by the author.

Currents and Surface Temperature of the North Atlantic Ocean. Presented by the Meteorological Committee of the Board of Trade.

Transactions of the Royal Society of Edinburgh. Vol. 26, part 2 and 3. Also, Proceedings of the same Session, 1870-71. Presented by the Society.

Railway Amalgamation. A paper read before the Civil and Mechanical Engineers Society. By B. Houghton, Esq. Presented by the Author.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Official Reception.—His Royal Highness Prince Arthur, Her Royal Highness the Princess Louise, Marchioness of Lorne, His Royal Highness the Duke of Cambridge, and the Marquis of Lorne have expressed their intention of being present at the official reception on Saturday evening, the 27th April, 1872. As stated last week, the picture galleries as well as the Albert-hall and conservatory, with the connecting quadrants will be thrown open and lighted up. The method of lighting employed has been found to be entirely successful; a trial took place on the 10th inst., with a highly satisfactory result. The Royal Albert Hall and the Orchard entrances of the Exhibition will be opened at 8 p.m. His Royal Highness the Duke of Edinburgh, K G., will arrive by the royal entrance of the Albert-hall, where he will be met by her Majesty's Commissioners, who will accompany him to the Arena. Foreign ambassadors, her Majesty's Ministers, and other distinguished personages, will assemble in the Arena. His Royal Highness the Duke of Edinburgh, after passing through the Hall, will visit the Foreign and British picture galleries, and will then return through the arena of the Hall to the royal entrance. Only those persons whose invitation cards bear the words "Pass to Arena," will be admitted to that part of the Hall, until after his Royal Highness the Duke of Edinburgh has proceeded to the picture galleries. All other invitation cards will admit to the gallery and balcony of the Hall, and to the picture galleries of the Exhibition, seat-holders in the Hall proceeding, if they see fit, to their own stalls and boxes. The most convenient entrances for those persons who wish to be present in the Hall will therefore be the East and West Gallery Entrances, and the East and West Balcony Entrances. The nearest entrance to the foreign picture gallery is that in Exhibition-road; that in Prince Albert's-road is nearest to the British picture gallery. The band of the Royal Artillery will perform in the Royal Albert-hall, the Grenadier Guards, &c., in the Conservatory and picture galleries. Performances will also be given on the great organ in the Royal Albert-hall. All persons must produce their cards of invitation upon entering, as the presentation of the season ticket without an invitation card will not insure admission. Holders of season tickets should therefore as soon as possible obtain these special invitations, which they can do by applying to the agent who supplied them. Those who obtained their season tickets from the Society of Arts should at once apply to the Financial Officer, Mr. S. T. Davenport.

Printing.—Among the many interesting things that will be shown in connection with this division of the Exhibition will be a practical illustration of the progress that has been made in the manufacture of type. Two large sheets will be placed side by side, the one showing an impression taken from the style of type used a century ago, and the other showing that now in modern use. A comparison, therefore, will be easily made.

Fine Arts.—Artists will be admitted to the galleries of the International Exhibition to-morrow (Saturday), the 20th April, for the purpose of varnishing and touching the pictures which they have sent for exhibition. Sculptors who desire to see to the cleansing of their works will be admitted to the galleries on the same day.

Refreshments.—The public will be glad to learn that increased accommodation has been given for the purpose of supplying refreshments during the hours of the exhibition, and Messrs. Spiers and Pond are making arrangements which will materially add to the comfort and convenience of the visitors. New bars will be opened in various places, in addition to those of last year. There will be one in the Swedish school-house, which is in rear of the western building; and to supply the deficiency felt last year by visitors on the eastern side, a bar will be opened in the iron building known as the Queensland Annexe. There will also be a tea-room in the Albert-hall, in addition to the bars on the ground-floor. The dining-rooms will be, as last year, in the southern buildings.

EXHIBITIONS.

Dublin Industrial Exhibition.—The Duke of Edinburgh will visit Ireland in June, to open the Dublin Fine Arts Exhibition. The *Pall Mall Gazette* says:—"The interest felt in the Exhibition project is enhanced by the fact that the entire risk is borne by Sir Arthur Guinness and his brother, Mr. Cecil Guinness, to whom the building itself belongs. Large sums of money have been expended upon its adornment for the forthcoming display, and the concert room will be the finest in Ireland. A grand musical performance will take place at the opening. Every inch of space is already appropriated, and almost every Irish nobleman and many gentlemen of property have sent their treasures to enrich the halls. A committee is to be formed to arrange for the reception of his Royal Highness, and a lively season is expected."

French Provincial Exhibitions.—The annual exhibition of modern works of art is now open at Rouen, and the collection is reported to be very satisfactory, although recent events have interfered with the arrangements and caused the date to be altered from winter to spring. The Lorraine Society of the Friends of Art has appointed the 15th of May for the opening of the Nancy exhibition; works to be sent in on or before the 8th of that month, with a letter containing the name of the artist, the subject, and the price of the work. This exhibition is remarkable from the fact that, in addition to works of fine art of all kinds, photography being included, everything connected with applied art is included in the programme, such as designs for porcelain, furniture, jewellery, and stuffs, and even specimens of such productions possessing any originality or special claim from an artistic point of view. This is an innovation which deserves notice, and may mark a new era in local exhibitions. Dieppe also announces an exhibition of pictures and other works of art, but as the society having the direction of it has not conformed to the almost universal practice in case of provincial exhibitions, of relieving the artists from the cost of the carriage of their works to and from the exhibition, it is expected that the number of pictures will be extremely small.

Exhibition of Domestic Economy in Paris.—An International Exhibition of Domestic Economy will be opened at the Palace of Industry, in the Champs Elysées, Paris, on the 15th of July next, under the auspices of the National Society for the Encouragement of Industrial Workers (*Travailleurs Industriels*). This society has for its object, in its own terms, the honour of labour, by protecting, encouraging, and rewarding it, the raising of the intellectual and moral level of the workman, the facilitating of his independence by means of the savings bank, and providing for him in his old age, by other methods than the assistance given by the State. The exhibition is divided into forty-six classes, composing ten groups, comprising every object that can contribute to the material as well as the moral welfare of the artisan. Group 3 is devoted to buildings, and contains five classes, which are thus described:—Class 18. Models and plans of married or single working men, characterised by cheapness, combined with comfort and healthfulness; models of furnished rooms. Class 19. Models and plans of public buildings, for the use of artisans, schools, lecture rooms, hospitals, almshouses, baths, washhouses, &c. Class 20. Building materials. Wall papers. Class 21. Examples of barrack buildings, and sailors' lodgings on shipboard; camp furniture. Class 22. Municipal and domestic hygiene, ventilation, water supply, and drainage. Group 10 contains but one class; but its scope is sufficiently comprehensive. It consists of historical documents of every kind relating to the moral condition of the artisan, from the earliest period to the present; books, pictures, engravings, examples of clothing, tools, &c. The prizes, which will consist of gold, silver, and bronze medals, and honourable mentions, will be awarded by an international jury to the exhibitors. Certificates will also be presented to workmen who have invented or produced articles exhibited. The Exhibition will be open from the 15th July to the 15th of October next. Applications for space must be made before the 15th of June, 1872, specifying the name and address of the exhibitor, the nature of the object he desires to exhibit, and the space required. All communications should be addressed to the Direction of the Universal and International Exhibition of Domestic Economy, 23, Rue de la Chaussée d'Antin, Paris; or to the Vicomte de Vallat, French Consulate, No. 38, Finsbury-circus, London.

CORRESPONDENCE.

THE RECENT THEORY OF TURNER VISION.

Sir,—M. Liebreich has, in this hypothesis, pushed the venerable fallacy that all differentiation or variation in the copies made by a number of artists, from the same object or scene, may be ascribed to their seeing things differently. Imperfections in the mechanism of the eye may increase the difficulty of correctly interpreting and pourtraying external nature, but not in the way the holders of the same views as the learned Professor suppose. Let us first take distortions of form, produced by what is called astigmatism of the eye. It is said that in this affection the image of either a true circle or a square is elongated, either vertically or laterally, on the retina; this may be the case, but a slight exercise of common-sense will show that if a painter, afflicted with this kind of defective vision, have to copy either a circle or a square, he must also draw a true circle or a square upon his paper or canvas, as no other figures but these would produce the same proportioned oval or parallelogram upon his retina. It must be clear that if he drew an oval, and placed it side-by-side with the circle he attempts to copy, it would not appear like the circle. No possible oval or parallelogram he could draw would ever produce the same impression upon his eye as either a circle or a square, for they, according to the conditions of the disease, would appear still more elongated on the retina. Or, let it be put in this way:—Suppose that on the left-hand, against the wall, hangs a circular metal ring, and on the right a similar ring, and also an oval one; which of these two rings would the man afflicted with astigmatism pronounce to be the more correct representation of the circular ring on the left? Clearly the circular one. For we must have similar external objects to produce similar internal impressions. The same kind of reasoning will apply to colour, but the argument, when applied to form, is divested of many complications, and is the more readily comprehended. It scarcely requires more effort of thought to perceive that although a wave period, say that which produces the sensation of yellow in the healthy eye, may produce a quite different sensation in those afflicted with abnormal vision, yet that the pigments used by the latter, being as objective as the nature they may be copying, they must use the Naples yellow of their palette to represent a wall distempered with Naples yellow. If the wall actually appeared green to them, so would the pigment called Naples yellow; and so in respect to other objects, and the pigments necessary to their representation.

There is, however, one point touched upon by the professor which is of more importance, viz., the affirmed discolouration of the lens by age; this may, indeed, throw the painter out, for the eye when suffused with any colour sensation, as by means of glasses, becomes after a time insensitive to that sensation, by a compensating reaction, and all objects which appear to other people of that colour, whiter. In this case the painter would be entirely deceived in the values of certain pigments, and the colour effects of certain objects in nature upon the healthy eye.

The mistakes to which a painter would then be liable may be exemplified by those which he makes in first painting by gas-light. Every painter must recollect the jaundiced appearance, when viewed in the morning, of his first attempts at painting by night. There is a principle, too, involved in this which should be understood in order to paint correctly in any light, and of which painters are, as yet, entirely ignorant.

The decadence of vitality as age advances is quite sufficient to account for imperfect work,—the faculties cannot then be knit together as in vigorous youth and manhood, for determined elaboration and exactitude. The same faults, disproportions, and eccentricities may be observed in childish productions, and when the eye is perfectly normal, but before the other faculties are trained to observe correctly. There can, however, be but little doubt that all abnormal conditions of the artist's eye must increase the difficulty of rendering nature correctly, for it must be remembered that even the quickest work is dependent on memory, and that the artist is then copying his retained impressions, also that he cannot at all times put his work in juxta-comparison with the original. We know, too, that the power of correctly retaining impressions becomes impaired with age.—I am, &c.,

W. Cave Thomas.

SUBSOIL DRAINAGE OF LAND AS SANITARY WORK.

At a meeting of the Association for the Promotion of Social Science, at which a paper, on "The Haunts of Typhoid and other Fevers in England and Wales, from Statistical Returns, showing their Geographical Distribution," was read by Mr. Haviland, M.R.C.S., Mr. Edwin Chadwick, who presided, said:—There are statistics and statistics. There are statistics which, when you have by examination of particulars ascertained the existence of given elements in them, serve to measure the extent of those elements; and there are statistics which serve to indicate the direction of inquiries to ascertain the extent of the existence of those elements in the particulars. Of this last sort are the statistics of Mr. Haviland's paper. They may serve to indicate the direction of particular inquiries into the localizing causes of typhus. But first and last I prefer going to the particulars, and examining them, apart from the figures by which they are enumerated. On such examination, made a long time ago, the different water-bearing power of different strata, as bearing an excess of water, which, if simple water by surface evaporation, created damp, and so lowered temperature, and as damp lowered vitality and strength, and engendered rheumatism—but where the stagnant moisture of the stratum contained decomposing animal and vegetable matter, there it engenders ague, and fevers of different types. These miasms are tempered by the ventilation of scavenging winds. The subsoil drainage, which removes the surplus water, and makes soils permeable for agricultural production, besides being a great agricultural, is, as I have demonstrated, a primary sanitary work. I have asked farmers as to what effect had been observed from the field drainage on the health of the population? They have commonly answered, although they were guardians, that the health of the population was none of their business;—but that the effect on the health of their cattle was great indeed. The late Lord Lonsdale, who was one of those who scoffed at the sanitary improvement of towns, was a keen observer of the effects of subsoil drainage in improving the health of the deer of his park. By the very imperfect ditch drainage, as I deem it, of the Fen districts—imperfect as drainage by ditches instead of by pipes—ague has been so much reduced that ounces of bark are used now where pounds were used formerly. In my report of 1842, on the sanitary condition of the labouring population, there is a chapter of testimonies, chiefly from the reports of ministers in Scotland, on the improvement of the health of the population that has followed subsoil land drainage. As a member of the first General Board of Health, I went into the subject thoroughly, and prepared minutes of instructions from comprehensive practical information as to the subsoil drainage of lands forming the suburbs, as well as the sizes of towns. It is a subject grievously neglected, from a want of knowledge of it, by those medical officers whose education in preventive medicine has been neglected, or is imperfect, and who commonly assume that house drainage and sewage is almost the only sanitary work to be regarded. Why here, in the metropolis, after the prevalence of easterly winds over the Kent and Essex marshes, there is more of ague than appears in returns, and at times marsh diseases of a peculiar type; and surveys and preparations were made for the agricultural drainage of those marshes, as a measure necessary for the sanitary improvement of the metropolis, but that measure has hitherto been neglected. Of the drainage works carried out under the Public Health Act within the towns, one effect was the subsoil drainage of some of the sites, as denoted by the lowering of the wells. On a very cursory examination, as I might show, and a report by a medical officer of the Privy Council, on the results obtained by the works in those towns, it appeared that there had been a marked reduction of cases of phthisis. Mr. Simon, the chief medical officer of the department, in his report, treats this reduction of phthisis as a novel and important result. It was likely to be novel to him, as one among other primary elements of sanitary science which are not likely to have been brought within his observation in curative practice within the four walls of a hospital. But if he had read with due attention my sanitary report of 1842, as recommended by Dr. Charles Williams, of University College, in his "Principles of Medicine," as containing elementary instruction in sanitary science, he would have seen that diseases of the respiratory organs, including consumption and pneumonia, were from the very first put forth as one of the great categories of disease to be attacked by sanitary measures. And this was put forth on out-door experience, that reductions of inflammations of the lungs, as well as ague and typhus, were attendant on subsoil drainage works. As to its being curious, as he treats it, I always understood that pure air, and dry air, if possible, was the desideratum for incipient phthisis. There may be some moisture, but it is essential that it should be pure moisture, which the moisture from ill-drained and surcharged subsoils rarely is. The knowledge of geology, as indicating the water-bearing power of different strata, is of primary importance in army sanitary science for the selection of sites for encampment. This was displayed by Mr. Robert Rawlinson, as Army Sanitary Commissioner in the Crimea, when he showed that, by errors as to springy or surcharged sites, the force was greatly reduced which might have been maintained in better sites within a hundred yards distant. But this geological knowledge is not obtained in curative hospital practice, or in the study of pathology. Sir John Pringle, one of our earliest sanitarians, gave instructions to note where wells were near the surface, for he had observed that such sites were bad camping grounds. On such facts, instructions embodying the best obtainable experience in agricultural engineering were prepared for the drainage of suburban lands, for the protection of the health of the population of towns and rural districts, as well as for agricultural production. But these instructions have been ignorantly and heedlessly neglected. The necessity of subsoil land drainage for health, as well as for agricultural production, is a leading condition that requires drainage areas, and lines of watershed from the hill-tops to the dividing river of the valley bottom, as areas of sanitary administration, independently of the areas for other administrative purposes. I may show the enormous waste as well as obstruction to sanitary work created by ignorance, and neglect of this one condition of the drainage areas for the metropolis. Notwithstanding all that has been said on the subject—I have it on the authority of Mr. Bailey Denton—for every acre of land in this country that has been subsoil drained, more than twelve require drainage. This is a work which public administration may and ought powerfully to aid. The most common obstruction to subsoil drainage is the want of outfalls. These, I have shown, may be provided for contiguous lands by an improved road drainage, which is necessary to the maintenance of the roads themselves. The sanitary engineer —and there must be such engineers for efficient and economical sanitary work for a district—should be a scientific road engineer. This again leads to extended drainage areas as efficient and economical sanitary areas, which at this time require to be considered in the pending legislation.

NOTES ON MANUFACTURES.

M. E. Duchaux has presented recently to the Academy of Sciences the results of his experiments on the eggs of the annual silkworm, in which he indicates the physiological conditions of its existence and hatching. He shows that as soon as the eggs are laid, and the change of colour takes place, they rest in a species of slumber, which lasts nearly to the winter, and from which they are only moved by the effect of the cold. The embryo, which has remained stationary up to this time, commences its work of motion. The impulsion once given, the work is carried on, and though it may be inconvenienced it is not arrested by the temperature; they require a heat carefully graduated. If the heat is too forward, or badly regulated, the eggs deviate from their normal direction, and lead to a slow eclosion, and to weak worms tinged with red. It is possible to abridge or augment considerably, without danger, the duration of the second period, which is usually three months to three months and a half. The first, which is five or six months, is much more elastic, and may, without inconvenience, be reduced to twenty days, or prolonged to fifteen or eighteen months. For this purpose it is only necessary to submit them to the action of cold under the conditions indicated by M. Duchaux in the following propositions:—1. To prevent the eggs hatching at the ordinary period, they should be preserved from the commencement in a temperature between fifteen and twenty degrees centigrade, exposed to the cold for fifteen days, about three months before the time required for hatching, and then treated as ordinarily. 2. To have the eggs hatched before the ordinary period, twenty days after they have been dropped they should be exposed to the cold for two months, and then removed six weeks, afterwards they will be found in the same condition as normal seed, and can be treated in the same manner. From the researches of M. Duchaux, it would seem that we may have, at any moment of the year, seed ready to hatch, and probably by this means two gatherings in the year.

The British Consul-General at Bangkok draws the attention of those engaged in the manufacture of brass work to the large amount of this ware imported from China to Siam. It consists principally of large cups and basins, trays, &c. As these are very badly made, and sold at high rates, there is every reason to believe that similar articles made in England would compete successfully with those in Siam. It would, however, be necessary, at least in the first instance, to keep to the same patterns as those at present in use in the country. Upwards of 1,572 packages, valued at 124,000 dollars, were imported at Bangkok in 1870.

For some years shipments of wood in a manufactured state, such as doors, window-frames and sashes, panelling, moulding, &c., have been carried on from Sweden, and seem to assume proportions that indicate remunerative returns to the manufacturers. All these articles are machine made. Several factories are now established in Gothenburg and other parts of the country, some of them on a large scale. A factory in Stockholm supplied most of the fittings for the new buildings of St. Thomas's Hospital, and as they were shipped from Gothenburg, this may account for the increase in the value of the customs returns at that port of manufactured wood, amounting in value, in 1870, to nearly £20,000.

What becomes of the tallow? is a question raised by the *Grocer* in an interesting article. It states that every application of tallow has been invaded, first by vegetable, and then by mineral novelties:—"The beauty, cheapness, and brilliancy of the paraffin wax and the mineral lamp oils, have brought them into use everywhere, among all classes, and in all countries and situations. The tallow candle appears to be going the way of the old tinder-box; and tallow is only used as an exceptionally high-priced and luxurious lubricant. Thus it appears that the demand for tallow is wonderfully diminished, while the Australian supplies are still increasing. How is it, then, that the price of tallow still keeps up? What answer can we give to the question? What does become of the tallow? It is well known that vast quantities of kitchen-stuff and

Australian fat, which formerly were consumed by the tallow-chandlers and soap-makers, have lately found their way into the empty Dutch and other butter-tubs which are now bought up more freely than of old; that much of this purified fat has been shipped to Holland and other butter ports for purposes of admixture; that although the monstrous newspaper nonsense about making butter from Thames mud is utterly baseless, the river Thames has borne upon its bosom many and many tons of white fried fat that has been prepared within a moderate distance of its banks. It is a significant fact that, during all last winter the usual consumption of butter was continued in London, &c., although the excessively dry summer which preceded it had decreased the English dairy produce very considerably, and had diminished the supply from other sources materially. At the present moment fresh butter is offered for sale in some parts of London at 1s. per lb. retail, while the farmers are selling their produce wholesale at 1s. 4d. to 1s. 8d. This one-shilling fresh butter is quite a different article from the cheap Australian butter that has been recently imported. Artificial butter has a special interest and importance in connection with this subject, for here we have an article of primary importance, which, if honestly dealt with, may become an immense blessing to mankind, especially to the poorer classes, but which otherwise may be kept in the dark, held back from its legitimate uses, and made simply to serve as a means of fraud by the dishonest, and as an ever irritating source of distrust and vexation between the honest dealer and his customers. While such false butter is sent away to Holland, to Ireland, &c., to be mixed with the genuine article, the shopkeeper is liable to be deceived; he may, with the best possible intentions, and in spite of every precaution, be supplying his customers with an article which is quite different from what he supposes he is selling—for in this case the analytical chemist cannot help him, whatever he may profess to do, the difference between cow-butter and the mixed butter being so small as to pass beyond the reach of chemical detection. The remedy is simple enough. Let any enterprising capitalist connected with the trade commence openly and fairly the manufacture of artificial butter, to be made and sold as such. Let him, in the first place, use materials which will not be offensive either to the imagination or the palate (such, for example, as clean and wholesome Australian mutton fat); in order to secure the confidence of the shopkeepers and the public, let him open his works to visitors, just as Messrs. Huntley and Palmer, Messrs. Peek, Frean, and Co., and other biscuit makers do; and then let him sell his butter under an honest name, and we believe that he will be able to overcome all prejudice, and in a short time do a handsome business, with good profits, and have the satisfaction of knowing that he has enabled the poor man and the poor man's child to enjoy a cheap slice of bread-and-butter, and many other luxuries of which butter forms a part, and also that he has destroyed a nefarious system of false dealing; for there is a certain peculiarity about the artificial butter which will become understood when the trade is familiar with it, and this will finally aid its detection in admixture." We have already given some attention to the subject, and have tasted some purely artificial butter, which was really good, sweet, and pure. Bread-and-dripping are commonly given to children in lieu of bread-and-butter, and the artificial butter, properly prepared, is really a purified dripping of very superior quality. The artificial butter has the further advantage of not becoming rancid, however long it is kept, and thus it requires no salt. With both articles honestly placed before the purchaser, viz., the dairy butter and the butter made from animal fat, he could choose which he preferred, and pay the fair value of either."

In the United States Senate, on the 22nd March, in the course of debate on the Tariff Bill (since rejected by the House of Representatives), Mr. Morton (Rep. Ind.) said while a prohibitory tariff was an obsolete idea free-trade was out of the question, and that the doctrine generally accepted by the American people at this time seemed to be a tariff for revenue, so adjusted as to discriminate in favour of American industry. Upon this tariff question political parties were divided, and the position of the Democrats seemed to be that they were opposed to a reduction of the duties upon the articles in the production of which their particular States were interested, and in favour of a liberal reduction upon all other articles. The tariff, he said, was a question of labour and wages more than anything else. Wages in England were about seven-twelfths of American wages, and in Germany and Belgium they were only one-third as much as in the United States; and with such a disparity in wages it was idle to suppose that our industries could thrive without protection. There was an impression abroad that American manufacturers were making enormous profits. He believed this to be erroneous, and he asked Mr. Anthony to state his opinion as to the average profit of manufacturing in Rhode Island during the last five years.—Mr. Anthony (Rep. R. I.) said he thought it could not be more than 8 per cent.—Mr. Morton asked Mr. Morrill (Rep. Vt.) his opinion on the subject.—Mr. Morrill said that during the war some of the New England manufacturers had made large profits, chiefly by the great rise in value of the raw material they had on hand at the beginning of the war, but that their profits on an average did not exceed 8 per cent.—Mr. Morton then asked Mr. Scott to state the average profits of the iron manufacturers of Pennsylvania.—Mr. Scott (Rep. Penn.) could not state the average throughout the State, but said that in his region (the Juniata iron region) very few of those who had established manufactories had been able to maintain themselves through the period of depression that had come upon the trade.

A number of gentlemen connected with the Iron and Steel Institute and from most of the leading works in the north of England, assembled at the Deeside Works, Middlesbrough, to inspect the new American machine of Mr. Danks, which supersedes puddling by hand. The machine has just been erected, and it worked well. Mr. Danks was present, and explained the nature of the machine to inquirers. The charge when put into the furnace is carried round in a revolving cylinder, whereby it is worked sufficiently in about three-quarters of an hour, and then withdrawn by mechanical contrivances. Between 600 lb. and 700 lb. was generally the weight of the charge, but it has been in most cases greatly enlarged. The trials were mostly made with molten metal,—pig iron taking a considerably longer time, generally about an hour and a half. The quality of the iron produced, which was from Cleveland pig, was highly spoken of by practical men. Several iron masters of the United Kingdom combined together and arranged to give Mr. Danks £50,000 for the right to erect and have the full use of 200 of his machines, but some doubt as to the force of the patent is said to have prevented the completion of the arrangement in the meantime.

The *Manufacturer and Miner*, an Indiana paper, says:—"The struggle for pig iron by the various mills of the country at the present time amounts almost to a panic. With an advance of from 1·50 dols. to 3·50 dols. a ton, the furnaces are not willing to make contracts ahead, and some of them even refuse to sell. And the prospect is that there will be a pressure on the entire furnace capacity of the country for some time to come."

A discovery of unusual interest has just taken place, according to the *Engineer*, at Merthyr, which throws a little light on the mode, or one of the earliest modes, of making iron. At the back of a row of houses in Pontmorlais, built evidently within a few feet from a long bank of earth, sufficient soil from this bout has been sliced away to admit of drains, gardens, and other accommodations, leaving the rest intact; and that this remainder was of old deposit may be inferred from the fact that the earliest tramway, for which an Act of Parliament was obtained in 1854, and on which tramway Trevithick ran his first locomotive, passed over this bank. In the rear of one of the houses, occupied by Mr. John Emerys Jones, a sculptor, and a man of more than ordinary intelligence, a further portion of this slope was cut off lately, and in the progress of the labour he came upon several huge stones and a vessel of backed fire-clay, much in appearance like a crucible. Great care was at once taken in the exhumation, and the character of the discovery resolved itself into the following:—In the centre of a circle of red ashes, placed on a pitched ground, was a circular vessel of baked fire-clay 1 ft. in diameter and ¾in. wider at the bottom than at the top. This was evenly lined within, and at the bottom, which bore traces of great heat, were the remains of iron cinder, lime, and partially fused bones. By the side of this were pieces of rusty iron and a larger collection of bones, evidently of animals. The pieces of iron when fitted together appeared much like a "tuyere" for conveying blast, and near this was a wall built a little higher than the vessel, which, when examined by practical men, supplied the key to this interesting discovery. It would seem the contrivance was an early one for iron making or for making steel. This vessel would apparently be filled with iron ore, coal, bones supplying sulphate of lime; limestone for yielding carbonate of lime; and, from the existence of mortared bricks in the vicinity, the vessel would next be bricked up, leaving an aperture for the blast. It is supposed that a circle of coal fire would then be brought to act on the vessel, and when a certain degree of heat had been obtained a fire kindled within, and the blast brought to bear upon it through the tuyere from a bellows erected on the wall. The vessel would yield but about fifty pounds weight of iron, a fact which hints at very primitive times in iron making. If the contrivance—certainly long prior to the Bessemer era—were for blowing in the oxygen and making steel, the discovery is even of still greater interest.

New Mode of Washing.—The ill-effects of soda on linen has given rise to a new method of washing, which has been extensively adopted in Germany, and introduced into Belgium. The operation consists in dissolving two pounds of soap in about three gallons of water as hot as the hand can bear, and adding to this one tablespoonful of turpentine and three of liquid ammonia; the mixture must then be well stirred, and the linen steeped in it for two or three hours, taking care to cover up the vessel which contains them as nearly hermetically as possible. The clothes are afterwards washed out and rinsed in the usual way. The soap and water may be reheated, and used a second time, but in that case half a tablespoonful of turpentine and a tablespoonful of ammonia must be added. The process is said to cause a great economy of time, labour, and fuel. The linen scarcely suffers at all, as there is little necessity for rubbing, and its cleanliness and colour are perfect. The ammonia and turpentine, although their detersive action is great, have no injurious effect upon the linen; and while the former evaporates immediately, the smell of the latter is said to disappear entirely during the drying of the clothes.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

April 24th.—"On Nuts: their Produce and Uses." By P. L. Simmonds, Esq. On this evening Professor Bentley will preside.

May 1st.—"On Telegraphy without Insulation, the means of cheapening Internal Communication." By H. Highton, Esq.

CANTOR LECTURES.

The Second Lecture, on "Silicates, Silicides, Glass, and Glass Painting," by Professor Barff, was delivered on Monday evening, April 15th. The remaining lectures will be given as follows:—

Lecture III.—Monday, 22nd April.

Manufacture of Glass (continued)—Coloured Glasses—Glass Staining—Glass as a Decorative Material—Glass Painting.

Lecture IV.—Monday, 29th April.

Glass Painting (continued)—Mosaics—Enamels.

Lecture V.—Monday, 6th May.

Styles of Glass Painting—Illustrations with the Electric Light, illustrative of the Nature of Colour.

Lecture VI.—Monday, 13th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose have been issued.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon. ....**SOCIETY OF ARTS, 8.** Cantor Lectures Prof. Barff, "On Silicates, Silicides, Glass, and Glass Painting."
Institute of Surveyors, 8 Discussion on Mr. Cadle's Paper, entitled "Leases versus Yearly Agreements."
Social Science Association, 8. Dr. Stallard, "Educational Difficulties, Compulsion, Payments, and Religion in Elementary Schools."
Royal Geographical, 8½. 1. Letter from Dr. Kirk on the movements of Dr Livingstone. 2. Capt. Sherard Osborn, "On Recent Explorations of the North Polar Region."
British Architects, 8.
Medical, 8.
Anthropological, 8.
London Institution, 4. Prof. John Ella, "Elementary Music."

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8. 1 Mr Edward Welsh, "River Witham Drainage-pumping Machinery and Works at Lade Bank." 2. Mr. Bashley Britten, "On the Construction of Heavy Artillery, with reference to Economy of the Mechanical Forces engaged."
East India Association. (At the House of the Society of Arts.)
Royal Institution, 3. Dr. Guy, on "Statistics, Social Science, and Political Economy."
Antiquaries, 2. Annnal Meeting.

Wed.....**SOCIETY OF ARTS, 8** Mr. P. L. Simmonds, "On Nuts: their Produce and Uses."
Geological, 8 1. Mr. R. Daintree, "Notes on the Geology of the Colony of Queensland." With descriptions of the Fossils, by Mr. Etheridge. 2. Mr. S. J. Whitnell, "Notes on Atolls or Lagoon-islands." Communicated by Prof. N. S Maskelyne.
Royal Society of Literature, 4½. Annual Meeting.
London Institution, 12. Annual Meeting.

Thurs...Royal, 8½.
Royal Society Club, 6.
Royal Institution, 3. Prof. Tyndall, "On Heat and Light."
Society for Encouragement of the Fine Arts, 8. Mr. Henry Tidey. "Children of the Mist."
London Institution, 7½.

Fri.......Royal Institution, 9. Prof. Blackie, "On the Genius and Character of the Modern Greek Language"
Royal United Service Institution, 3. Mr. Beazeley, "Fog Signals."
Quekett Club, 8.

Sat.......Royal School of Mines, 8. Swiney Lectures. Dr. Cobbold, "On Geology."
Royal Institution, 3. Mr. R. A. Proctor, "On the Star Depths."

Journal of the Society of Arts.

No. 1,014. Vol. XX.

FRIDAY, APRIL 26, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

NINETEENTH ORDINARY MEETING.

Wednesday, April 24th, 1872; Professor Robert Bentley, F.L.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Anderson, Sir James, F.S.S., 16, Warrington-crescent, W.
Barrington, Richard, 48, West Abbey-road, Kilburn, W.
Bennett, Thomas, 70 and 71, Turnmill-street, Farringdon-road, E.C.
Bentley, Charles S., Hazleville-villa, Sunnyside-road, Hornsey-rise, N.
Butler, Rev. Henry Montagu, D.D., Head Master of Harrow School.
Chinery, D., F.R.G.S., Bosworth-lodge, Willesden, N.W.
Kenwick, George, 6, Percy-villas, Campden-hill, Kensington, W.
Pickering, John, 28, Springfield-mount, Leeds.
Pritchett, George James, New Adelphi-chambers, John-street, Adelphi, W.C.
Sandars, Samuel, 28, Gloucester-place, Hyde-park, W.
Townend, Edward, the Nooke, Cullingworth, near Bingley, Yorks.

The following candidates were balloted for and duly elected members of the Society:—

Chisman, Herbert C., 3, Adelaide-road North, St. John's-wood, N.W.
Denison, Christopher Beckett, M.P., 16, William-street, Lowndes-square, S.W.
Dewhurst, John Bonny, Skipton.
Forden, Robert, Mayor of Winchester.
Iles, Henry William, 1, Circus-place, Finsbury, E.C.
Lace, Francis John, Stone-gappe, Cross-hills, Leeds.
Lay, George William, A.K.C., 44, Poultry, E.C., and 24, Addington-square, Camberwell, S.E.
Marchant, Robert, Phœnix Mills, Dartford, Kent.
Pim, William Harvey, jun., Junior Carlton Club, S.W.
Pyne, Joseph John, Hope-house, Heald-grove, Manchester.

The paper read was:—

ON NUTS, THEIR PRODUCE AND USES.

By P. L. Simmonds, Esq.

The subject on which I propose to address you may at first sight appear somewhat trivial and unworthy the notice of a scientific society. What is there, it may be asked, in nuts of interest, commercially or scientifically, that merits attention or consideration which is not generally known? But I think, before I have concluded, I shall be able to remove any such superficial idea, and to show how large a part Nuts play in the roll of commerce, and how important are the uses of their several products, as evidenced by the fact that we pay more than 3½ millions yearly for nuts and the products of nuts.

But first it is necessary to define what a nut is; and here I fear we shall meet with numerous conflicting opinions. In the popular sense of the term, it would probably be described as some seed with a hard shell enclosing a kernel; but then chestnuts and other thin-shelled fruits vary the idea. The strict botanical designation would probably be a fruit consisting of a hard pericarp surrounded by bracts at the base, of which the acorn and the filbert are examples. The seed-vessel, enclosed within an involucre or husk of the cultivated hazel-nut, is of the same nature as the cup of the acorn, and the prickly case in which the nuts of the chestnut and the beech-mast are enclosed. Most probably my learned friend in the chair, if asked to define a nut, would state it to be synonymous with gland, an inferior, dry, hard, indehiscent, one-celled, one, or rarely two, seeded fruit. It is also applied to a superior fruit by some botanists, of a similar character in some respects to the above, as in the cocoanut. Nut is also applied to such fruits as those of labiate and boraginaceous plants, which are properly "achenes," and defined as a dry, one-celled, one-seeded, indehiscent fruit, with a hard covering. Willdenow's definition was "A seed covered with a hard shell which does not burst." N. Bayley's Dictionary, revised by Dr. Scott, and published in 1764, defines a nut as "A fruit or kernel included in a shell, or a seed included in a brittle but not stony shell; if the shell and kernel are in the centre of a pulpy fruit, they then make not a nut but a stone." But as I am about dealing with the subject commercially, and not botanically, I shall have to extend the range of definition very largely to take in all that are called nuts in commerce. The merchant and the broker are very lax in their designations; all, for instance, are *gums* to them, whether soluble, resinous, elastic, or mere inspissated extracts; so with many of the nuts of commerce, such as almonds, the seed of drupes, nutmegs, myrobalans, coquilla, cohune, candle nuts, ground nuts, *cum multis aliis*, which are not botanically nuts.

A variety of special dealers have certain so-called nuts in their trade.

The fruiterer and the Italian warehouseman have their edible nuts in cocoanuts, Brazil nuts, small nuts (Spanish and Barcelonas), cobnuts and filberts, walnuts, chestnuts, peccan and hickory, butter nuts, sapucaya, pistachio, and cashew nuts, seeds of the pine cones, besides the prepared *marron glacé* candied, burnt and sugared almonds, &c.

The grocer, his bitter and sweet almonds and nutmegs, his sassafras and Ravensara nuts.

The oil broker, his ground nuts, candle nuts, palm nuts, palm kernels, oil nutmegs, bassia nuts, and others.

The turner, his coquilla, vegetable ivory, cohune, betel nuts, and others.

The druggist, his nux vomica, physic nut and cumara nuts, or tonquin bean.

The tanner, his nut galls, myrobalans, also called gall nuts in India, and bedda nuts, valonia, or acorns and cups.

Even the coal merchant has his nuts, in a description of small coal so termed.

Then there are hundreds of other so-called nuts which have limited but special uses, such as the marking nut, the clearing nut, the soap nut, and the Bonduc nut.

To some of these nuts I propose directing your attention, and although it is somewhat difficult, from the varied uses of many, to strictly classify them, I will endeavour to throw them into a few groups which shall comprise, 1, the edible nuts; 2, the oil nuts; 3, the turnery nuts; and another group, which may include those of a miscellaneous character.

The following table gives an aggregate view of the value of our imports of nuts and their products for the latest year for which the official returns are published—1870:—

	Quantities.	Value. £
Almonds (sweet), cwts...	36,189	138,864
,, (bitter) ,, ..	7,618	20,966
Chestnuts, bushels	31,767	22,108
Cocoanuts, No.	3,546,276	30,622
Small nuts, bushels ..	294,236	193,452
Walnuts, ,, ..	152,681	42,638
Turnery and unenumerated nuts		42,972
Ground nuts, tons	5,845	94,419
Other oil nuts, tons ..	18,033	231,123
Nutmegs, lbs...	537,978	32,510
Palm oil, cwts.	868,270	1,583,830
Cocoanut oil, cwts... ..	198,602	392,657
Coir fibre, tons	1,105	24,347
Cordage of ditto, cwts. ..	11,407	13,547
Cable yarn, ,, ..	168,544	177,956
Myrobalans, cwts.	56,610	32,928
Valonia, tons	25,718	395,546
Nutgalls, cwts.	17,748	54,169
		£3,524,657

Edible Nuts.

The commerce in edible nuts of various kinds forms a considerable item, and furnishes a carrying trade of at least 10,000 tons. The average annual value of those sold amounts to upwards of £500,000. There are but five sorts specified in the official trade returns—Almonds, chestnuts, cocoanuts, small nuts (hazel nuts), and walnuts, but there are various other kinds forming articles of commerce in a minor degree, among which may be enumerated Brazil nuts, pistachio nuts, cashew nuts, souari and sapucaya nuts, hickory and peccan nuts. Twenty years ago it was stated that the sale of filberts in Covent-garden amounted to 1,000 tons in the year, and of walnuts 25,000 bushels. Of the quantities grown in England there are no means of forming an estimate. The imports of nuts in 1848 were:—

	Bushels.
Hazel nuts	150,022
Chestnuts	63,033
Walnuts	29,604

The progress of the import trade in these is shown by the following figures, from which it will be seen what a great advance has been made in the consumption of sweet almonds, walnuts, small nuts, and cocoanuts:—

	1855.	1860.	1870.
Almonds, sweet, cwts.	24,581	19,638	36,189
,, bitter, ,, ...	7,366	7,361	7,618
Chestnuts, bushels	64,756	25,218	31,767
Cocoanuts, number	2,217,350	2,479,251	3,546,276
Small nuts, bushels	243,458	198,563	294,236
Walnuts, do.	21,949	52,090	152,681

I now proceed to give a few details as to each of these kinds of nuts:—

Hazel nuts are the fruit of the wild bush of *Corylus avellana*, unchanged and unimproved by cultivation. They seldom attain to any size in this country when left wild. The fruit differs from that of the domesticated varieties only in being smaller, while the tree is more hardy. The plant, which is a native of all the cooler parts of Europe, Northern Asia, and North America, is the parent of the many varieties of nuts and filberts now cultivated for their fruit. The trade in "small nuts," as they are termed in the official reports, does not vary very greatly in this country, perhaps 10,000 bushels more may be imported in one year than another. The maximum never exceeds 300,000 bushels. Of 294,236 bushels received in 1870, the bulk came from Spain, 14,000 bushels from Sicily, and about 11,000 from Russia, Turkey, and other countries. Their import value is from 10s. to 13s. 6d. a bushel. In commerce, though both produced by the same variety, *Barcelonensis*, the nuts are classed into two kinds. 1. The Spanish, which are the nuts coming from Gijon. They will not keep any time, and are said to be coloured by the dealers with the fumes of sulphur. They arrive in bulk in small schooners. 2. The Barcelonas, which are kiln-dried, and shipped from Tarragona to the extent of 8,000 tons a year, in bags of about 128 lbs. In Russia and Turkey large quantities of fine nuts are produced of the Constantinople variety (*C. colurna*), which are roundish and very hard. 160,000 cwt. are annually raised at Trebizond and Kuirasond. The filbert has been referred to a distinct species, *Corylus tubulosa*. The term was originally applied to those kinds of nuts which have very long husks, and in which the nut is also of a lengthened shape; but owing to the number of varieties that have of late years been obtained, this distinction, which was never scientific, appears to be nearly disregarded, and nuts and filberts are almost synonymous terms, excepting that the wild, uncultivated fruit and those varieties which most nearly approach to it are never called filberts.

The best known varieties of the filbert are the white, the red, and the frizzled. The white is the kind most commonly grown in this country. In Kent many hundreds of acres are planted with filberts, for which the county is celebrated, and whence the London market is principally supplied. As much as 30 cwt. per acre has been raised on particular lands. When quite ripe filberts will keep for several years in a dry room, and if the air is excluded, or the nuts placed in an air-tight jar, they will be sound and retain their flavour for an indefinite period. The hazel nut yields about 60 per cent. of a bland oil, which is used by perfumers.

The cob-nut of Kent is a large, roundish, prolific variety—*grandis*—of the ordinary hazel nut.

In almost every stage of its growth the fruit of the walnut-tree is used. When young, green, and tender, walnuts, are pickled and preserved with the husks on. About the end of June they may be preserved with or without the husks. When the nuts are fully ripe, which is generally at the end of September or the beginning of October, the kernel, deprived of its investing skin, is eaten in great quantities. As long as the skin can be easily removed, they are a nutritious and healthy article of diet; but when they get dry, so that their skins stick to them, they become indigestible.

The larger portion of the walnuts consumed in England are of foreign growth, and the imports are annually increasing, for whilst a quarter of a century ago we only imported 20,000 bushels, now we have come to require 153,000 bushels. The bulk of these come from France and Belgium, and small quantities from Holland and Italy. Their value is much less than that of small nuts, being only 5s. 6d. to 6s. 6d. a bushel.

The albumen, which constitutes the bulk of the seed of the walnut, contains an oil which is used in large quantities, especially on the Continent. It is obtained by reducing the seeds to a pulp by means of a stone wheel and basin, and then expressing the oil, first without heat, and then by the application of heat.

In the provinces of the Peninsula where the olive does not grow spontaneously, and cannot be cultivated except in certain places having an equal temperature, as on the banks of the lakes, walnut trees have been planted from time immemorial. They yield an oil which, when fresh, is used for food and lighting purposes, or for painting when it becomes rancid. In the north of Italy, in the valleys of the Alps, and also of the Apennines, the walnut tree forms and gives its name to a special botanical region.

In Nassau and Switzerland this bland oil is much used, and is no bad substitute for olive oil in preparing salad. It is also expressed in Cashmere. The shells of the large kinds of walnuts are often mounted with hinges, as fancy receptacles for miniature articles, such as tiny wax dolls, scissors, thimbles, &c. The Limerick gloves are packed in walnut shells, whilst rings, jewels, and other small presents are occasionally disguised in this rough case as an agreeable surprise.

Our trade in foreign chestnuts, the fruit of *Castanea vesca*, is not large, and has scarcely ever reached an import of 70,000 bushels. In the three years ending 1831 the average was 21,000, and they then paid a duty of 2s. a bushel. In 1842 the imports were 34,000 bushels. In 1855 the imports had advanced to nearly 67,000 bushels, but they have since fluctuated and declined. Of the imports in 1870 (31,767 bushels) about half came from France, and the remainder from Portugal and Spain. They are valued at 11s. to 17s. a bushel, those from the Peninsula being considered the best. The local consumption of chestnuts in France is said to be about six million bushels annually. In Spain, Corsica, and the North of Italy, they form an important article of food, and serve in a great measure as a substitute for potatoes and bread. The best are those which permit of being kept good for several months. This is done by preserving them in layers of straw or in sand. In parts of France and Corsica the fruit is husked and dried.

The kernel of the Tahiti chestnut (*Inocarpus edulis*), which is kidney-shaped, about an inch in diameter, is eaten when roasted by the Pacific Islanders, and in New Guinea and the Moluccas. It is sweetish, but less pleasant than the chestnut, harder and not so farinaceous.

The large and handsome seeds of the Moreton Bay chestnut (*Castanospermum Australe*) are eaten by the natives in Queensland, but Europeans assert that they are hard, astringent, and not at all better than acorns. A good starch has, however, been made from them.

The almond is one of our important edible nuts of commerce. Prior to 1832, when the duty was reduced, the consumption of almonds, here, was only about 3,000 cwt.; in 1836 it had sprung up to 8,000 cwts., and now it has reached about 43,000 cwts., an evidence of the progress of commerce and the advantages of lower prices, for in 1839 the prices of the best Jordan were £9 to £10 per cwt.; Valencia, £4 to £10; and Barbary bitter, £2 10s. Now the best Spanish are about £6 10s.; other sweet kinds, £3 to £4, and Barbary bitter, £2 10s. The imports in 1860 were 7,361 cwts. of bitter almonds, and 19,638 cwts. of sweet almonds. In 1870 the imports of bitter were about the same, but of sweet the quantity was 36,189 cwts. The Valencia almonds are the largest and broadest in the kernel of any. The Jordans, which come from Malaga, are longer and narrower, with a more pointed kernel, about an inch long. The Barbary sweet and bitter are both small, irregular-shaped almonds. The Sicily almonds, although small, are larger and plumper than the Barbarys.

The study of, cultivation, and commerce in almonds is one of considerable importance, for the fruit enters largely into domestic and other uses, forming a principal ingredient in cookery, medicine, and trade. The Provence almonds of France are soft shelled, sold ordinarily in the shell. The "Princesses," consumed in France, Belgium, Holland, Germany, and Russia; the "Ladies," sent chiefly to the United States; wavy almonds, which keep the best, and realize double the prices of the ordinary varieties. These are principally used in confectionary, as burnt almonds, and for fine pastry. The bitter almonds are used in the preparation of liqueurs, macaroons, and different medicinal compounds. A bland oil is expressed from almonds, which is used in medicine. It is obtained alike from the sweet and bitter varieties, and is of the specific gravity ·915, of a pale yellow colour, but becomes colourless when long exposed to the light. It soon grows rancid. It is so plentiful, that $5\frac{1}{2}$ lbs. of almonds have yielded 1 lb. 6 oz. of oil by cold extraction, and $\frac{3}{4}$ lb. more on heating them.

The Brazil nuts of commerce, called castanhas in Brazil, are the seeds of *Bertholletia excelsa.* About twenty of these nuts are contained in cells, within a hard spherical capsule. They form a delicious fruit when fresh, and also yield a large quantity of oil. One pound of nuts will afford 10 ounces of a pleasant, bland, clear, yellow oil, which might be furnished in abundance to the markets of the world. It has a great tendency to change if kept, but is used for culinary purposes when fresh. About 90,000 bushels, valued at £36,500, are annually shipped from Para, and they arrive in bulk in small schooners. The first arrivals will often fetch about 42s. per barrel of $3\frac{1}{2}$ bushels.

The nuts in the drupe of the *Pistacia vera* and its varieties, natives of Syria, are imported in small quantities here, shelled or unshelled. The pale green kernels have a flavour like sweet almonds, and are used as a dessert fruit in cooking and in confectionery. Although they are not now enumerated in the Board of Trade returns, in 1855 we imported 3,210 cwts. of these nuts. The imports are, however, much less than this now. On the Continent and in Turkey pistachio nuts are much esteemed. From Aleppo the exports are about 1,300 cwts. yearly. One of our large West-end perfumers (Piesse and Lubin) make large use of the pistachio nut, in its meal, much recommended as a substitute for soap, pistachio nut soap, and pistachio oil for the hair, which is said to be used in Spain for the raven tresses alike of the mountain peasant and the court beauty; and a powder and milky emulsion for the complexion are also made from it.

Pine seeds are an edible nut in very many countries. Those of the stone pine (*Pinus pinea*) are largely used at dessert with wine in Italy, under the name of pine nuts. They are brought to market at Lisbon, strung upon threads like beads, and suspended upon a girdle round the waist. The seeds of Lambert's pine, in North America, of Slave's pine, in Mexico, and of Gerard's pine, in Thibet and Affghanistan, are also eatable when fresh. In Switzerland the seeds of the Siberian stone pine are used in some places as food, and in others as an article of luxury. The shell being very hard, and requiring time and skill to separate it from the kernel, the doing so forms an amusement for some persons in the long winter evenings. The pinones of the imbricated-leaved pine of Chili are a chief article of consumption among the Indian tribes. As the seeds will keep long, they are often imported into the southern districts of Chili from the Cordilleras, and when boiled are eaten by the country people either hot or cold. The seeds are buried in pits by the Indians for winter use. Another species of *Araucaria*, whose fruit is called Bunya-bunya by the natives, forms the principal article of their food in Northern Australia. The cone is very large, nine to twelve inches in length by nine inches in diameter. The seeds, which are readily shed, are from two to two and a-half inches long by three-quarters of an inch broad, sweet before they are perfectly ripe, and after that resemble roasted chestnuts in taste.

The seeds of the cones of *Pinus monophyllus*, of the Rocky Mountains, constitute the principal subsistence of some of the Indian tribes.

The nutmeg may, perhaps, be included under the edible nuts, as it is an important article of commerce. In the four years ending with 1841, the average import was only 121,000lbs. In 1850 it had risen to 312,418 lbs., and now the import and consumption is 538,000 lbs., worth 1s 6d. per pound.

Formerly the production was a monopoly of the Dutch East India Company, and although the cultivation has been attempted in other quarters, it only succeeds in the Straits Settlements and the Islands of the Eastern Archipelago. In the Banda Islands the produce is about 530,000 lbs. annually (in 1847 it was as much as 755,000 lbs.), and all above that quantity used to be rigorously destroyed. The collected nuts when ripe are dried in the sun or by the heat of a moderate fire till the shells split. They are then sorted and sometimes dipped in lime-water, to preserve them from the attacks of insects.

The shape of the nutmeg varies considerably, being spherical, oblong, and egg-shaped; but the nearer they approach sphericity of figure, the more highly are they prized. Those of good quality should be nearly round, heavy, weighing on an average ¼ of an ounce.

The broken nuts are made to yield, by expression or boiling, a concrete oil, termed nutmeg-paste or butter, which is used for flavouring. Its specific gravity is about ·948. What is erroneously termed oil of mace is obtained by distillation from the nutmeg, and should bear its name.

The long (wild or male) nutmegs of commerce are the produce of *Myristica tomentosa*, and are not so much esteemed as the round.

The cashew nut (*Anacardium occidentale*) is another tropical fruit, occasionally imported for its sweet kernels, and which has this peculiarity, that the nut is attached to the fruit, instead of growing within, as is usually the case. A thick, black, oily, viscous juice, called cardole, is obtained in the East Indies from the pericarp, which is a powerful vesicating agent. The white kernel, which is oleaginous and of an agreeable flavour, furnishes an oil considered superior to olive oil.

From North America small quantities of two edible nuts, the peccan and the hickory, are occasionally imported. The former is the seed of *Carya olivæformis*, the latter of *Carya alba*. An excellent oil for burning and machinery has been made from the hickory nut, in Ohio, which continues in a fluid state at a very low temperature. It is used for delicate machinery, and when properly refined would be suitable for watchmakers. The pig-nut, *C. glabra*, is preferred in the manufacture, on account of its thin shell and greater yield of oil, which is bitter. The oil obtained from the ordinary shell-bark, and large sweet hickory nut, might come into general use for the table.

The sapucaya nut is a pleasant edible nut, which comes in small quantities from South America. The fruit in the capsule is suspended from the branches, and presents an appearance like small cocoanuts. The monkeys are exceedingly fond of the nuts.

The "cabombas," or cups of the Zabucai or monkey pot (*Lecythis urnigera*, Mart.), which contain the sapucaya nuts of commerce, are frequently of great size and excessive hardness, and are closed by a lid like that of a pyx or soap-box. The aborigines of parts of South America use these not only as goblets, but as pots and dishes. Hence Linnæus called the plant *Lecythis ollaria*. The lid of the cup falls off when ripe. Portuguese turners make pretty boxes and other fancy articles out of these solid cups. In the Brazilian Court, at the London Exhibition of 1862, some handsomely-carved and mounted specimens were shown.

The butter nut, or Souari nut, is the fruit of *Caryocar tomentosa*, of South America. Only very small quantities are received. It yields an edible oil. The fruit of another species, *Caryocar brasiliensis*, furnishes, in Brazil, the Piquia concrete oil, of a brown colour, retaining much of the flavour of the fruit.

In China and Japan, under the name of gingko nuts, the seeds of *Salisburia adiantifolia* are eaten.

Before passing from this section of edible nuts, I may draw attention to the various fancy uses in the series kindly shown by Messrs. Fortnum and Mason, which includes pistachio nuts and pistachio chocolates, glacé walnuts and marron glacés, green candied almonds, burnt almonds, sugared almonds, and sugared nuts. And in contrast with these finished products of the confectionary trade, we have the almond and cocoanut rock of the sweet shops, for children, which sell under the curious names of stick-jaw and eggs and bacon.

Oil Nuts.

I pass on now to a consideration of the oil-yielding nuts. I might properly speak of the olive as the principal one, which would as equally of right come into the category as some other oil-bearing seeds and fruits I shall have to allude to, but then, as it is never spoken of commercially as a nut, I must pass it over.

After the olive, the palm family furnish the principal quantities of oil to commerce, in those two important and well-known oils, palm oil and cocoa-nut oil. From the fruit and kernels of the oil palm of Western Africa (*Elais guineensis*) we now draw our largest supply of vegetable oil. In the year 1808, 200 tons of palm oil were received from Africa; in 1827 the quantity had increased to 4,700 tons. Some few years later it had risen to 14,000 tons. What do we find it now? Last year (1871) 51,087 tons, valued at £1,789,000, were imported. Palm oil has become one of the most important articles of commerce from the west coast of Africa, especially to this country, although we are not the only importers. The collection and shipment has done more than anything else to suppress the slave trade. The oil, as manufactured for home consumption in Africa, is slightly different from that prepared for export. It is darker coloured, and is obtained by beating, pressing, and boiling the fruit (sarcocarp). Palm-nut oil is obtained from the seed or kernel by roasting, beating, and boiling. Formerly these kernels were thrown away; now they form an important trade. In 1863, the palm kernel trade, then newly introduced, furnished for shipment at Lagos 2,665 tons of oil, in 1869 20,394 tons were exported from that port, besides one and a half million gallons of palm oil.

The next great source of oil from the palm is that obtained from the pulp of the cocoanut, and, considering the wide-spread range of this palm, it is strange that the import of the oil has made such little progress compared with its great rival, the African oil palm. One reason may possibly be that the fruit is more generally used for food, and for the refreshing drink in the nuts when young. The cocoa-nut palm is cultivated in great abundance on the Malabar and Coromandel coasts, Ceylon, the Laccadives, and every where in the Straits Settlements and the islands of the Eastern Archipelago.

In the West Indies, Central America, and Brazil, the cocoanut is extensively grown; there are groves of it for about 280 miles along the coast of Brazil, from the river St. Francisco to the bar of Mamarguasse. From Para alone 7½ million cocoanuts, worth £130,000, are annually shipped to the United States and elsewhere.

The cocoanut is very widely spread over the Pacific Islands. From the Fiji Islands 500 to 600 tons of oil and 1,500 cwt. of cocoanut fibre are annually shipped. The trees there, however, suffered severely a few years ago from a violent hurricane, from which they have hardly yet recovered.

Many years ago Dr. Royle estimated the average produce of cocoanuts from the whole of Malabar at from three hundred to four hundred millions annually, valued at £500,000, and copperah, or the dried kernels, was exported for as much more. Thirty years ago there were in Travancore more than 5½ million cocoanut trees, and since that period the cultivation has largely increased, as the demand for the oil and the coir has advanced. From Cochin more than 3,000 tons of the latter are exported.

I have not alluded to cocoanuts under edible nuts, although the 3½ millions imported here doubtless go to the fruiterers' shops and hucksters. They are brought principally from the West Indian Islands, British Guiana, and Honduras, and range in price from 12s. 6d. to 17s. 6d. per 100. Some small quantity of dried copperah is also imported, for the oil-presser's use. The husk forms an important article of commerce, and is readily bought by the brushmakers, being even more valuable than the nut. The quantity of nuts imported would yield about 530,000 lbs. of coir.

The products of the cocoanut are numerous; besides the oil, fibre, yarn, rope, and matting, brushes and brooms are made of the coir from the husk; spoons, ladles, drinking-cups, and carved fancy articles from the shell.

So far back as 1857 the value of the products of the cocoanut, shipped from Ceylon, was £274,462, viz:—

		Value. £
Cocoanuts	1,420.856 No. ..	3.717
Coir rope	18.881 cwts...	13,984
Coir yarn	31,652 „ ..	21.364
Copperah or dried cocoanut pulp	20,381 „ ..	12,143
Oil	1,767,431 gals. ..	223,254

These were chiefly the produce of native plantations, situated on the south-west side of the island.

There were about 22,000 acres of cocoanut trees under cultivation by Europeans, which were being annually added to, but none of them were then fully in bearing.

In the ten years ending with 1869 the value of the shipments from Ceylon were—

Oil	£1,445,928
Coir......................	349,622
	1,795,550

The quantity of oil shipped does not vary much, being on the average 1½ million gallons yearly; but the coir has doubled in the last ten years, now amounting to 67,000 cwts., worth about £45,000, for the mere husk of the cocoanut.

A cocoanut tree, growing in a favourable soil in Ceylon, may produce from 80 to 100 nuts annually, having from eight to 12 branches, or spadices, each bearing five to 15 nuts. It continues to bear for 60 or 70 years. The pericarp of 40 nuts gives about 6lbs. of coir. In some parts of Ceylon the natives separate the coir by burying the husks along the borders of the extensive salt-water lakes, whence, after a few months, they are dug out very clean, the fibres easily separating from the cellular tissue of the husk. This mode of preparing the fibre prevents the offensive smell emanating from macerating the husk in water.

The following is an analysis of the cocoa-nut:—

Water	39·7
Albumen	0.5
Emulsin	1·1
Oil	29·3
Amygdalin	14·0
Sugar	3·6
Woody fibre	9·5
Gum	2·1
Mineral matter	0·2
	100·0

Or, in other words, the proportions in one pound of the kernel are:—

	oz.	grs.
Water	6	14
Albumen		35
Emulsin		77
Oil	4	303
Amygdalin	2	106
Sugar		252
Woody fibre	1	228
Gum		147
Mineral matter		14

The oil is ordinarily procured by first extracting the kernel from its outer integument or shell, and boiling it in water. It is then pounded, and subjected to strong pressure. After boiling over a slow fire, the oil floats on the surface. This is skimmed off as it rises, and again boiled by itself. Fourteen or fifteen nuts will yield about two quarts of oil. A somewhat different practice obtains on the Malabar Coast. The kernel is divided into half pieces, which are laid on shelves, and underneath a charcoal fire is kept in order to dry them. After two or three days they are placed on mats, and laid in the sun to dry, after which they are put in the oil press. When the oil is well extracted by this method, a hundred nuts will yield about two and a-half gallons of oil. This is the method usually resorted to when the oil is required for exportation, the former when merely used for culinary purposes.

Of late years the application of steam power or hydraulic pressure for the purpose of procuring the oil has been attended with the greatest advantage in Ceylon. It is requisite that care should be taken not to apply too great and sudden a pressure at once, but by degrees an increasing force, so as not to choke the conducting channels of the oil in the press. The oil becomes solid at about 70°. It is curious that when cocoanut oil is first manufactured there is no unpleasant smell for the first 30 or 40 hours, but after that it acquires that rancid taste and peculiar odour which no scent will entirely kill. Fresh expressed cocoanut oil is used by the Malay women in the Eastern Archipelago in the hair. It is perfumed by allowing the flowers of the jasmine, the tuberose, and other plants to remain for some time in it, the fat oil of the nut extracting and retaining the essential oil of the fragrant flowers. Cochin oil bears a higher price than that of Ceylon. Poonac, or the refuse oil-cake, is sold as food for poultry and for manure.

The trade in cocoanut oil is steadily increasing at the Seychelles; fresh plantations are being laid out, and others coming into bearing. The quantity shipped in 1869 was 127,112 gallons, valued locally at about £16,000. From Penang there is an export trade in oil and copperah. Cocoanuts are grown in small quantities throughout the Straits Settlements, but it is only here and there that plantations of any magnitude are met with.

Coir is the fibrous rind of the nuts, with which the latter are thickly covered. There are several ways of stripping the fibre from the husk. One is by placing a stake or iron spike in the ground, and by striking the nut on the point the fibre is easily stripped. The fibre is greatly improved in quality and appearance by beating, washing, and soaking. The tannin which this substance contains prevents the fibre from rotting. The fibre is rather difficult to twist, but coir-yarn is made into good ropes, and forms the strongest, lightest, and most elastic cables for ships.

The fibrous husk of the cocoanut is not its least valuable product, and gives rise to a a very large trade both in the East and to Europe. At first it was much used in this country for stuffing mattresses and cushions, but its applications have been enlarged and its value greatly increased by mechanical processes, and in a small pamphlet issued by Mr. Treloar 20 years ago, he stated that its natural capabilities having been brought out, coir has been found suited for the production of a variety of articles of great utility and elegance of workmanship, table mats, fancy baskets and bonnets. Instead of being formed into rough cordage only, and mats fabricated by hand, by means of ingeniously constructed machinery, the fibre is rendered sufficiently fine for the loom, and matting of different textures and coloured figures is produced, while a combination of wool in pleasing designs gives the richness and effect of hearth-rugs and carpeting. Brushes and brooms for household and stable purposes; netting for sheepfolds, pheasantries, and poultry yards, church cushions and hassocks; hammocks, clothes lines, cordage of all sizes, and string for nurserymen and others; for tying up trees and other garden purposes; nose bags for horses; mats and bags for seed crushers, oil pressers, and candle manufacturers, are only a few of the varied purposes to which the fibrous coating of the cocoanut is now applied. The cocoanut shell furnishes cups which, carved on and set in silver, are a great ornament. It also makes small baskets, cups, ladles, spoons, and other such domestic articles, and fanciful ornaments. By being burnt and pulverised and prepared with other ingredients, it produces blacking not inferior to Day and Martin's, lamp black, black paint, &c.

The fruit of the Chili palm (*Cocos chilensis*) is, in every respect, like the cocoanut, except that it is not larger than a walnut, about an inch in diameter. Every tree produces a great number, which are highly esteemed, and they form a considerable article of export to Peru. A curious method is employed to free the nut from the green husk in which it is enveloped, a process that was formerly attended with a very great loss of time and labour. A number of cows and oxen are driven into an enclosure, where a quantity of the fruit is spread, and being fond of its husk they immediately begin to feed on the fruit, only slightly masticating it in the first instance, and swallowing the whole. Afterwards, while chewing the cud, the nuts are rejected, and when the meal is finished a heap of them is found before each of the animals, perfectly free from the husk, and thus the cattle are supplied with food at a season when little grass remains on the hills.

Before leaving cocoanuts, I must not omit mention of the sea cocoanut of the Indian Ocean, the produce of *Lodoicea Seychellarum.*

The fruit, from floating in the sea, was known long before the plant which produces it, or the locality in which it was found, and various fables were invented as to its origin, and marvellous virtues attributed to it. The few known specimens which existed were valued at an enormous price, till, in 1745, the discovery of the Seychelles Archipelago made known the habitat and nature of this singular production. Three of the islands composing the archipelago—Praslin, Cunense, and Ile Ronde—were covered with magnificent forests of this unique palm, and their soil strewed with its huge and singularly shaped nuts. The value of their shells as domestic utensils for various purposes was at once perceived, and from that time to the present they have supplied to the inhabitants the place of baskets, bowls, jars, dishes, measures for grain and liquids, drinking vessels, paint-pots, &c. The trees are fast being destroyed. On Ile Ronde not a plant remains. Cunense has a considerable number of fine young trees. At Praslin a great many have been destroyed by fire, and there are not, perhaps, a score of trees in the other islands. This palm is of very slow growth, for the trunk does not show itself till twenty or twenty-five years after the germination of the seed, and then it takes fourteen or fifteen years before it blossoms.*

I have no recent statistics of the trade in these nuts; but in 1859, 3,310 of these were exported, valued at £831, and 11,800 lobes or cups made of them, valued at £590. Although they have now lost much of their traditional repute, they are still held in such estimation by the negroes and poor people of other islands, that sailors always try to bring away some in their vessels. When preserved whole, and perforated in one or two places, the shell serves to carry water, and two of them are suspended from opposite ends of a stick. Some of these nuts hold six or eight pints. If divided in two between the lobes, each portion serves, according to its size and shape, for plates and dishes, or drinking cups, these being valued, like calabashes, for their strength and durability.

I have here a three-lobed nut, and they are sometimes met with five lobes, and I have heard of one having as many as seven. The kernel contains a portion of oil, but its excessive hardness, and the difficulty of detaching it from the shell (itself so valuable), render it practically useless for oil manufacture. The shell is about equal in hardness to that of the ordinary cocoanut, and equally susceptible of a fine polish. It is from one-tenth to three-sixteenths of an inch in thickness.

A fixed oil (called Manteiga de Assahay) is extracted by decoction from the fruit of the *Euterpe oleracea* palm, which abounds in Para. The oil is of a greenish colour, slightly bitter, and used for lighting and other purposes.

The pulp of the fruit of the Aoura palm, of Guiana (*Astrocaryum vulgare*), yields an oil which is used for many different purposes. A yellowish, bitter oil, used for soap-making in Brazil, is obtained by decoction and expression from the fruit of the *Sagus taediga*, which is abundant in Para.

From the nuts of *Œnocarpus bacaba*, a palm also abundant in Brazil, an oil of a clear green colour is obtained, which, when purified, is used for lighting and culinary purposes. From the fruit of other species —*O. pataua* and *O. disticha*—fluid oils, clear, yellow, and transparent, are obtained, which, when purified, are inodorous, and used in cooking in place of olive oil.

There are two or three species of *Carapa*, the nuts of which yield a fixed oil. Crab oil of Guiana is from the the *Carapa guianensis.* It is extremely bitter, but used externally for the hair and for soap-making. It is abundant in Para, where it is known as andiroba oil. The nuts are so common in some of the districts of French Guiana that, when they are ripe, the soil is covered at least a foot deep with them for many hundreds of yards. That of Africa, known as mote grease, from mote or kundoo nuts, is from the *Carapa talicoonah* or *touloucouna*, which yields 33 per cent. It yields 70 per cent. of oil.

I have here a pomade alleged to be made with this oil, and said to be used by the East Indians for beautifying, softening, and increasing the growth of their hair, and which, according to the label, has wonderful properties; but it is to be regretted that intelligent pharmaceutical chemists should not have known, after figuring and labelling the plant with its scientific name, that Guiana is not in the East Indies, and that the oil is not likely to be carried and used there when an allied indigenous species, *Xylocarpus granatum*, is to be met with.

The nuts of the sapotaceous plants yield a large amount of oil, especially the *Bassias* and the *Argan* of Morocco (*Argania sideroxylon*).

The shea butter or solid oil from the Niger, is obtained from the fruits of *Bassia Parkii*, by boiling them in water. The yield of oil is about 30 per cent. The fruit of another species (*B. longifolia*), yield by expression in India the Elloopie or Mee oil, which is used for lamps among the poorer classes, and is one of the principal ingredients in making country soap. It is of a clear yellow, depositing stearine, density 0·912. The seeds of *B. latifolia* yield by expression a large quantity of concrete oil, called Madooka, which is used in lamps, and for other purposes. The kernels are easily extracted from the smooth chestnut-coloured pericarps, when they are bruised, rubbed, and subjected to a moderate pressure. The oil concretes immediately it is expressed, and retains its consistency at a temperature of 95°. It is used locally for the manufacture of soap. It is usually of a greenish white colour, and has been imported into this country, under the name of mohwa oil, from Calcutta.

From *B. butyracea* a pure vegetable oil is produced, called choorie and galam butter. The kernels of the fruit are bruised, put into a cloth bag with a moderate weight laid upon it, and left to stand till the oil is expressed, which becomes of the consistence of lard, and of a delicate white colour. It is considered a valuable preservative when applied to the hair, mixed with some sweet scented oil. It makes excellent soap, and when pure burns bright, without smoke or smell.

There are one or two species of *Bassia* found at Gaboon, yielding 56 per cent. of oil. One, *B. gabonensis*, contains a true vegetable fat, of which two varieties are made, one called "noungu" by the natives, which has the consistency of goose fat; the other, named "djave," is only available for the preparation of soap.

The Borneo concrete vegetable tallow of commerce, judging from the cotyledons of seeds received, would seem to be from one of the *Bassias*. The fat is made up into large, round, flattened cakes, of the consistence and colour of cheese, and also cylindrical masses, which have assumed the form of the bamboo sections into which it had been poured when in a liquid state.

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* Mr. George Clarke, in Annals and Magazine of Natural History.

The nuts of *Coula edulis*, in Western Africa, yield 53 per cent. of an edible oil. The Booma nut of Central Africa much resembles an almond, both in shape and size, and with the fleshy covering is about the size of a walnut. It is probably the fruit of a species of *Vitex*. It furnishes an abundance of sweet bland oil, much used by the natives in their cooking.

In Jamaica a fine limpid oil is obtained from the bread-nut (*Omphalea triandia*, the *O. nucifera* of Swartz), but whether it will bear a low degree of temperature without congelation has yet to be ascertained. From another species an excellent oil is produced in Guiana, called Ouabe, which is suitable for lubricating machinery.

Ground nut oil is an important trade article, and the seeds enter largely into commerce.

The plant which produces the ground-nut (*Arachis hypogea*) is a little annual, one of a class which bury their pods in the earth when they ripen, instead of raising them into the free air. Having buried itself sufficiently deep, the pod then begins to swell, and when ripe becomes an oblong, rugged, pale-brown fruit, containing usually about two seeds, as large as the kernel of a hazel-nut. It is now found in a state of cultivation all over the hottest part of the tropics. It was unknown until the discovery of America, and every region in the old world where it is now grown owes it to Brazil; so that we have in this plant a further example of the rapidity with which vegetables will take possession of soils where the climate is suitable, for it is now grown very generally in different parts of Africa, in India, the West India Islands, and the United States. The ground-nut, the staple product of the Gambia, is principally cultivated down the borders of the river.

In 1837 the export was but 671 tons, valued at £8,000, but it has gone on annually increasing, for in 1860 it was 11,200 tons. The natives have unfortunately introduced of late years the pernicious system of beating or thrashing, instead of picking by hand, so that the nuts are mixed with leaves, stones, and other extraneous substances, causing large deductions in the French market, and also depreciating their value in the United States as an article of food, or rather as a favourite repast for the tables of the rich.

In Brazil it is known under the name of "amendoum," and has long been used there parched for food and to extract oil from. This oil is used for cooking, medicinally for rheumatic affections, and for lighting.

The roasted seeds are sometimes used as a substitute for chocolate; and, according to Dr. Davy, they abound with starch as well as oil, a large proportion of albuminous matter, and in no other instance had he found so great a quantity of starch mixed with oil.

Dr. Muter, in an article in a popular periodical this month, after giving the following analysis of ground-nut meal, urges strenuously its more general use as an important article of food:—

Moisture	9·6
Fatty matter	11·8
Nitrogenous compounds (flesh formers)	31·9
Sugar, starch, &c.	37·8
Fibre	4·3
Ash	4·6
	100·0

From this analysis it is evident (observes Dr. Muter) that the residue from them, after the expression of the oil, far exceeds that of peas, and is even richer than lentils in flesh-forming constituents, while it contains more fat and more phosphoric acid than either of them. On these grounds we are justified in urging the adoption of the ground-nut meal as a source of food, it being superior in richness of all important constituents to any other vegetable products of a similar nature. Although in the raw state it possesses a somewhat harsh odour, similar to that of lentils, this flavour entirely passes off in the cooking, and when properly prepared we consider that it has a very agreeable flavour. It has been tried in three forms:—First, boiled plain with water, like oatmeal porridge, and eaten with milk; second, made into a custard, with sugar, milk, and one egg to the pint; and third, washed, ground, and taken as a beverage, like cocoa. In all these three forms, but especially in the two latter, it was exceedingly palatable.

This seed is held in much estimation in the United States, where it is known as the pea nut.

There are fully 550,000 bushels sold annually in the city of New York alone. Previous to 1860, the product of the United States did not amount to more than 150,000 bushels, and of this total nearly five-sixths were from North Carolina. Now, North Carolina produces 125,000 bushels; Virginia, 300,000; Tennessee, 50,000; Georgia and South Carolina, each 25,000 bushels; while from Africa come about 100,000 bushels a year. In one week of the month of January, 1871, there were received at the port of New York, 2,751 bushels.

Another underground seed, passing under the names of rush nuts, ground pistachio nuts, chufas, souchet, &c., is *Cyperus esculentus*, the *amande de terre* of the French. They are eaten like nuts, being nutritive, restorative, and stimulant, and are also employed in the preparation of orgeat, a refreshing drink. The toasted roots have been used as a substitute for coffee, and yield a preparation resembling chocolate. In this country we have an earth or pig nut (*Bunium denudatum*, Dec.), which being aromatic, sweet, and mucilaginous, might form occasionally an addition to our winter desserts, eaten raw, boiled, or roasted.

Under the name of candle nuts, some considerable quantities of the seeds of species of *Aleurites*, an euphorbiaceous tree, now come into commerce. They are known to the French as bancoul nuts; in the Pacific Islands they are called kukune. The natives of India are fond of the nut, which is said to be palatable, and something like our walnuts. It yields, by pressure, an oil of a density of ·923, which has various uses. It forms a good drying oil for painters, for, after boiling, it dries in about six hours. It is used for soap-making at Tahiti, in the place of cocoanut oil. It burns without that objectionable smell which cocoanut oil has, and gives a good light without injuring the lamp. It is used also as a drastic purgative. At Nukahiva the nuts are skewered together for lighting at night. The first burns for about ten minutes and communicates to the others, so that a row of 24 will last for about four hours. In the Marquesas and other islands, however, this mode of illumination is giving place to whale oil, purchased from the whale ships.

In the history of the "Mutiny of the *Bounty*" it was stated that the rooms in Pitcairn's Island were lighted up by torches made of doodoe nuts (*Aleurites triloba*), strung upon the fibres of a palm leaf, forming a good substitute for candles. These nuts are also so strung and used by the San Blas Indians in Central America, and a child is in attendance to knock off each nut as it becomes burned out.

By an hydraulic pressure of 20 horse-power, 60 per cent. of oil can be obtained from the kernel of these nuts, but the shell has to be removed by heat or steam, being exceedingly hard to crush. One hundred kilogrammes of the nuts yield 33 of the kernels, and 100 kilogrammes of these, with proper pressure, will yield fully 66 per cent. of oil. The marc or oil-cake left is good for feeding cattle, or for manure. There is a species indigenous to the Eastern Archipelago (*A. malaccensis*), the oil of which is said to be used for culinary purposes in Java, which results probably from a more careful mode of preparation.

In China another species of *Aleurites* (*A. cordata*) known as the Tungshu-tree, yields such an abundance of oil, that it is said to be one of the largest products of the province of Szechuen. In point of quality it is inferior to that of the camellia, but it is very extensively used for lighting purposes. The natives call it Tung-oil.

Beech nuts, the seed or fruit of *Fagus sylvaticus*, serve to feed swine on now in forests, but before the general cultivation of cereals they were, like acorns, the food of uncivilised men; dried and ground into meal they make a wholesome bread; roasted, they form a tolerable substitute for coffee. A clear, yellow, inodorous oil is obtained from them in France; a bushel of beech mast will produce about a gallon of oil, or the yield may be said to be 12 to 15 per cent. of oil. In some parts of the Continent this oil is used instead of butter for culinary purposes. In the reign of George I. a petition was presented, praying letters-patent for making butter from beech nuts. It is a pity some wholesome vegetable fat cannot be brought into commerce in the present day, when butter is so dear and so bad. A beech oil company was one of the most noted commercial speculations of Queen Anne's reign.

In Brazil, the fruit of *Myristica bicuhiba*, Schott, yield a concrete oil, of a brown colour, which is employed in cases of asthma, rheumatism, tumours, &c.

A good quantity of the small oil nutmegs *(Virola sebifera)* have lately been imported. The seeds bruised and pressed by heat give 26 per cent. of a substance entirely soluble in potash water, fusible at 34·5, and composed of two parts of oil, one neutral and the other acid, the last forming about three-fourths of the mass. The neutral part, having glycerine for its base, forms a solid soap with soda. This oil is well adapted for candles; it is very abundant in Guiana, and deserves the attention of business men.

Physic nut is a name for the seed in the capsules of *Curcas purgans* and *C. multifidus*, which furnish an oil used for lighting and in medicine.

It has the same qualities and uses as croton oil, but in large doses is a dangerous poison. The oil is largely used in Indian camps. It is odourless, of a deep yellow, and viscous, but burns well. When cold it deposits a considerable quantity of stearine; density ·918. It is largely produced in the Cape Verd Islands, from whence nearly 300,000 bushels are annually shipped.

Turnery Nuts and Ornamental Seeds.

Of nuts for turnery and ornament there are not many received in this country, but a few have some degree of commercial importance, and one or two others may be incidentally noticed.

Our continental neighbours seem to be more shrewd and clever than we are in applying nuts and seeds to purposes of personal decoration, and although, from being cheap, many of these ornaments are despised by our belles, yet none can deny their interest and beauty, and the ingenuity and taste with which they are arranged. The field is an exhaustless one, and many well-known ornamental nuts and seeds of India and South America have not yet made their appearance in this country.

The vegetable ivory nuts of commerce, corosso nuts as they are usually termed, and tagua by the Indians of Magdalena, are the fruit of the *Phytelephas macrocarpa*, a South American palm. The fruit, a collection of from six to seven drupes, forms clusters which are as large as a man's head, and stands at first erect, but when approaching maturity, its weight increasing, and the leaf stalks, which up to that period supported the bulky mass, having rotted away, it hangs down, and the creeping caudex is seldom higher than six feet. A plant bears at one time from six to eight of these heads, each weighing, when ripe, about twenty-four pounds. The drupes are covered outside with hard woody protuberances. Each contains from six to nine seeds, but generally even. From the kernels (the hardened albumen) the European turners fashion the knobs of walking sticks, the reels of spindles, small boxes, and various little toys. It is of the same nature as the nutmeg and the pulp of the cocoanut, which in some palms becomes more hardened. That of the date, the *Raphia vinifera*, the talipot palm, and others, is quite as hard, but it is neither large enough nor white enough to be of use to the turner. In contact with sulphuric acid the vegetable ivory takes a splendid red colour, almost equal to magenta. This colour, at first pink, then bright red, becomes much deeper and more purple when the acid has been allowed to act for about twelve hours.

The demand for vegetable ivory nuts is largely on the increase, for button making and other purposes, as much as a ton a day is frequently worked up in Birmingham. In 1870 we received 31,430 cwt., valued at about £20,000.

The waste and shavings of this nut furnish a good charcoal, which is utilised by some chemists. A paragraph has lately been going the rounds of the papers, stating that the turnings and raspings of the nut are used to adulterate ground bones. But this I much question, as they could scarcely be obtained in quantity. The value of the other nuts imported for turning, &c. (besides the vegetable ivory nuts) is about £20,000.

The coquilla nut, the produce of *Attalea funifera*, one of the palms which yield the piassaba fibre of commerce, is another ornamental turning nut, but of a dark mahogany colour. The supplies of this, however, from South America have been failing, owing to the indiscriminate destruction of the trees, and the nuts imported lately have been small and immature, and, therefore not appreciated and useful. The cohune-nut, from another species of the same palm, can also be turned into little articles. In Bogota they have small nuts, exceedingly hard, called toparos, which are often made into tinder-boxes, adorned with silver.

The seeds of the shreetaly, or talipot-palm (*Corypha umbraculifera*), being a species of vegetable ivory, are turned into marbles, beads used by certain sects of Hindoos, button moulds, and various minute articles. Little bowls and other fancy ornaments are made from them, and when polished and coloured they are easily passed off for genuine coral. These nuts could be obtained in large quantities in Canara, Malabar, and other parts of India; the chief objection is that they are of such small size.

The fruit of the doom-palm is turned into beads for rosaries, and, in Africa, is made into little oval-shaped cases for holding snuff.

The betel nut, the produce of the *Areca catechu* palm, may here been incidentally known, because it has been turned into ornamental articles, although its principal uses are for other purposes. Small quantities are imported for making tooth-powder and paste, and as a dog medicine, but in India a large commerce is carried on in this nut, chiefly as a masticatory; catechu is also made from it. Betel nuts are pale when mature, but dark-coloured when collected and dried in an immature state, hence the distinction of red and white nuts in the eastern bazaars, the former being only half the value of the latter. About 4,000 tons of these nuts are annually shipped from Ceylon to different quarters. At Travancore the quantity grown is enormous; in Penang 3,000 tons are produced, and in Sumatra 4,000 to 5,000 tons.

The nuts of various other palms have some few useful applications. The grugru nuts, the seed of *Acrocomia sclerocarpa*, are turned and carved into very pretty beads, rings, and other small articles, the hard black texture of the nut taking a fine polish.

The albuminous fruit of *Raphia vinifera* are carved into little figures by the African negroes.

Peach, cherry, and other fruit stones are often seen carved and highly ornamented, and made into rosaries, bracelets, &c., evidencing the patience and skill of the workman who has laboured on them; the hard stones of the date-plum, and other indigenous fruits, are frequently beautifully and elaborately carved by the Chinese and Japanese.

Under the name of Quandung nuts, the corrugated seeds of the Australian native peach (*Santalum acuminatum*), are often set and mounted for scarf pins, bracelets, and other ornaments.

The spherical corrugated seeds of *Elæocarpus ganitrus*, and other species, cleared of their soft pulp, are used by the Brahmin priests as beads. They are also made into necklaces and bracelets for ladies, which are much admired, especially if gilded or capped with silver mountings. Those of *Monocera tuberculata* are used for a like purpose in Travancore. The nuts of *Putrangiva Roxburghii* (the wild olive), called in Hindostan "Jeeopatra," are strung by the natives, and put round the necks of their children as an amulet.

The seeds of the bladder nut (*Staphylea pinnata*) are as hard as bone. The nuts, in some parts of Europe, are threaded for paternosters, and made into necklaces and chaplets. They are also called cut-noses and false pistachios. The kernel has a little of the flavour of the pistachio, but is very acrid, and occasions nausea if eaten to any extent. It yields by expression a bland oil.

Miscellaneous Nuts.

Under this last group I may include those used for tanning and other purposes. Among the tanning and dying nuts or seeds are valonia, under which name the large acorn cups of *Quercus ægilops* are imported from Turkey. The incipient acorns are called camata and camatina. In 1859, 25,579 tons, valued at £332,527, were imported; last year 27,706 tons, valued at £441,998, were received. Under the name of myrobalans, the dried fruit of some species of *Terminalia*, chiefly *T. chebula*, are imported, sometimes to the extent of 6,000 tons in the year. In 1870, 3,000 tons, valued at £33,000, were imported. One species sometimes comes in under the name of Bedda nuts. From its astringent properties, the dried fruit is much used by the Hindoos in their arts and manufactures. The outer coat of the fruit, mixed with sulphate of iron, makes a very durable ink; hence they are called in the bazaars of India ink-nuts.

The Belleric myrobalan (*T. Bellerica*, Roxb.) is also astringent, and sometimes used in medicine in the East. The kernel of the nut mixed with honey is given in certain cases of ophthalmia. It is said to intoxicate if eaten in great quantity. An oil expressed from the seed is used in India for strengthening the hair. The kernel of the nuts of another species (*T. Catappa*, Lin.) has the flavour of an almond, and may be used for the same purposes. The oil is very like the almond oil of Europe, both in taste and smell, but becomes turbid by keeping. It only requires care and attention in its preparation to render it of commercial value and importance. To extract the oil, the fruit is gathered and allowed to dry in the sun for a few days, when the kernels are cleaned and bruised in a mill.

Nutgalls, the spherical concretions and excrescences formed upon the leaves and leaf-stalks of several species of oak and other trees in the south of Europe, are made by the puncture of the female gallfly. There are blue, black, green, and white galls; the last are of little value. Those from Aleppo and Mosul are the best; they are about the size of a nutmeg, and mostly of a blueish or grayish colour, hard, heavy, compact, with numerous small tubercles on their surface. The imports in 1870 were 17,748 cwts., of the value of £54,169.

Grey Bonduc nuts, sometimes called Nata in India, and in Barbados the horse nicker or chick stone, are the stony seeds of *Guilandina Bonducella*. They are intensely bitter, and have hence some medicinal reputation. They are used for playing a game in Western Africa. Ornaments made of them are very common in museums, and I have seen baskets, bracelets, rosaries, and other articles made with them.

The kola nut of Western and Central Africa, the seed of *S[illegible] [illegible]uminata*, have attracted some attention from their use in food and medicine by the natives; and after careful analysis, Dr. Attfield found they contained 2 per cent. of theine, which is more than the average in tea [illegible].

The poison nut, or ratsbane, the seed of *Strychnos nux [illegible]*, is contained in a pulpy fruit, about the size of an orange. As a medicinal agent these seeds possess valuable qualities, but are highly poisonous, except in very minute doses. What is done with the 5,000 or 6,000 cwt. imported it is difficult to say.

The seed of another species (*S. potatorum*), the clearing nut, has more useful properties, for they are employed in India to clear muddy water. One of the seeds is well rubbed round the inside of the earthen vessel containing the water, which is then left to settle; in a short time the impurities fall to the bottom, leaving the water clear and perfectly wholesome.

The marking nut, the fruit of *Semecarpus anacardium*, is in general use in India for marking cloths with the juice of the pulp; the colour is improved and preserved from running by the mixture of a little quicklime and water.

Under the name of soap nuts, the round, black seed of *Sapindus saponaria*, *S. emarginatus*, and some other species are much used for rosaries, necklaces, bracelets, and other ornaments. They derive their name of soap berries from the acrid saponaceous pulp being used for washing linen. The kernels of *S. esculentus* are eaten in the West Indies, and deemed as palatable as the hazel nut or almond.

Horse chestnuts are much used on the Continent for making starch, and an oil is said to be obtained from them which is sold by some chemists as a sedative in gout.

The drupe of the wild almond of the Cape (*Brabijium stellatifolium* R. Br.), after having been soaked for some days in water, is eaten by the natives, being considered injurious when quite fresh. The kernel roasted is used as coffee.

Ravensara nuts are the aromatic fruit of *Agathophyllum aromaticum*, used sometimes instead of nutmegs.

Sassafras nuts, another aromatic seed, are the isolated lobes of the seeds of *Nectandra puchury*.

Cumaru nuts of Brazil and Guiana are the seeds of *Dipterix odorata*, the tonquin bean of commerce, which yields a pleasant perfume for snuff, clothes, &c. A clear yellow fixed oil is obtained from them, which is used in perfumery and for ulceration of the throat.

I have thus taken a hasty survey of nuts and their products, necessarily, from the wide field I have had to cover, very superficial; but I think those who have followed me in my investigation will admit that it is an interesting subject of inquiry, and that the commercial uses of nuts and their products are of high importance in this and other countries.

The paper was illustrated by a large and varied series of specimens of nuts and their products from Mr. Simmonds's own collection, besides numerous specimens of rare nuts and confectionary contributed by Messrs. Fortnum and Mason, an interesting series of products of the cocoanut from Mr. Treloar, of Ludgate-hall; and carved cocoanuts from Mr. W. Wanham, 15, Castle-street, Leicester-square; also from J. W. Draper and Sons, Covent Garden-market.

DISCUSSION.

Mr. Botly thought the paper a very suggestive one. With regard to filberts, he had been told of an estate in Kent where the filberts, which were sold in the London markets, produced an amount equal in value to the fee-simple of the property. He rather doubted it at the time, but now it was corroborated by the lecturer's statement, that 30 cwt. were produced per acre, which would make, at 1s. per lb., £168. As to the use of nuts, it was well know that in the New Forest the produce of mast and acorns was so great, that people sent their pigs there to feed by hundreds, and brought them home in September and October fattened. He thought that acorns might be profitably used to feed sheep, and the year before last, when sheep food was scarce, acorns fetched 6d. a bushel.

Mr. Christian Mast suggested that the addition of maps or diagrams of the principal places from which the nuts mentioned in the paper were brought would be a great assistance to many persons whose geographical knowledge was not as perfect as it might be.

Mr. McAdam said it was, of course, impossible for Mr. Simmonds to allude to the various uses to which the oleaginous nuts might be applied, but he might mention that the palm-nut meal was a most valuable article for cattle-feeding, particularly dairy stock, increasing both the quantity and quality of the milk and cream. Like everything else, it must be used with discretion, however, or an oily character and taste would be imparted to the milk and butter.

Dr. Muter said the *Aractus hypogea*, or ground-nut, had been found very useful for cattle-feeding purposes. Some samples of it were shown in Mark-lane, but, being unknown, nobody would try it, and its effects on poultry and pigs were found to be almost miraculous. It was very cheap, and could be supplied, he believed, at about 1½d. per lb., at which price it would yield a good profit, both to the wholesale and retail dealer. When cooked, with a little milk and sugar, it was very palatable, being not nearly so harsh in flavour as lentils, and far more nourishing.

Dr. Yeats said he had been delighted with the paper, which showed the uses to civilised man of many of the products of uncivilised countries. He thought it would be very advantageous if the Society of Arts could, by a reflex action, be instrumental in conveying to the rude cultivators or collectors of these various products the same information, they would probably be more benefited even than ourselves. The paper necessarily took but a hasty glance at a very wide subject, but its usefulness would be much increased by the addition of information as to the mode of growth and propagation of the various plants referred to, so that it might be known how far they might be expected to repay an attempt to transfer them from a thinly-populated country to another. If the Society could in any way disseminate information on this point it would be productive of great benefit.

The Chairman, in proposing a vote of thanks to Mr. Simmonds, said the paper was so full of details that one could scarcely expect to have much discussion upon it. It was, in fact, rather fitted for reading and study than for discussion at the moment, and it would be a most valuable addition to the *Journal* when published. He was very glad to find that the subject, of which this formed a portion—viz., Economic Botany—was growing in interest in this country. It appeared to him and to many others very strange that in a great commercial country like this so little general interest was taken in the different products to which the welfare and prosperity of the country was in great measure due. He was very glad to make these observations in that room, because the Society of Arts had done as great and good work as any body in the kingdom in inaugurating and promoting those exhibitions which had tended so greatly to familiarise the public with the many vegetable and other products of various regions of the earth. He looked for the future education of the people in this respect, not only to exhibitions, but to the establishment of museums; and it certainly seemed extraordinary that, even 21 years or more after the first great exhibition, so few museums had been established. Mr. Cole, one of the vice-presidents of the Society of Arts, notwithstanding all the opposition he had met with, had succeeded in establishing a great economic museum at South Kensington. Besides this, there was the Kew Museum, which was one of the wonders of the world; but otherwise there were still few in London, whereas there ought to be a great museum opened in each district of the metropolis, where might be delivered, by competent men, courses of elementary lectures, aided by diagrams and such other appliances as could only be obtained in such institutions. He hoped it would not be long before this subject of economic botany would be taught, to some extent at least, in all schools. The great progress of this country was due to the persevering energy of a comparatively few men, but if it was to be continued it could only be by the better education of the masses. He had been referred to in the paper as giving a hard and dry definition of the word "nut." Of course, if a botanist were asked to define a nut, he would do so in accordance with his botanical knowledge, much in the same way as it was given in the paper. At the same time, he might say that even amongst botanists there was a great want of agreement as to the definition of fruit, and therefore it was no wonder that commercial men should feel a little uncertain as to the definition of a nut. A botanical definition would hardly be a fair one to apply to such a purpose, since a nut simply meant a fruit, but as applied commercially it did not mean a fruit, but a seed or the kernel of a seed. Probably the nearest definition for commercial purposes would be, a seed or kernel, with a dry or hard shell which did not open. That would include both fruit and seed. It would include, for instance, a seed with a dry or hard shell which did not open, and it would include a fruit such as a nut, which was really a fruit; and a kernel with a hard shell which did not open would include fruit nuts. Practically, therefore, some such definition would include nearly the whole proper nuts of commerce, although there might be a few exceptions. With regard to the paper itself, he might perhaps criticise one or two little matters, though he should not say much about them; because it would hardly be fair to do so with regard to a paper which doubtless had to be prepared somewhat hastily. With regard to the description given of the preparation of nutmegs for the market, it was not quite correct in some respects. The ordinary nutmeg was the kernel of the seed, which was encased in a wooden shell. This was very liable to the attacks of insects, and, therefore, in order to prevent them, they were first smoke-dried for a considerable time, until the kernels rattled in the shell. The shell did not separate, but when it was so far dried, the shells were broken. Again, with regard to the limewater, nutmegs generally used in England were brown, and these were not cured with lime. It was quite true that nutmegs were limed, but they always had a white appearance, and were very little, if at all, used in England. With regard to what was termed oil of mace, Mr. Simmonds probably meant oil of nutmeg. The concrete oil which he particularly referred to as nutmeg, was that known as the crude oil of mace. The ordinary oil of mace, obtained by distillation, was rather the volatile oil of nutmeg, obtained from the seed. With regard to the sapucaya nuts, he was much surprised to find that they had not been more appreciated in England, for to him they were much more agreeable than Brazil nuts. The history of the cocoanut fibre manufacture was very interesting; and nothing would better illustrate the value of a knowledge of economic botany than a lecture or paper, giving a full history of the cocoanut, with the various products of the oil palm, the development of the trade in which, as had been so well said, had done more than anything else to stop the slave-trade. He was very glad to hear Dr. Muter's observations with regard to the earth-nut, and the result of his investigations showed the value of such papers being published and read. From the association of this plant with other leguminous plants, it might have been expected to be valuable as an edible, as appeared to be the case. With regard to the oil of horse chestnuts; he should like to know if Mr. Simmonds could give any information with regard to its manufacture. He knew there was such an article commonly sold, but must confess to ignorance as to its real composition and source. In conclusion, he said he must express his high appreciation of the pains which must have been taken to prepare such a paper as Mr. Simmonds had read. Those who knew the trouble which was involved in collecting such an amount of information, which could not be got from books, would, he was sure, agree with him in tendering Mr. Simmonds's a most hearty vote of thanks.

Mr. Simmonds said it was very satisfactory to find that his statements and observations had been corroborated by so competent an authority as Professor Bentley. He had necessarily taken a wide survey, and might have fallen into a few incidental errors in a paper which, he must admit, had been somewhat hastily compiled. In fact, he had been very much engaged of late in one of those undertakings to which the chairman had alluded—the formation of a museum, being employed in the arrangement of the food specimens and animal products which had been transferred from South Kensington to the Bethnal-green Museum, an institution which he hoped to see copied in other parts of the metropolis. He believed that, hitherto, the fear had been that the establishment of local museums would interfere with existing institutions, such as the Botanical Museum at Kew, the Mineralogical in Jermyn-street, and the British Museum, but this notion was now losing ground, and he thought general museums, such as that in Edinburgh, if established throughout the country, would be very valuable for educational purposes. He said this because he quite agreed that the more economic botany was studied the better would it be for all classes of the community. Several amusing instances had lately come under his own observation of errors which a little knowledge would have prevented. An ivory turner, a very intelligent man, had his card ornamented with a representation (from his own design) of the palm, from which the vegetable ivory nuts were obtained, the tree being like an ordinary cocoanut palm, with negroes climbing up and collecting the nuts, whereas it should have been a kind of recumbent palm, reaching but a small height from the ground. Again, a manufacturer who had been introducing the fibre of the silky cocoatree, or *Bombax*, for stuffing beds, which was largely used in Holland, having been shown at the Amsterdam Exhibition, published a pamphlet setting forth all its good qualities, but giving a drawing of the *Theobroma cacao* instead of the *Bombax* as the source of supply. Not long ago a drugbroker's warehouseman showed him a seed or fruit which had been sent from India, and was represented to be a wonderful poison, but no one knew what it was or anything about it. By examination, and tracing the meaning of the native name, he ascertained that it was the *Barringtonia cutangula*. He was pleased to find that Mr. Botly's practical knowledge had supported his statement with regard to the produce of Kentish nuts and filberts; but he was always pretty careful not to make such assertions without good foundation. Acorns he had not treated of, because there was hardly any trade in them in this country; on the Continent they were used for making imitation coffee, and also for starch and other purposes. He did not think it would be advisable to encumber such a paper with maps or diagrams, which would have to be very numerous, and the different places could easily be traced out in a gazetteer by those who were interested. He had not alluded to the use of palm-nut meal for feeding purposes, because he did not think it was obtainable in sufficiently large quantities for ordinary commercial purposes. The ground nut, which had also been alluded to, came in much larger quantities, and might be used in that way. As to the chemist who used the erroneous label for his pomade, he found, on joking him about it, that it was an article which had long been sold in the shop, and he did not care to alter it; still, he thought it would have been better to correct such a gross error. He had failed to obtain any satisfactory information with regard to the oil of horse chestnuts, and must say he doubted its source. Horse chestnuts were largely used in France for making starch, but he could not trace the manufacture of oil from them, and was inclined to think it was merely a fancy name for an article said to be a specific for gout.

Some beautiful specimens of ornamental turning by Mr. Forshaw, a member of the society, and an amateur mechanic, were exhibited to the members at the close of the meeting.

CHANNEL PASSAGE COMMITTEE.

The Committee met on Wednesday, 20th of March, at three o'clock—Present: Messrs. Seymour Teulon (Vice-Chairman of the Council), in the chair, Edwin Chadwick, C.B., Vice-Admiral Ommanney, C.B., F.R.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., E. J. Reed, C.B., and General Eardley Wilmot, R.A., F.R.S.

Mr. G. C. Mackrow, Naval Architect, of the Thames Ironworks, and **Mr. Henry Liggins** attended to give evidence.

Mr. Mackrow said that for some years his firm had been building the vessels that ran between Dover and Calais, and he was perfectly well acquainted with the mode in which they were fitted up internally, and he had brought the plans of one of the old boats with him; but since that the *Prince Imperial* and *Emperor* had been built.

Mr. Chadwick said the two great points to be considered were, what could be done for the prevention of sea-sickness, and for securing ventilation.

Mr. Mackrow—The first point, of course, is, what are the dimensions of the vessels. Has that been determined?

The Chairman said at present it was assumed that, as large vessels were now running between Folkestone and Boulogne, and Dover and Calais as the French harbours would admit. The Committee wished to elicit, if possible, some mode by which some of the inconveniences attending the present class of vessels might be avoided.

Mr. Mackrow said he came up under the impression that the Committee were considering those very large schemes which were now before the public.

The Secretary said the present object was rather to see what could be done with the existing vessels, to make them more commodious and agreeable for the passengers.

Mr. Mackrow said in 1854 they had gained about 25 feet in the length and 4 feet in the beam. He remembered at the time of the Spithead Review, when there was a considerable gale, a vessel called the *Albert Victor* being chartered to carry passengers out from Dover, or some point along the coast, to see the review. Of course, as the weather turned out very rough she brought but very few passengers; but the captain stated that she made a most excellent passage. She was a vessel with a deck-house. If there is a question of extra accommodation and ventilation, it appeared to him that if you could not get it in breadth you must go to height. The vessel he referred to was like some of the vessels to be seen on the Thames, and it was doubted whether it was advisable to send such a vessel through a gale; but the captain assured him that her behaviour was most excellent, and that if more passengers had come they would have had a far better passage in her than in many of the other ships which were supposed to be more sea-worthy. As a naval architect he should hardly have suggested such a vessel for the Channel passage; but if length and breadth was limited, it was clear any extra accommodation must be found in extra depth by carrying up a deck-house.

Lord Clarence Paget asked if the *Albert Victor* was about the same length as the vessels plying between Dover and Calais.

Mr. Mackrow said he thought she was somewhat longer; she was 230 feet long and 25 feet beam, the deck house stood about six feet above the gunwale; it was entirely on the deck, and there was a promenade deck over that. He did not know what had become of her lately; he believed she had been a blockade-runner, and was afterwards converted into a saloon steamer.

The Chairman said a vessel of that kind ran for some time between Folkstone and Boulogne, called the *Lord Warden*. He understood she behaved very well at sea, but there was a difficulty in entering the harbours: the wind, when athwart her, caught the deck-house and created a difficulty.

The Secretary said the committee had been informed that deck-house steamers were almost inadmissible on that station, because, however well they might behave at sea, they were extremely dangerous entering the harbours in a gale.

Mr. Liggins said he crossed with Captain Paul, the Commodore of that service, in the *Lord Warden*, in one of the most terrific gales, and he never was in a better vessel in his life. He never heard one word of difficulty about the deck-house. He had heard, however, that when the new boats came out the *Lord Warden* was reduced to a cargo boat, and the deck-house, being in the way, was taken off. There was not the least difficulty in her entering the harbour on the occasion referred to. There were scarcely any passengers on board, because it was so rough, and therefore he could not judge as to the amount of sea sickness. He only crossed himself because it was so rough, to see the behaviour of the boat. He was quite sure it would be useless trying to prevent sea-sickness.

Mr. Chadwick—Do you mean to say there are no means of reducing sea-sickness but by having the vessel of great length.

Mr. Liggins—There are no means, either by length or otherwise, of preventing sea-sickness, in my opinion.

Mr. Mackrow said accommodation for a few passengers might be found in the way of swinging cots, but with the present size of boats the majority of the passengers could not be provided for in that way. There might be a range of berths with swinging cots, as was done in the sick bays in the transport vessels. He would replace the sofas by swinging cots in a double tier, as was done in the *Serapis* Indian transport. There was a plain upright stanchion, with a projection on it from which the cot hung, something like a common hammock.

Mr. Chadwick asked if flexible suspenders were used. He understood they had been introduced for the transport of sick in America, with very great advantage.

Mr. Mackrow said they had been used to some extent, he believed, in the *Prince Frederick William*, which had lately been fitted for a yacht, and she had one of these suspended berths in the cabin, hung with gimbals; they occupied an enormous space, and if this sort of thing were introduced generally, it would very much curtail the cabin-space, and there would be only room for one tier, for there was only just depth enough in the vessel for one to be fitted.

The Secretary—Do you think that the present arrangement of cabins—the main cabin, the ladies' cabin, the steward's pantry, and the water-closets and so on, is as good as it can be?

Mr. Mackrow—I do not think we could much improve it. The ladies' cabins are as near midships as possible, in order to avoid the pitching and sending motion. The steward's pantry takes up very little room, and in a paddle steamer the engines must occupy the centre of the vessel. The water-closets are placed close to the ladies' cabin, for their convenience when unwell.

Lord Clarence Paget—Do you think that the deck-cabin could be substituted in these vessels for that dreadful black hole of Calcutta below. The last time we met, a gentleman suggested a compromise, namely, that we should have a deck-cabin, but that it should be rather sunk.

Mr. Mackrow—That is like the *Lord of the Isles* and the *Lady of the Lake*, which run from Southampton, both of which vessels were built by my firm. The *Lady of the Lake* is an improvement on the first one, as we have carried the sponsons over the side well, with the paddle-box right round; she is a very nice boat, and much admired by every one, and I believe they are projecting another little fleet like her; the windows come just above the rails.

The Chairman said this plan had been suggested by Captain Scott, R.N., and that the surface of the deck should not be higher than the vessel's bulwarks, so as not to catch the wind.

Mr. Mackrow said in the *Lady of the Lake* the bulwarks were open, so that the air came direct into the windows round the top of the cabin. If the length and breadth of the vessels were limited, any increase of capacity must be gained in height.

Admiral Ommanney asked what room there would be for walking on deck.

Mr. Mackrow said by the plan before him there was a space of four feet round the raised deck house. With regard to artificial ventilation, he said that could be obtained to any amount by means of a fan. Of course there would be a little addition to the weight of the hull by the addition of the raised deck house, and the object had always been to diminish that as much as possible, and to have the greatest power possible, so as to reduce the length of the voyage to the smallest limit. Of course, if there were any weight added there would be so much more resistance, and greater power would be required to get the vessel through at the same speed. He apprehended that on the top of the deck-house they would want a skylight and seats on the top, which would all add to the weight. If he had known that this was the point to which the committee were directing their attention, he would have come better prepared on the subject. Some of the old boats had behaved very uneasily, and it had been the impression, as it was his own for many years, that a great deal of rolling motion would result from the centre of gravity being too high, but this impression was now to a great extent removed. The *Emerald*, on the Ostend line, behaved capitally. It was true she was two feet deeper than any they had built, being increased from 11 to 13 feet of water in depth, but he was told she behaved admirably. That confirmed him in the idea that the deck-house principle was the right one for this class of vessels.

The Chairman asked in what way Mr. Mackrow would propose to use artificial ventilation—by exhausting the foul air or driving in fresh air?

Mr. Mackrow said he should force in the fresh air through pipes fitted with louvres, by which it could be regulated as was desired. This was done in the *Magdala* and *Cyclops*, and any amount of fresh air could be obtained. He had no doubt that when they got to Calcutta, instead of going on deck to get fresh air they would go below, for, the fan being always at work, there would be a thorough supply of air always circulating. A bottle of eau de Cologne thrown down occasionally would be of immense benefit. They had just supplied a small boiler for the purpose of working the fans. Originally they were worked by one of the small marine boilers, but of course that would be a very expensive process when the vessels were in harbour.

Mr. Liggins said—On Friday evening next, I am to read a paper at the Institute of Naval Architects, of which I am an associate, on this subject of Channel service which is to be followed by a more elaborate one by one of our presidents, but, having met Mr. John White, who was here last week, he recommended my coming to give any information I could to this committee. Therefore, anything I may say now will be rather forestalling my paper, but, as the more it is published the better, I will give you its purport shortly, which is condemnatory of the grand schemes of a gigantic nature such as were illustrated in the *Graphic* the other day. In the first place, I think it is impossible ever to get money for such projects, and, if it were obtained, it would be many years before we should derive the benefit of it, and therefore we, on behalf of ourselves and those of our friends who suffer from the present inconveniences, should direct our minds to utilise the present means that can be adopted. I am glad to hear that the views I hold, which are derived from great experience and travel, are also held by this Committee. At the same time, I think it is utterly impossible to provide for the large number of travellers who now go to the Continent with our present boats, and that we should build a superior class to those now employed. The boats in the Belgian service are much superior to the South Eastern; they are longer and faster, and, being larger, have much more cabin and deck area; and that higgledy-piggledy appearance of the people that is shown, though somewhat exaggerated, in the picture in the *Graphic*, is to a great extent avoided. If a person could have a little decent accommodation for lying down, I think in many cases that would prevent their being sick. Therefore, I think it is absolutely necessary that ships with larger cabin area should be provided, though no doubt great improvements might be made in the present boats. I believe the reason the deck-house was taken from the *Lord Warden*, as I said just now, was that she was no longer used for the passenger service, being superseded by larger boats, and, therefore, the deck-house was taken off to adapt her to carrying cargo. I never heard of any complaint as to her sea-going qualities, but have always heard passengers speak of her in the highest terms. These deck-houses can be ventilated by openings overhead and on each side, allowing a free current of air to circulate.

The Secretary—Perhaps you will just, before going further, kindly inform the Committee what your experience has been in these matters.

Mr. Liggins—I am not a professional seaman, but having had great affection for the sea, and having the opportunity of indulging it, I have studied it and practised it the whole of my life. I have been a ship-owner and a successful one, and therefore I know a good deal about the construction, repairs, and management of vessels. I have crossed the Atlantic eighteen times in ships of my own, and in the Royal Mail and Cunard Companies' vessels, and having done that with my eyes open, I think I can form an opinion. With regard to the English Channel, I have never crossed it more than fourteen times in one week, or more than twice in one day, but last year I did cross it twice in one day, on board the *Livonia*, and I suppose altogether I may have crossed it about five hundred times in various kinds of vessels, from an open boat to a Channel steamer. I happen to be a friend of Mr. Ashbury, who is so distinguished as a yachting man, and last year I spent two months on board the *Livonia*, around the coast of England, Ireland, and Scotland. Both in the *Livonia* and the *Cambria*, Mr. Ashbury has gone to the expense of about £100 to have a swing cot fitted up for his own use. That swing cot is of a longitudinal box shape, suspended on gimbals, like a mariner's compass. I had charge of Mr. Ashbury's yacht in a race from Dover to Liverpool last year, when there was nobody on board but myself, and a smart gale coming on in the Irish Channel, I found, from the bad manner in which the builder had done his work, my bed was untenable. I tried the swing cot, and I must say a more wretched, miserable, unsatisfactory, disagreeable thing I never slept in in my life. Still I was safe from being pitched out, and to that extent it was an improvement on my own. But there was a nasty jerking motion with it, and I am satisfied you cannot introduce such articles as these swinging cots without the risk of having to pay pretty heavy damages for injuries. You must recollect that these gimbals must have a frame on which they are supported, which must be sufficiently far off from the cot to allow of its swinging properly, for it sometimes makes a considerable arc as the ship rolls. Whether that distance is enough to get your ankle in, and break your foot off, or only sufficient to crush your fingers, would make very little difference to the surgeon, but it would be a very serious thing if, after a smart storm, you found several of the passengers with their hands or feet torn off, or their knees dislocated, or other injuries, by contact with the edge of the framework. Mr. Ashbury, from practice, manages pretty well, and I have never heard of his being injured, but I felt it was very dangerous, and therefore I never slept in it a second time. I am never sick, and therefore do not want it. It is a costly and cumbersome thing to fit up, because you must have a weight suspended underneath, to balance it, as is the case with swing-tables. That requires an amount of depth which, in these shallow boats, is very difficult to obtain. Unless you have double gimbals I do not see much use in having swing cots at all. Dr. Cotton, of the Hospital for Consumption, says it is not the stomach which is the cause of sea-sickness, but it is the effect of the motion upon the brain, and the stomach sympathises with it. It is evident that if we lie on a bed in a cabin, and it keeps moving about, the room itself appears to move, and it thus produces the same effect upon the brain, and I believe it has more influence on the mind and on the stomach, than the actual motion itself. I know, from observation and experience, that if you can get people to lie down on a fixed bed and close their eyes they are much less likely to be ill than in these swinging cots. I have made cots myself, and have slept in them afterwards, and have tried hammocks, and they are very well to me who am not sick, but they are very objectionable to sea-sick people. When in a hammock they see the beam over their heads apparently swinging backwards and forwards, and that produces the effect I have spoken of.

The Chairman—Still, Mr. Ashbury has adopted this swinging cot in his second yacht, having tried it in the first.

Mr. Liggins—Yes.

The Chairman—Admiral Ryder, who was here the other day, told us that he never goes to sea without adopting some expedient of that kind for suspending himself.

Mr. Liggins—If he does so, and feels the benefit of it, I can say no more. My opinion is that, for the comfort of passengers, a comfortable sofa bed is the best. I would have the sofas made more comfortable than at present, much wider, so that a person might lie down safely without rolling off on to the floor. They might also be fitted with boards hanging down at the sides, which in rough weather might be turned up so as to form a side.

Mr. E. J. Reed—The last time I crossed the Channel I put that theory about lying down to the test. I had very bad journeys across, both in going over and on the return. I went below before the vessel started, and lay down and closed my eyes, but I got much worse than I had been at all on any previous occasion, and went on deck in a perfectly miserable condition. It was the first time for several years that I had been actually sick.

Major-General Eardley Wilmot—Might not that be for want of ventilation?

Mr. Reed—Perhaps so; but merely lying down shutting your eyes in any ship, I am satisfied, would not prevent sickness.

The Secretary asked Mr. Liggins if his views were consistent with using the present boats, or whether it was necessary to have entirely new ones?

Mr. Liggins—I think they might be very materially improved in many little matters, but I should suggest that proper boats be built, with a sufficient amount of room to give passengers comfortable accommodation, and that is quite consistent, I believe, with the present harbours. I only look, of course, to Boulogne. In the paper I shall read on Friday, I shall show shortly how that may be done. With regard to swinging in the harbours, I do not see any necessity for that, for the vessels might easily be made sharp at both ends, to avoid the necessity of turning.

The Chairman—How would this affect the arrangements for first and second-class passenger accommodation in the boat?

Mr. Liggins—I do not know why the first-class passengers should not go first, except that perhaps in very rough weather there is more wet forward, but the boat could be turned directly she got out of the harbour. Still, I believe there is room to turn much larger boats than now go to Boulogne.

Mr. Reed—Has the Committee any evidence with regard to the stability of these various passenger steamers?

The Chairman—I think not.

Mr. Reed — The qualities of these boats are extremely different as to their stability, as is apparent to everyone on looking at them. It would be very easy, on a fine day, by a simple experiment, to ascertain their stability, and I should think the proprietors would be disposed to facilitate that. It seems to me one of the most fundamental principles is to have a proper adjustment of stability in the first place to check the rolling. The rolling was very violent on the last occasion I crossed. One of the boats rolled very badly indeed.

Mr. Liggins—With regard to ventilation, I agree that a great deal may be done by a little fan, driven by an engine, sending the air in in finely divided streams through the floor, adjusting it as required. Then, again, there is no proper sitting or lying accommodation on deck. There, again, the difficulty is in the narrowness of the boats. I think there ought to be comfortable sofa-seats, six feet long, or a little longer, such as are provided on the boats from Southampton to the Channel Islands, which are always taken possession of by the ladies. I do not see why something of the kind might not be arranged between Dover and Boulogne. An awning might be made, to put upon them in wet weather, and take down when not required. It is these little things which really make all the difference between comfort and discomfort in the passage. The quickest passage on record is, I think, that of the *Victoria* from Boulogne to Dover, in one hour and 34 minutes, and I suppose we shall not be able to get boats of this size to go faster. To do a journey of 25 miles in an hour and a quarter we should require boats of probably 250 or 300 feet long. We might get magnificent vessels of a light draught of water, but they would be very costly; still I think they would meet the public wants, and would render unnecessary any of the vast outlays that are proposed by other schemers. My idea is it would be much better to do the thing properly, by having good boats. In my paper I draw attention to the finest specimen of passenger boat that I know of—that is the Scotch vessel *Iona*, in which I have travelled many times. She runs on the western coast of Scotland from Glasgow to the Crinnan Canal, taking passengers for the whole west coast of Scotland. She goes there and back every day, and a portion of the voyage is sometimes very rough, particularly at the entrance of Loch Fyne. She has a deck-house fore and aft. There is a similar boat to be seen on the Thames, one of the old blockade runners, fitted up as a passenger boat. The *Iona* goes 21 miles an hour. I have seen her on a Sunday with 4,000 passengers on board, though of course, they are very much crowded. Dimensions of the *Iona* are as follows:—Length, 255·5 feet; breadth, 25·6 ft.; depth in hold, 9·0 ft.; draft of water, 4·6 ft.; breadth over paddle-boxes, 44·0 ft.; gross tonnage, $390\frac{34}{100}$; registered tonnage, $112\frac{86}{100}$; nominal horse-power, 180; indicated ditto, 800; speed (trial trip), 21 miles; speed (working), 19 miles; number of passengers licensed for, 1,400. I am inclined to think that I could arrange such a vessel with increased depth, say eight feet draft of water, to get over all the present difficulties.

Lord Clarence Paget—Have you any suggestions to offer as to landing and embarking?

Mr. Liggins—I have, but it is so simple that it almost speaks for itself. One of the greatest discomforts is to get out of a train on a rainy or snowy day, and having to walk a considerable distance with an umbrella, carrying your carpet-bag, and attending to those who are with you. All that ought to be done under cover. The train should go under a shed, just sufficiently high to admit it—not an expensive, grand construction. Then the passengers might walk under cover to the deck of the steamer, and they would be at the door of their cabin without the necessity of putting up an umbrella. The same could be done on the French side. The rail there is already along the side of the west quay; if they choose, the passengers can land on the west side. I understand they are going to bring the rail at once to the east quay, to oblige the shopkeepers of the town, who do not like the passengers taken away from their shops. Another very great point is the arrangement of the baggage. One of the greatest drawbacks to travelling is the constant anxiety of looking after your baggage. If a man is going to Vienna or Berlin he is sure not to want his heavy baggage until he gets to Paris, and it might all be put into large boxes, which might be arranged half the size of a railway truck, so that two such boxes would occupy a truck, and they could be easily lowered from the train into the hold of the steamer by a steam crane. It would occupy a very few minutes, and would remove all anxiety on the part of the passengers.

The Chairman—You are aware that small parcels and other luggage are frequently put in wicker cases, and pass the frontier in that state.

Mr. Liggins—Certainly. That is an arrangement for the convenience of travellers, and I think it ought to be carried further. It has been in daily use for many years in the United States, and what can be done there can be done here. They have a splendid system there of checking your luggage. You may go the whole way from Baltimore to new York with the greatest comfort. After going some distance in the train you find you have run against the side of the river, and in a few minutes more you are on the deck of a steamboat without moving from the carriage. If you like you can get out, walk down a broad staircase, go into the saloon and have a good luncheon, and presently you are on the other side. This steam-ferry business is simply a copy of what has been many years in existence in the United States.

Lord Clarence Paget—With regard to the ticket, would it not be a great convenience if the tickets, instead of being taken on board the vessel, were given up on the landing-place?

Mr. Liggins—Certainly; I was coming to that, and also to another class of tickets, for the purpose of checking baggage. Referring again to the journey from Baltimore to New York, at a further stage you have some distance to go on a river steamer, where there is every possible accommodation, and she goes at the rate of about fifteen miles an hour Whilst on board I noticed two clerks coming round, and one of them asked me if I wanted my baggage checked on. Having only been two days in the States, I did not know what he meant. He had a basket before him, full of little round metal tickets, the size of a penny-piece, and the other man had a book. He explained that if I was going to New York I might give him my ticket for my luggage, and for the charge of one shilling they would see that it was conveyed from the vessel to any hotel I wished to go to, or to any private house. I asked a genman if it was all right, who informed me it was, and I then trusted him with the check the railway had given me for my luggage. This was registered in the man's book, and he told me that I should find my luggage there before I was there myself. When I landed for the first time in my life in New York, I had nothing to carry but my umbrella, and, having some knowledge of the city from a map, I walked up to the St. Nicholas hotel. When I got there I gave in my name, and the clerk said, "Your luggage has arrived some time ago; it is in No. 19." I went to No. 19, and there I found it uncorded and ready for use. It was a very great comfort; and all that cost me one shilling. These little things greatly facilitate the comfort and convenience of travelling.

Mr. Reed observed that, with reference to putting luggage into boxes for cities like Berlin, it must be remembered that luggage must be opened on crossing the frontier or at Cologne.

Mr. Liggins said of course they could not interfere with Custom-house rules, but he referred rather to the transit to Paris. Most persons stayed a day or two at Paris, when they would want their baggage. In reply to a suggestion of the Chairman, that passengers might entrust their keys to some official, in order that the baggage might be searched, he said he did not think ladies would like to have their baggage looked at in that way. Some persons advocatod the examination of baggage between England and the Continent on board the steamers, but, speaking from some experience, he thought there was nothing more disagreeable. It might easily be proved by going down the river and meeting any of the Continental steamers, where the examination was frequently conducted by the Custom officials in coming up from Gravesend. When it took place at six or seven in the morning it was very annoying indeed, particularly to ladies, and he had known instances in which they refused to have their baggage looked at, but that offended the officers, and caused some unpleasantness. He did not therefore approve of examining baggage on the voyage, when people were sea-sick, and he thought the proposals must emanate from persons who had had no Channel experience. Putting the baggage on board in boxes, as he had suggested, would save a deal of time, as well as the damage which was frequently done, and for which the excuse was that there were only so many minutes allowed, and they could not take proper care. It was obvious that if you had to handle fifty packages instead of one, it must take some time. With a steam crane it might be done very easily, and by lowering the boxes, running on rails, it might easily be shifted to any portion of the hold required. In his opinion, very little could be done with the present boats to meet the necessity of the case, but he thought it would be more to the advantage of railway companies to get proper boats, as they would then get the whole of the traffic between the two countries, which was now split up into a number of routes, viz., Southampton to Havre, Newhaven to Dieppe, Folkestone to Boulogne, Dover and Calais, Dover and Ostend, London and Havre, London and Boulogne, London and Calais, and London and Ostend. He understood that owing to the improvement of the Ostend boats a great many passengers used that route; last year the number being 25,154 outwards, and 32,301 homewards, being a daily average of 69 out and 88 home, though, no doubt, that route was affected last year by the war on the Continent. There could be no doubt, however, that the more perfect you made the boats and the shorter the route, the more certain you were to get the passengers, and he believed there was yet room for a very great reduction in fares. He saw no reason why passengers should not be carried as cheaply here as in the United States, where you could go a much greater distance than from London to Paris for less than £1. He believed that if the first-class fare from London to Paris was fixed at £1, there would soon be at least a thousand passenergs daily each way.

The Chairman asked what kind of boats Mr. Liggins suggested, and if larger boats were possible with the present state of the harbours on the French coast.

Mr. Liggins said he should suggest boats very much like the *Iona*, or perhaps larger. Some of the boats now were 230 feet long, 34 feet beam, 56 feet over the paddle boxes, and 7 feet draft of water. The length ought to be extended as much as possible, say to 300 feet, which would give a very roomy boat. He was referring principally to the harbour of Boulogne, because he considered that was the proper route. Calais was a little insignificant place at which no one cared to stop, whereas Boulogne was fashionable; it was only about four miles further by sea, and was an hour nearer Paris, and he was quite certain much larger boats might enter the harbour than those now running, for the harbour had been much widened since the west dock had been built. He was also of opinion that the best sea route was that between Dover and Boulogne. A straight line from pier to pier carried you clear of the Varn, whereas in coming from Folkestone the route lay very close to the Varn, and some six or seven years ago the *Victoria*, cutting it too fine in order to save time, got into broken water, did not rise fast enough, and the sea came on board and knocked in her foreward deck. A plan of Boulogne harbour showed that it had been much widened, and there was room for much larger vessels to swing in than the boats now running, especially just opposite the dock. The *Victoria and Albert* royal yacht had swung there, which, he believed, was considerably over 300 feet long. But if necessary a V piece might be cut out of one side of the harbour, to allow room for swinging. He was not a shipbuilder, but if the class of boats required were indicated to gentlemen like Mr. Reed, he had no doubt they would design what was necessary. With regard to the fittings, he had his opinion about them, but probably experience would be gained while the work was going on, and the plans would not be perfected until the vessel was finished. He had no objection to a deck-house, but the principal thing was to have greater length. There were no more splendid vessels in the world than the Holyhead boats, but they drew too much water for this service. If a piece was cut off the bottom, so as to make them more flat, he thought they would form a very good model for this service.

Mr. Reed said he should like to see them pitch and roll a great deal less than they did, for when he had crossed he had seen more than half the forecastle deck right under the solid sea, and they rolled extremely.

Mr. Liggins said that arose in a great measure from their being driven through the water so fast. In crossing the Atlantic in the *Atrato* he had seen her with 100 feet clean under the water.

Lord Clarence Paget said he thought it was near Holyhead that the boats came to grief.

Mr. Reed said he had seen it the whole way across; both coming and going they rolled very heavily, but he believed this might be got rid of altogether by attending to two things, first, by having a proper adjustment of stability, giving the same attention to that as had been given to other matters, and next by making them with bilge keels. An Admiralty corvette had been fitted with bilge keels six feet deep, which absolutely destroyed everything like a tendency to roll, and at the same time there was no appreciable loss of speed; it was necessary, however, to take care that the bilge pieces were not made too long, or else they held the ends of the vessel down.

Mr. Liggins said he knew a case in which passengers actually refused to go in a large steamer because she rolled so frightfully. The company put two bilge pieces upon her about six or eight feet under water, which made her very steady indeed, but took a knot an hour off her speed. In the paper he was about to read he suggested the use of bilge keels or centre boards, to be used only in the deep part of the Channel to prevent rolling.

Mr. Reed said that Mr. Froude's investigations had absolutely proved that such a device would not check rolling. With regard to loss of speed, he might mention that Captain Jackson, the proprietor of the steamers running from South Wales to Waterford, consulted him with regard to a Scotch-built vessel, which rolled very badly. He was opposed to bilge keels, on the ground that they would destroy both the speed and the steerage. He (Mr. Reed) advised him, however, to try them, putting them well up, very deep, and very short. He did so, and the result was that the rolling was cured, and the vessel both steamed and sailed better than before, because there was not the time lost in rolling. Captain Jackson assured him from one of the worst it became one of the best boats on the line. The bilge keels had often failed, because they had been put in the wrong place, made very shallow, and carried to too great a length. Mr. Froude's investigations of wave motion had proved that a vertical keel was absolutely useless to check rolling. He referred, not to the rolling caused by pressure of canvas, but to that produced by the wave-motion of the sea. The great point was to attend to the stability in the first instance; and that could easily be done now, after the experiments made in the navy. Then other conditions came in to limit the amount of stability to be attained; but in this case he thought it would be most valuable if the owners of the boats would allow an experiment to be tried to determine the stability, which would form a guide for future action. Messrs. Samuda were now building an Austrian yacht from his design, which was to be fitted with bilge keels; but they were not to be affixed until after she had been tried, so that it would be clearly seen whether or not that interfered with her speed. It was quite possible that in a paddle-steamer they might be so close to the paddles as to interfere with their proper action. With regard to ventilation, he quite agreed with the system of artificial ventilation, and thought the ventilator of Mr. Silber, to which he had previously referred, was well worth attention.

Mr. Chadwick stated that the best ventilation of which he knew had been done in France. At Paris, the late M. Duvoir Le Blanc had contracted for results. He contracted to keep the air warmed at any temperature required, and to remove it as often as required, and in any direction required, and he did it. He contracted for the warming and ventilation of the great hospital La Riboisière, to keep it warmed at an equal temperature (60° Fahr.), and to change it every hour, night as well as day, at a rate of two sous per bed, or for a space of 56 metres, and he did it. He would contract to cool as well as ventilate, and would do it by leading the outer air over cooled or warmed surfaces, as required. The plan of ventilating by driving in air he rejected, and it is now rejected, as it drives the air in channels, leaving stagnant sides or corners, or in heaps in particular parts. The principle which he adopted, and which is approved by the leading authority on ventilation, General Morin, my *confrère* of the Institute, is the principle of ventilation by aspiration—by suction—and the rule in respect to it is to suck the air out as closely as practicable to the source of vitiation. On shipboard it would be accomplished by drawing the vitiated air from above the hammocks, close to the face between decks, or close over the beds in cabins. In houses and sick rooms it had been done by leading the trumpet-mouthed suction-pipe close over the sleeper. Now, why could could not all this, which had been done in hospitals and houses, be done on shipboard?

Mr. Reed said the question presented no difficulties with regard to ships, because the power required was but a small fraction of that constantly at command.

Mr. Chadwick said it was to be hoped that the Earl Shipbuilding Company, of which Mr. Reed was the manager, would give us complete examples of the *desiderata*.

Mr. Liggins said there was one little point connected with ventilation which had not been mentioned, and that was the smell of the oil and grease from the engines, which to many persons was so offensive, that ladies frequently preferred going in the fore part of the vessel in order to avoid it. He would suggest, therefore, that the engine-room might be ventilated, in order to remove this annoyance.

Mr. Chadwick said the conclusion seemed to be that great length meant steadiness of motion.

The Chairman—It did not prove so in the *Great Eastern* steam-ship.

Mr. Reed—I think at present the amount of stability is a matter of the purest accident. In a matter of this kind, the first step would be, proceeding experimentally, to obtain the exact character of the vessels now running, and bring them within the sphere of existing knowledge; then, in designing new vessels, it should be made a condition that a prescribed amount of stability should be conformed to. The necessary experiments might be made on any fine day, when the vessel is lying in the harbour, in a very short time. It only requires a box or two of ballast with which to incline the vessel on one side. All you want to know is, what angle of inclination is produced by transferring a known weight through a known distance.

Mr. Liggins said he might add, with regard to Boulogne harbour, that since it had been altered he had seen Prince Napoleon's yacht there, which must be considerably over three hundred feet long. She was the finest French yacht afloat, and had previously always been kept at Havre.

The Committee met on Tuesday, the 23rd inst.; present—Mr. Seymour Teulon, Vice-chairman of the Council, in the chair; Mr. C. W. Eborall, Major-General Eardley-Wilmot, R.A., F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., and Captain R. Scott, R.N.

Mr. Eborall gave evidence with reference to the boats of the South Eastern Railway Company.

Mr. Henry Liggins attended, and gave further evidence supplementary to that of the previous meeting. The evidence will appear in a future *Journal.*

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts & Co., the Society's bankers, and to forward the same to the secretary or financial officer at the house of the Society of Arts, John-street, Adelphi.

ALBERT MEDAL

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

The Council invite members of the Society to forward to the Secretary, on or before the 29th of April, the names of such men of high distinction as they may think worthy of this honour.

SILK CULTURE AND THE SOCIETY'S GOLD MEDAL.

The following is taken from the *Queensland Times*:—

Sir,—I have received by this mail the gold medal of the Society of Arts, which will be exhibited in Mr. Lyons's window this day (Thursday). It is a fine medallion bust of the Prince of Wales, who sat to Wyon for the likeness, and bears the inscription, on the rim:—"To C. F. Chubb, for the importation into this country of silk cocoons grown in Queensland." The following letter I received with it:—

"Society of Arts, Manufactures, and Commerce,
"Adelphi, London,
"21st Dec., 1871.

"Dear Sir,—I have delayed acknowledging the receipt of your letter until I could see your brother, Mr. William Chubb, and learn from him how best to transmit the medal and the specimens of silk. I have only seen him within the last few days. At his recommendation I have posted the medal (registered) to go by the mail leaving on the 23rd instant *viâ* Southampton. This has been done to-day, and I trust it will reach you safely. Please let me have an acknowledgment of its due arrival.

"The specimen silk, organzine and tram, together with half-a-dozen scarves, will be sent in a small box, lined with tin, by an early ship. If I can get the name before my letter closes I will put it in. Your brother has had two of the scarves, and the remainder we are keeping here, with specimens of the silk, as a record. I trust this is the beginning of a new industry for Queensland, and that others of your compatriots will carry on the culture, and that in time we may have a goodly supply from your land.

"The account you give of the mulberry growth is marvellous, and the growth of the stem which you relate is scarcely to be credited by us here, though of course we do not for one moment doubt the *bonâ-fides* of your statement. When you speak of the tree 'attaining a girth nearly equal to a man's body in two or three years,' we fancy there must be some mistake; and we should be glad if, in writing to me, you would say if this is really the case, or whether some error has not accidentally crept into your letter.

"You have already seen the report of the Macclesfield Silk Supply Association, contained in the Macclesfield paper to which you refer; it is therefore needless to send you a copy. I send by this post a copy of our *Journal*, in which you will see the terms in which the Council allude to your doings and the award of the medal. The Society will be greatly obliged if you would, from time to time, communicate to them the progress making in your country, whether as regards silk or any other of the products.

"I am, dear sir,
"Yours faithfully,
"P. Le Neve Foster, *Secretary*."

The mulberry-tree referred to is the large-leaved, long, black-fruited kind, and I think of Chinese origin. I measured two this day, each thirty-six inches round the stem at the bottom, and where they branched off the separate stems were twenty-two inches. I also measured the stem of a peach-tree, budded only the season before last—the fruit from which obtained the prize this year—and it measured nine inches. The reason for this growth is that the trees are planted in a filled-up gully, consequently have a great depth of new soil and ample drainage.—Yours, &c.,

C. F. Chubb.

MEMORIAL TABLETS.

The Council have received the following letter, and thankfully accept the offer therein made:—

My Dear Sir,—Referring to my late conversation, I am now able to say that two friends of mine, Benj. Whitworth and H. D. Pochin, are willing to provide £50, to be applied by the Society of Arts in putting up the kind of tablets already affixed on the dwellings of selected eminent persons. I give a list of suggested names, and the donors would prefer to have the names follow in the order in which they stand. It may be stated in some cases permission cannot be had to affix the tablets.

If, therefore, the Society of Arts are willing to undertake the offer, I shall be glad if at your leisure you will kindly furnish me, for submission to my friends, a list of the names you are prepared to adopt, and the place where the tablets are to appear.—I am, &c.,

W. Newmarch.

67, Lombard-street, London, E.C.,
March 15th, 1872.

1. Mrs. Siddons
2. Edmund Burke
3. C. J. Fox
4. Mr. Pitt
5. Mr. Farraday
6. Sir H. Davy
7. Samuel Johnson
8. Bishop Berkeley
9. Lord Nelson
10. Gainsborough
11. David Garrick
12. George Canning
13. Sir. W. Petty
14. Jeremy Bentham
15. Sir R. Walpole

MOSCOW POLYTECHNIC EXHIBITION, 1872.

The Committee of the above Exhibition are desirous of forming, for reference in Moscow, a collection of catalogues or price lists of makers of machines and tools of all kinds, and of mathematical instruments. Parties willing to assist are requested to send at once to the Secretaries of the London Committee for the Moscow Exhibition, now sitting at the Society of Arts, Adelphi, London, two copies of each such catalogue or list (illustrated preferred), and the same will be forwarded to Moscow, free of expense.

Members of the Society are requested to give publicity to this notice, as it is very desirable to render the collection as complete as possible.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscription paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicatate once with Mr. Le Neve Foster, the Secretary of the Society. Season ticket holders will be invited to a reception that will be held by his Royal Highness the Duke of Edinburgh and Her Majesty's Commissioners on April 27th. The Albert Hall, the Conservatory of the Royal Horticultural Society, and the Picture Galleries of the Exhibition, will be thrown open, and military bands will play.

SERIES OF 18 CONCERTS AT THE ROYAL ALBERT HALL.

Single tickets for the concerts to be given at the Royal Albert Hall on the 8th May, can now be obtained of Mr. Samuel Thomas Davenport, at the House of the Society, at the following prices:—Amphitheatre, 10s. 6d.; arena, 7s. 6d.; balcony, 5s.; ditto, 4s.

BARRY'S ETCHINGS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, have had a limited number of sets of the 29 plates etched by the late James Barry, printed. A set has been hung in the Society's meeting-room for the inspection of the members previous to its dispatch to Ireland. The impressions are taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, is £10 10s.

ANNUAL INTERNATIONAL EXHIBITIONS.

To-morrow the Exhibition for this present year of 1872, will be practically opened, that is a reception will be held, as has already been announced, by his Royal Highness the Duke of Edinburgh, on behalf of his brother, the Prince of Wales, and the Royal Commissioners. At this reception a large number of distinguished persons will be present, including other members of the Royal Family. The privileges of season ticket holders have been considerably increased this year, while a diminution of their price has taken place. Every season ticket holder has received a special invitation to the reception, and is further favoured with what may be termed two days' private view before the public are admitted by payment; so that very great facilities are given for a quiet inspection of the articles by those who wish to do so, either for the purpose of studying the progress of the manufactures of the year, or for the purpose of profiting by the artistic designs collected together. The public will be admitted on the 1st of May, when the charge for admission will be half a guinea; on the following days the charge will be five shillings, Saturday, the 4th of May, being the first shilling day.

The following is the programme of the opening:—The Royal Albert Hall and the Orchard entrances of the Exhibition will be opened at eight p.m. His Royal Highness the Duke of Edinburgh, K.G., will arrive by the royal entrance of the Albert-hall, where he will be met by her Majesty's Commissioners, who will accompany him to the Arena. Foreign ambassadors, her Majesty's Ministers, and other distinguished personages, will assemble in the Arena. His Royal Highness the Duke of Edinburgh, after passing through the Hall, will visit the Foreign and British picture galleries, and will then return through the arena of the Hall to the royal entrance. Only those persons whose invitation cards bear the words "Pass to Arena," will be admitted to that part of the Hall, until after his Royal Highness the Duke of Edinburgh has proceeded to the picture galleries. All other invitation cards will admit to the gallery and balcony of the Hall, and to the picture galleries of the Exhibition, seat-holders in the Hall proceeding, if they see fit, to their own stalls and boxes. The most convenient entrances for those persons who wish to be present in the Hall will therefore be the East and West Gallery Entrances, and the East and West Balcony Entrances. The nearest entrance to the foreign picture gallery is that in Exhibition-road; that in Prince Albert's-road is nearest to the British picture gallery. The band of the Royal Artillery will perform in the Royal Albert-hall, the Grenadier Guards, &c., in the Conservatory and picture galleries. Performances will also be given on the great organ in the Royal Albert-hall. All persons must produce their cards of invitation upon entering, as the presentation of the season ticket without an invitation card will not insure admission. It is not the intention of the officials to appear in uniform. It is of course optional with the gentlemen who attend whether they will appear in uniform or evening dress.

The general public will find the exhibition a very interesting one, possibly more so than that of last year, inasmuch as the manufactures illustrated are such as those not immediately engaged in connection with them will be able to appreciate, from the fact that the articles manufactured are those that are in daily use, and that are easily understood. The various machines, for instance, in use in the production of the many articles included in the term stationery, as well as those that illustrate the most powerful agency now in existence for the diffusion of knowledge—the printing press. The production of a newspaper is a matter in which every reader is interested to an extraordinary degree, and as there will be few visitors to the exhibition but who will be capable of appreciating the value, not only of clear but rapid printing, but also the rapid dissemination of news, the methods employed in producing a daily paper will be of great interest; the same may be said of the manufacture of paper, from that used in bank notes, of which there is a fine illustration, produced at a cost of £300, and which, enclosed in a frame, is placed against the light to show the various water-marks, to that which comes from Japan, soaked in oil, and which has all the appearance of embossed leather. The uses of paper, from the costly valentine, such as those produced by Messrs. Mead and Co., to the paper curtains that hang in graceful folds, and which are not by the eye to be distinguished from real drapery, with all the intermediate uses, are also of great general interest. In former *Journals* some idea has been given of the various articles that go to make up this year's exhibition. For the benefit, however, of members, the following remarks, showing where the various classes may be found, will perhaps be useful in early visits:—

Machinery connected with the manufactures exhibited this year, will be found in the Western Buildings, in Rooms 1, 2, 3, 4. 5. and 6, and in the iron shed, on the eastern side. That belonging to cotton is in Room 1; that belonging to paper, stationery, and printing, is distributed throughout the others. The "Walter" machine, by which the *Times* is printed, is in the iron shed.

British Fine Art is, as last year, in the Western Galleries. Oil paintings in Rooms 6 and 10; miscellaneous art, including pottery, cabinet-work, upholstery, mosaics, gold and silversmiths' work, in Rooms 7 and 9. Watercolours will be found in Room 8.

With regard to British fine art, the *Athenæum* points out some of the more remarkable works thus:—"Prominent among the new pictures is Mr. Leighton's large painted design, in monochrome, of the gate of a mediæval city, with the people choosing and making armour and weapons. Alma Tadema's 'Egyptian at his House-door,' shows a man dressed in white and leaning against a porphyry column: this artist exhibits another capital example. M. Fantin sends a fine work, representing mortuary flowers; Mr. Wyngfield's 'Death of the Duke of Buckingham' was recently at the Royal Academy, and looks well here; by Mr. W. F. Douglass is a good figure of a girl leaning against a sea-wall and weeping, and looking out to sea, where a low and heavy cloud broods and a ship sails away; Mr. G. F. Watts's 'Daphne among Laurels' has been almost entirely re-painted, and is perfectly admirable; Mr. Elmore's 'Home Life in Algiers' is near this; close by is Mr. Frith's 'Derby Day,' looking rather horny and faded; above the last is Mr. E. M. Ward's 'Luther in the Study'; near it are Mr. O'Neil's 'Death of Raphael;' Mr. F. Walker's 'The Old Gate,' from the Academy Exhibition of 1869; Mr. Armitage's 'Fortune and the Sleeping Boy,' R.A. 1870; Mr. Faed's 'Father and Mother'; a charming snow-piece, by the late M. Mignot; 'The Pyramids' is by Mr. Dillon; a Roman street scene, by Mr. K. Halswelle, called 'Roba di Roma,' recalls a fourth-rate French picture—it is rather coarsely executed. Close by is Mr. Watts's fine portrait of Mr. Robert Browning; Sir E. Landseer's two magnificently painted lions are, if we mistake not, novelties. Mr. Elmore sends 'The Tuileries, 29th June, 1792,' one of his best pictures, which looks as fine as ever; a large rocky landscape, by Clint, belongs to the better days of an artist who outlived his fame; 'Lady Godiva,' a full-length naked figure, not very aptly rendering the face of the subject, is neverthe-lesr extremely good. We may also mention Mr. W. H. B. Davis's 'Evening,' and his fine 'Moonrise,' likewise Mr. Watts's 'Diana and Endymion.' Mr. Millais's very remarkable 'Ophelia,' drowning, a famous picture of the early pre-Raphaelite era, will be most welcome to those who do not remember all the nonsense talked about it; the picture is still in perfect condition, and a masterpiece in a fine and learned mode of execution; contrasting with it is 'Pizzaro,' by the same, painted when the artist was sixteen years of age. There are also exhibited Mr. Frith's 'Last Sunday of Charles the Second,' which is, perhaps, the most powerful of his works, and his 'Railway Station;' Mr. Eyre Crowe's 'Arrest of Lord Lovat;' Mr. Elmore's 'Eastern Women on the Housetops' was at the Academy in 1867; Maclise's 'Girl at a Spring;' Mr. C. P. Knight's 'Bound for Melbourne," R.A., 1869, has been often admired—a fine picture of sunlight on the sea." Sir Edwin Landseer has the two lions, exhibited three years ago, and several other works well known.

Stringed and Wind Instruments, are in Room 11, on the ground floor of the eastern building. This class includes accordion makers, bugle and trumpet makers, concertina manufacturers, drum makers, flageolet makers, flute makers, foresters' horn manufacturers, fret-cutters (pianoforte), guitar makers, hammer rail makers, harmonicon manufacturers, harp makers, harp string makers, horn, trumpet, and bugle makers, military musical instrument makers, musical box makers and importers, musical instrument makers, musical instrument string makers, musical instrument turners, musical tube makers, music smiths, music wire manufacturers, organ builders, organ key makers, organ metal pipe makers, organ turners, pianoforte action makers, pianoforte hammer coverers, pianoforte hammer-rail makers, pianoforte key makers, pianoforte makers, pianoforte pin makers, pianoforte silkers, pianoforte small work manufacturers, pianoforte string makers, pianoforte turners, seraphine makers, trumpet makers, tuning fork manufacturers, violin and bow string makers, violin bow makers, violin makers, and violoncello makers.

Jewellery, both real and imitation, is in Rooms 12, 13, 14 and 15.

The trades which exhibit under the general head of jewellery are no fewer than the following:—Black ornament makers, burnished silver manufacturers, cameo cutters, chasers, coral and jet carvers, coral and jet workers, coral manufacturers and merchants, diamond cutters, setters, and workers, diamond merchants, electrotypists, embossers, enamellers, gilt jewellers, gold and silver chasers, gold and silver engravers, gold and silver ornament makers, gold and silver mounters, gold and silver piercers, gold and silver thread makers, gold and silver wire drawers, gold chain makers, gold cutters, gold enamellers, gold plating manufacturers, gold ring makers, goldsmiths and jewellers, gold swivel makers, gold weavers, jet ornament makers, jet workers, jewellers, jewellers' stampers, lapidaries, mourning and wedding ring makers, pearl merchants, pearl ornament makers, pearl stringers, pearl workers, silver chain makers, silver chasers, silver engravers, stud makers, watch-guard makers, and wedding-ring makers.

Fine Foreign Art is in the eastern galleries, rooms 12 and 19 being devoted to France, and room 17 to reproductions. Among the works exhibited by France are some splendid specimens of Sèvres china. A fine collection of this famous ware was to have come last year, but the troublous times prevented its appearance. The French sculpture, with the larger bronzes, occupy the arcade west of the French Garden, and in the French Annexe is the enormous picture by Yvon, depicting allegorically the United States of America. The possessor of this picture is Mr. Stewart, of New York, who is understood to have given £3,000 for it, and spent another thousand upon the frame. Belgian and Russian Art is in Room 16; Bavarian and Italian in Room 18. Among the Belgian pictures are—"A View taken at Moulins," by Van Luppen, and "Early Autumn," by Lamoriniere. Two night scenes, "The Poacher Surprised," and a "Market Stall," by Van Schendel. There are also some by Campo Tosto. "The Sack of the Monastery," by A. Robert; and "The Rescue of the Virgins of Venice," by Van Lerius.

The *Standard* says:—"Russian art will strike many with surprise. The paintings are remarkably good, and of a kind which will be certain to attract general notice. One of the pictures indicates the genius of a Russian Frith. It represents a public festival at St. Petersburgh, a species of fair, with the Winter Palace in the background. The canvas is crowded with figures, and the scene is replete with animation, while the details are rich in little episodes, each telling its own tale. The frosty air and the gleam of ruddy sunshine are rendered with great effect. It is altogether an admirable picture, and one which conveys a great amount of information. There is a marvellous picture, the Black Sea off the Crimea, with a Russian frigate chasing a pirate craft. A moonlight view of the Crimean coast is by the same artist. The thawing of the snow at the close of a Russian winter is given by another painter with a semblance of "slushiness" in the foreground which is pleasantly counterbalanced by the lovely light which steals across the remoter fields. In contrast to this chilly landscape we have a radiant harvest scene in Central Russia. The wheat is being threshed in the open field, and some of the peasants are taking their noon-tide meal under the shadow of a lofty heap of straw, amid which the sunbeams are glancing with beautiful effect. An incident in the massacre of the Huguenots on St. Bartholomew's-day forms the subject of a fine painting. 'Monks in their Refectory,' is a picture remarkable for its thorough finish. A curiosity in art is furnished by a painting on coarse canvas so as to give the effect of tapestry. The subject is a Russian legend, and is ingeniously rendered. Among the remaining pictures we have a full-length portrait of Prince Gortchakoff; the 'Last Encounter with Schamyl,' 'Bokharian Troopers beheading one of the Soldiers of the Czar,' 'A Group of Opium-eaters' —faithfully hideous—'A Dry River Bed,' elaborately treated, and many others. A number of interesting bronzes will also appear among the articles sent by Russia."

Paper, Stationery, and Printing will be found in Rooms 21 and 22, situated in the eastern end of the southern range of buildings.

The following are the trades included in this division:—Bank note-paper makers, black borderers, Bristol board manufacturers, card and cardboard box makers, paper borderers, paper box makers, paper case makers, paper embossers, paper flat bowl manufacturers, cardboard box makers, card cutters, card manufacturers (playing), card stampers, coloured paper manufacturers, fancy box makers, fancy paper makers, gold and silver paper makers, hot pressers, millboard makers; millboard, paper, hat, &c., box makers, paper bag makers, paper glossers, paper makers, paper marblers, passe-partout makers, pasteboard box makers, pasteboard makers, playing card makers, ticket manufacturers, and tracing paper makers. The above refer to paper. In "Stationery" are included black lead pencil makers, envelope makers, ever-pointed pencil makers, fancy stationers, ink makers (printing), ink manufacturers, ink powder makers, inkstand makers, manifold writer makers, marking ink makers, marking plate makers, pencil makers, penholder makers, printers' ink manufacturers, quill and pen merchants and manufacturers, sealing wax and wafer makers, stationers, valentine makers, wafer makers, and writing fluid makers. As part of bookbinding connected with stationery, there are account book manufacturers, card case makers, pattern book makers, and pocket book makers; while printing includes anastatic printers, copper plate printers, gold and silver printers, label makers (parchment), lithographers, lithographic printers, machine rulers, music engravers and printers, music paper rulers, music printers, numerical printers, oil colour printers, paper rulers, printers, printers' wood type cutters, railway ticket printers, rulers (machine), steel plate printers, stereotypers, stereotype founders, type cutters (wood), type founders, typographical music printers, wood letter cutters, wood type cutters, and zincographic printers.

Scientific Inventions are as last year, at the southern end of the western buildings.

Cotton Fabrics are in the glass corridors which connect the main buildings with the Great Conservatory of the Horticultural Society. The illustrations of the raw material consist of a magnificent case of dried specimens, got together by Major Trevor Clarke, and exhibited in Room 1, and some specimens of growing plants, which are in a house near where the live animals were exhibited last year.

Photographs, Engravings, Architectural Drawings, and Lithographs are in the quadrants beneath the corridors. These quadrants have been closed in, the floor laid with encaustic tiles, and the walls very effectively decorated. Specimens will here be found of the various reproductive processes such as the Autotype, the Heliotype, and carbon prints of Muller.

Sculpture will be found in the Fine Art Galleries, and especially in the quadrants.

Stained Glass on the staircases.

Organs.—The large organs have been placed in various places. The Electric Organ of Messrs. Bryceson, and Co., is in the Jewellery Division. Mr. Jones' Organ is in the Scientific Inventions Court. The smaller and chancel organs are distributed throughout the rooms on the ground floor of the eastern building.

The Refreshment Department is under the management of Messrs. Spiers and Pond. The dining rooms are at the southern end of the Horticultural Gardens, in that part of the range of buildings most distant from the Royal Albert Hall. Hot dinners from the joint, 2s. 9d., including attendance, served in the hall west of the vestibule. Cold collations, 2s. 3d., attendance included, served in the hall east of the vestibule. Second-class Pavilion, where cold dinners can be had, averaging about one shilling, served in the large Pavilion south of the vestibule. Teas in the Pavilion and in the new tea rooms on each side of the entrance to the Albert Hall from the Conservatory. Buffets in the vestibule and arcades of the exhibition. Refreshments served on the terrace overlooking the gardens. A French café in the French Court. Australian wines and refreshments in the Queensland Annexe. On the west side, opposite the Queen's-gate entrance, is a Bier-Garten. Smoking allowed in the Bier-Garten and in the garden around the Queensland Annexe. It will be remembered that some letters appeared in the *Journal* a month or two back, suggesting that the dining rooms should be accessible to visitors after the exhibition had closed. It is satisfactory to know that special arrangements have been made for the dining-rooms to remain open till nine p.m. Visitors desiring admission to them at the close of the exhibition for the day will be directed by any of the attendants.

His Royal Highness the Duke of Edinburgh presided, on the 20th inst., at the Royal Albert Hall, over a meeting of the General Purposes Committee. There were also present the Marquis of Lansdowne, Sir Stafford Northcote, Sir Francis Sandford, Mr. Bowring, Mr. Cole, Mr. Gibson, Dr. Lyon Playfair, Colonel Ponsonby, and Major-General Scott (Secretary).

CORRESPONDENCE.

Sir,—Will you kindly correct an error in the report of my paper, read on the 17th inst. In page 464, paragraph 3, instead of "1s. 9d. for the gas supplied at the company's meters," read "*consumers' meters* for gas in accordance with the new *contract*," and not "New Central."—I am, &c.,

A. Angus Croll.

April 25th, 1872.

ENDOWMENT FUND FOR THE SOCIETY OF ARTS.

Sir,—I have read with great pleasure the announcement in the *Journal* of our Society that the Council has resolved to endeavour to raise a foundation fund of £100,000, for the purpose of placing the Society on a more durable foundation than it has at present, viz., an income derived from annual subscriptions alone, and thus enable the work of the Society to be carried on with greater efficiency.

I most heartily wish that so desirable an object may be realised. The announcement has led me to look back somewhat into the history of the various institutions of the country, and I am induced to forward the following remarks, and should they be thought worthy of the pages of the *Journal* I hope from time to time to be permitted to add to what I now send.

There can be no doubt that, from the earliest periods of the world's history, when people had increased and multiplied, and communities had established themselves in various parts of the globe, the sick, halt, blind, aged, and infirm have ever needed the aid of their fellow men. Religion, which ever professes to lead man the way in which he should go, sets forth charity as the greatest virtue man can exercise. Religious communities themselves may, in some instances, be said to have become communities of beggars. But while there have ever been those needing and deserving of the charitable assistance of others, it is, doubtless, equally a fact that there have also been those who were idle and dishonest, who develop and exercise only the lowest characteristics of man's nature, and who would rather beg or steal than work.

Many Acts of Parliament have been passed in this country, from time to time, directing and regulating the methods and measure of relief that shall be afforded to the able-bodied who preferred begging to work. In early times they were ordered to be taken to the nearest market town, there to be tied to a cart-tail, and beaten till blood ran from their backs, or to be put in the stocks; and in the twenty-third year of Edward III. it was enacted "that because many valiant beggars as long as they may live of begging do refuse to labour, giving themselves to idleness and vice, and sometimes to theft and other abominations, none upon pain of imprisonment shall, under the colour of pity or alms, give anything to such as may harbour or presume to favour them in their sloth, so that thereby they may be compelled to labour for their necessary living." In the reign of Elizabeth various attempts were made to ameliorate the condition of the poor and to suppress vagrancy; and in some of the statutes a parochial fund for the relief of the poor, and the principle of taxing the parishioners for that purpose, are distinctly recognised.

The statute 39 Elizabeth, c. 3, provides for the appointment of overseers of the poor in each parish, who are empowered to raise, weekly or otherwise, by taxation of every inhabitant and every occupier of lands in the said parish, in such competent sum or sums as they shall think fit, a convenient stock of flax, hemp, wool, thread, iron, and other necessary ware and stuff, to set the poor on work, and also competent sums of money for and towards the necessary relief of the lame, old, blind, and such other among them being poor and not able to work, and also for the putting out of such children to be apprentices. The 43rd Elizabeth, c. 2, is the foundation and text-book of English Poor-law, and under the provisions of which all relief of the poor in England and Wales has been administered for more than two centuries and a-half.

In our own day, Charity Commissioners for England and Wales have been created by the Charitable Trustees Act of 1853, whose duty it is to inquire into all charities, their nature, objects, and administration, and the conditions of the property belonging to them, with power for the production of accounts and documents from trustees, and to appoint inspectors to visit and report upon their management, and the Commissioners state that the Goldsmiths' Company's annual payments to the poor alone are nearly £3,000; and the Corporation Commissioners state that the Fishmongers' Company disburse between £9,000 and £10,000 annually in charities in England and Ireland.

Companies, or trade guilds, may be said to have taken their rise out of religious houses or communities, some of which, in early times, were not only the great means of distributing alms to the poor, but obtained a portion of their revenues by trading with Italian merchants of the 13th or 14th century, or the steelyard merchants of a later period.

Evidence of the semi-religious character of these early trade guilds or companies is to be found in the fact that we still have the "Guild or Fraternity of the Blessed Mary the Virgin, of the Mystery of Drapers," and the "Guild or Fraternity of the Body of Christ, of the Skinners." Trade guilds were not incorporated till the reign of Edward III., but that king, becoming aware of the increasing prosperity of the country, through the influence of trade fraternities, confirmed in many instances by letters-patent the privileges they had previously enjoyed more by sufferance than right, and enrolled himself as one of the Merchant Tailors. About the same time it was ordained that all artificers and people of mysteries should each choose his own mystery before the next Candlemas, and that, having so chosen it, he should henceforth use no other.

In the latter part of the 15th and beginning of the 16th century, many of the London companies sprang up, but the majority of them, with the exception of those which possessed large charities, or continued in close connection with their trades, succumbed to the arbitrary proceedings of Charles II., who compelled them to surrender their charters, but after the revolution of 1688 they were re-granted.

The company of parish clerks were the actors in the old miracle plays.

I shall be prepared to show the bearing of the foregoing in future letters if this my first be accepted.—I am, &c., H. G. H.

OPEN BOATS AND LOSS OF LIFE.

Sir,—One of the most prominent necessities of the day is to establish efficient means for saving human life, particularly from drowning. It is little imagined how many thousands, even millions, of our fellow beings are daily afloat, on the urgent pursuit of business all over the globe. From time to time, almost daily, we have painful experience of the fatal dangers which happen to so many of our seafaring countrymen. We learn of valuable lives lost which by common precaution need not have been lost. We never know the full extent of our losses, but we know that every year very many hundreds of lives are lost from boats. We shudder as we read of loss of life from boat accidents, but we get used to it; these accidents happen so often. The lives thus cut off in detail are not much missed, except by their widows, orphans, and other relatives left destitute.

On land we have almost every appliance for saving life; on sea we have little or none. Should this be so? It would be curious and instructive could we know how many ships are lost yearly at sea, on the open sea, never heard of—some from springing a leak, some capsizing, and all hands lost, simply because their boats, open boats, were useless for the emergency. Of the wrecks and loss of life on our coasts we know something, but not all. Could the dead rise from their watery graves, they would—most of them—say, "Had our boats been more perfect we might have been saved."

Is it right, is it fair, that the British nation should permit its war ships, its merchant ships, its passenger ships to leave its ports continuously daily, freighted with so many thousands of valuable lives, without establishing and insisting on such regulations as would ensure the utmost possible amount of safety for those lives? There are also hundreds of lives lost yearly from open boats, used for fishing or for pleasure, on our coasts, rivers, and lakes. The number of such boats is very great, and the question may also be asked with regard to them, why should they be allowed to be hired out, all gaudily painted as they are, to incautious people, who know not how to manage them or how unsafe such boats are, without precaution?

We have, it is true, our National Life-boat Institution, which has done and is doing valuable services, but such services are local and very costly. What is really required is, that every vessel afloat should, under any circumstances of difficulty, be able to help herself or save her crew. It will be idle, however, to attempt to make any alteration in the present mode of managing or "mismanaging" things afloat, except pressure be used. In a leading article in the *Times*, of April 8th, the remark was made, "As regards life-boats, and, indeed, all other novelties directed towards the saving of life, they will never be turned to proper account except under compulsion." It is useless to try it by any other means than by an Act of Parliament, a short one by itself, to enact "that every boat must be a life-boat—unsinkable." Until this is done loss of life from open boats will continue. There is, fortunately, but little difficulty in the way, for every boat now in use can be easily and at little cost rendered safe and unsinkable. It is earnestly hoped that some member of Parliament may, without delay, take this measure in hand.—I am, &c.,

Josh. Acheson.

Ballyane-park, near Ross, County Wexford.

DEFECTIVE COLOUR VISION.

Sir,—In a letter headed "The Recent Theory of Turner Vision," in the *Journal* for April 19, Mr. Cave Thomas argues that persons whose colour-vision is abnormal are not thereby prevented from producing representations of the colouring of nature correct to the normal eye. A very little consideration, however, of the facts of the case will show that such persons must not rely on their power to do this. The common defect, which affects more or less a very large per centage of the male population, has been ascertained to consist in the want of a due capacity for the sensation of red (See Professor J. Clerk Maxwell's lecture at the Royal Institution, March 24, 1871.) In consequence of this defect, there is little or no difference to such persons between the apparent colours of many pigments which to other persons are very different; between, for instance, a bright green and a yellow pigment; between a dark green and an orange-red pigment; or between a deep red and a dark brown pigment, or even black itself. From the same cause they see little or no difference between a rose colour and a blue, or between a sea-green and a gray. They are, therefore, very liable to mistake such pigments, and, in fact, they do mistake them, as I have myself had occasion to observe in several instances; having known, for example, yellow ochre taken for the colour of fresh grass, Indian lake for black, crimson lake for dark blue, and verdigris for gray. Hence, though a dichromist may use Naples yellow, as suggested in the letter referred to, to depict a wall distempered with the same, he is just as likely to use something else; and, with all his care, if he so mistakes his vocation as to attempt the painter's art, his errors in the practice of colour will be as many as the errors which some people seem bound to make in theory and fact when they attempt to upset the established sciences of light and of colour, or any way touch upon those bewitching subjects.—I am, &c.,

William Benson.

GAS AND ITS IMPURITIES.

Sir,—I regret that I was unable to be present on the 17th, when Mr. Croll read a paper on the subject of gas, and a discussion followed, but perhaps you will allow me by this letter to make an inquiry, which I would willingly have made in person of the lecturer, or of some of the gentlemen who took part in the proceedings, and who are much better acquainted with matters relating to gas than I am.

Almost everyone, however, who lives in London is obliged to be acquainted with gas to some extent, and unfortunately the complaints as to the quality of much of the gas supplied are loud and general; in the course of the present discussion there were a good many complaints, especially as to the quantity of sulphur contained, stated to be as much as 20 grains and upwards for 100 cubic feet; and I see in the *Times* of 15th April the report of the meeting of the Metropolitan Board of Works, at which great dissatisfaction was expressed at the "gas referees" proposing to allow 30 grains for 100 feet instead of 20, as at present, and thus making things worse instead of better. I see the names of Mr. Dresser Rogers and of other gentlemen as having taken part in both discussions.

Now, what I want to ask is, are we compelled to sit down with gas so admittedly impure as the present, and even allow it to become worse? I see Mr. Chubb, the secretary of the Imperial Gas Company, speaking of the "gas companies as rather hardly dealt with, as chemists found out the impurities, but left the companies to find out how to get rid of them." I should have thought this was just the business of the gas companies.

It is claimed now for a patent process, that of Dr. Eveleigh, and by a company which holds the patent—the Patent Gas Company—that they can and do get rid almost entirely of the impurities of gas, while they also claim to produce it cheaper, and of much greater illuminating power. Their works at Peckham and East Barnet have lately been examined and the gas tested by Dr. Letheby, and I have before me his report of his examination, under date 14th March, and addressed to the directors, and circulated by them to their shareholders and others, and open to any one who likes to see it. He certifies (*inter alia*) that the gas contains only 5·76 grains of sulphur for 100 cubic feet, and is quite free from sulphuretted hydrogen, while, as I have said, complaints are made at the two meetings mentioned, that the gas at present supplied by the different companies contains generally more than 20 grains, in some cases more, and to such an extent that an attempt is now being made to carry the standard of impurity allowed up to 30 grains instead of 20.

My inquiry is, what are the authorities and what are the gas companies doing to test the alleged merits of this new invention? To prevent any possible misunderstanding, I may say that I am a shareholder in the company, but I write this on my own motion solely, and it interests the public, because our company can only benefit by benefiting the public also. Besides being a shareholder, I write as one of the public, as a consumer of gas, and as a member of the Society of Arts.—I am, &c., WILLIAM MAITLAND.

2, Royal Exchange Buildings,
24th April, 1872.

RESOURCES OF INDIA.

SIR,—I enclose a letter from Mr. A. Graham, of Edinburgh, on this subject.—I am, &c.,

HYDE CLARKE.

32, St. George's-square, S.W.,
April 20th, 1872.

Ashfield-villa, Greenhill, Edinburgh,
April, 1872.

MY DEAR SIR,—I see from the programme of lectures, that you are to give one before the association "On the Progressive Capabilities of the Races of India in Reference to Political and Industrial Development." I should like to hear it, but London is now too far distant for me. so that I shall not be able to enjoy that pleasure.

You have taken such a warm interest in the settlement of European colonies in the hilly climates of India that I am induced to ask if there is any likelihood of the government taking up this important subject?

In order to show how such colonies could be profitably employed I have lately been collecting all the information I can procure on the various commercial articles which can only be fully developed by such industrial settlers. From one of the most experienced tea merchants, a practical man in this country, I have obtained notes on the best mode of manufacturing tea in India for the home market. On the silks of India, too, I am gaining information. cottons, dyes, fibres, lacs, &c., all of which will form important objects for our hill settlements.

With regard to silk. I was, when in India, engaged in a scheme of Sir John Malcolm's to introduce this cultivation at Ahmudnuggar for the industrial and profitable benefit of the natives, and I still take a warm interest in the extension of the silk cultivation of India. I have no doubt that the tusseh, or wild worm silk of India, might be greatly extended provided certain hindrances were removed. Major Cumberlege, Commissioner, Chuteesghur division, writes me from Rapore in the central provinces, that he does not think even at Sampulpore, where the manufacture of the tusseh-silk chiefly exists, that this manufacture is capable of much extension at present under the present social system of India. The occupation of hatching the eggs and rearing the worm until the cocoons are formed in the Sig Assun, or *Terminalia tomentoso*, also on the bair tree (*Zizyphus jujuba*) in the forests, is chiefly in the hands of the Ders and low castes, who are full of superstitious ceremonies. During that period these people will not engage in the work unless all their omens are auspicious. Then, again, the Reeghties, chiefly Mohammedan weavers, have in their looms a stupid elaborate gear, which is most difficult to work. The silk of Sumbulpore is made of an excellent quality, both for home use and export. The texture is very even, and the silk has a lustre which never fades, however long it may have been in wear, and it washes well and is much prized for ladies' dresses at home. Throughout the whole of the central provinces of India, which embrace an area equal to all the British Islands, there are only employed in connection with the silk manufacture about 2,000 looms, and the hindrances to the extension of this article of commerce are quite evident, which is, as Mr. Marshall remarks in his report to the Hon. Mountstuart Elphinstone on the natives of the Southern Marahtta country, "that, with few or no opportunities of comparing their situation with anything superior to it, the people have nothing but themselves to copy, and have not even the stimulus of emulation to lead to endeavours at improvement. The general tendency of their character is thus rather to sink into the savage state than to rise to civilization."

Major Cumberledge, however, forgets that the tusseh silk and the several varieties of it exist not only in the central provinces of India, but throughout the vast forests of many districts in India where the caste prejudices do not exist. The whole of the Assamese were a silk-clad population, and for ages exported it to Arabia in large quantities, and to other countries. As for gold, there is not a stream in Upper Assam but yields gold dust. I send you a paper, which first appeared in the *Edinburgh Daily Review*, but which I find has been copied into the *Illustrated Missionary News*. Perhaps it may interest you. The government of India, I am afraid, have made a great mistake in not forming townships and allotments, as was done by the New Zealand government, and encouraging married young men and women to go out and colonise. Now a most troublesome race of half-castes, without education, churches, and schools, are rapidly springing up to demoralise the country, having all the drinking habits, vices, and pride of the Europeans.

Such a state of matters is hurtful to these aboriginal tribes, and even has a tendency to degrade them below their original semi-savage condition. In some traits of their character they were noble; they would never deceive or tell a lie, and naturally hated the Hindoo. Now, their drinking habits and uncleanness will be greatly increased by the example of the Europeans settled among them.

The Rev. Dr. Templeton, connected with the Free Church of Scotland, has lately settled in the Santal country, at Pachumble. He says the Santals are dreadfully oppressed and harassed by the Hindoos and Brahmins, the agents who collect the revenue from the Santal villages, and when the people appeal to our cutcheries they do not obtain redress, the government servants being in league with these agents. Some gentlemen, who have estates, with several Santal villages, under them, are anxious that steady, intelligent, and well educated men, of thorough Christian principles, should go out and collect the revenue of these villages, and superintend them, so as to take a moderate per-centage, and thus unite those who have become Christians more entirely with the missions on the hills. There is now a young man engaged to go out and join Dr. Templeton, with a view to superintend and assist the cultivators in the villages, and raise them to a higher kind of civilised life. He is a practical man, and accustomed to manual labour, being a mason, of strictly sober habits, and thorough principle. He is young and intelligent, having obtained a testimonial of his qualification in mathematics from the Watt Institution in Edinbugh. He also draws plans of buildings very well, and has taken lessons in surveying and Hindustani. I am sure that such a man will greatly develop the resources of the Santal country, and help to elevate these interesting aboriginal races, and attach them to our government. There are more like Andrew Campbell in Edinburgh, and, if encouraged to go out, would prove a great blessing to those tribes who are now becoming Christians.

The government of New Zealand has just now granted an additional sum of £200,000 for emigration; and the Rev. Mr. Barclay, the agent for Scotland, told me the other day he had sent out a number of young men and women lately, and they were all doing well. The population, after the discovery of the gold in New Zealand, suddenly rose from about 10,000 to nearly 65,000, and although a good many left for other gold fields, yet it remains, including the united province of Southland, at about 62,000. I have no doubt that if the government of India would issue a proclamation that gold is treasured up in the snowy mountains which closely surround Suddya, amidst the quartz rocks, and that every encouragement would be given to miners and emigrants to proceed thither, a large emigration would follow. Suddya is the most advanced post we possess on the north-east frontier, having a fine, healthy climate, with a country around it composed of the richest alluvial soil, and only 30 to 40 miles distant from these snowy mountains. The water of the river which flows past the Kundil is so cold that it serves to cool the light wines for the table. All the necessaries of life are to be procured. The exports are gold and silver, amber, musk, ivory, dye stuffs, one of which, the *manjit*, makes a beautiful permanent dye. Here are the regions of the copals and varnishes, the fibres and the lacs, and the most wonderful forest trees. Here also were found the vast forests of the indigenous teas of Assam. There is a large portion of the land around Suddya running into waste and overgrown with jungle, from want of population. Steamers now run up to Debrooghur from Calcutta in about 20 days.

It is true that at first there might be a great rush of emigrants to the locality, of a low debasing character, as was the case to Australia in the gold discoveries, but still out of them a different race rises up, and new civilization follows. At Deehoogur there are schools and churches and Christian influences. The ruin of the tea planters is their bad habits and not the climate. In the Darjeeling Terai a vast tea field is now opening, and after clearing these plantations are healthy. Could you not advocate a Christian settlement in that quarter?

General Pollock has sent to Calcutta several specimens of the gold-bearing quartz from Candahar.

Kindly excuse my note. I think Sir Bartle Frere will help you.—I am, &c.,

A. Graham.

ON THE PROFITABLE CULTIVATION OF TEA IN INDIA.

By Frederick Campbell, Esq.

(*Continued from page* 453.)

It may not be amiss here to give an instance of what is actually being done at the present time, even under the adverse circumstances described.

A large tea-growing company last year realised a profit of £43,000, after expending £76,000 on their annual expenses, by allowing 25 per cent. as the amount necessary for the more expensive system unavoidable in a company as compared with private management, this would decrease the expenditure to £57,000, and increase the profits to £63,000, or more than cent. per cent. on the annual expenditure. The area of tea was only 4,000 acres, thus a profit of £15 per acre was realised after extravagant management.

From the foregoing, it will be seen that, notwithstanding the vast sums of money expended, there were very few gardens brought into existence on proper principles of cultivation, and the fact is that, with few exceptions, the tea-gardens which are now being worked can only be looked on as very second-rate poor affairs compared with what they would be if they had been properly planted and tended from the first. The system of half-cultivation, in order to force a large breadth of land called tea-garden, as I have described, is still very seriously felt.

Another instance will serve to show that what, at first sight, might be quoted as a failure of tea-planting, in reality shows that it is really profitable.

A company in Cachar is cultivating 900 acres of tea; its annual receipts and expenditure about balance, and amount to about £12,000. If from the outlay is deducted the 25 per cent. additional expenditure caused by its management by a company, there will be a profit left of £3,000 per annum. This estimate of additional expenditure is a very moderate one, and these two facts are only two amongst many which might be quoted, and ought to give confidence to those who wish for large and safe profits.

In calculating his profits, I should advise a tea-grower to take no account of the capital which he has expended on his tea-garden, but simply look to his profits as the balance in his favour over and above the annual expenditure. This, it will be seen, in the case of the large company above quoted, is more than cent. per cent.; in my statement of account, it is shown to be nearly 150 per cent., and this I can with the greatest certainty encourage the Assam planter to expect, whether he grows tea, cotton, rice, or any other crop.

In closing this subject, I will again refer to my table of expenditure, &c., in opening out a small tea-estate. The manner in which I have drawn up that statement is more simple than giving detailed cost of each operation carried on in a tea-garden and on other crops. It may be thought that 100 coolies put down in the statement are too much for such a small area to be planted as 35 acres, but the quantity of other crops, which are of equal importance, may be increased or decreased according to any surplus of labour there may be, so that no loss can arise from it, and it precludes the necessity of doing the tea-garden work in an ineffectual or slovenly manner. The amount put down for wages, too, will not be all paid to these hundred coolies, as some of them will be women and children, whose wages will be respectively 4 rupees and 3 rupees per mensem. The remainder will suffice for any local or casual labour which may be available in the country. My object has been to avoid too much detail, which would only tend to mislead or confuse.

On a small estate, the whole of the work will be under the immediate eye of the owner, and therefore task-work will not be so necessary, and the coolies will be kept strictly at work. They are, however, extremely clever in evading a fair day's work and its proper execution, and will require all the attention it is possible to give them. As a guide to the new settler, I give some of the tasks which a coolie is capable of performing. There being no fences or divisions showing the area of small plots of ground, the usual plan is for the overseers to measure out the tasks daily; this must also be occasionally checked, as the overseers will sometimes favour the coolies, on payment of a few annas. The instrument used for measuring the tasks is a rod 12 feet long, called a "null;" 300 superficial nulls measures one acre. A coolie will double hoe, that is, hoe a depth of 9 to 12 inches, 15 superficial nulls per diem, that is, a piece of ground one null wide and 15 long, and 50 nulls of light or surface hoeing per diem. The quantity of tea-leaf plucked daily will depend on the weather and the quantity of leaves on the trees, but, under ordinary circumstances, 10 seers (20 lbs.) per diem for a woman, and six or seven seers for a child, is a fair task, though I have known a clever woman pick 25 seers (50 lbs.) in the same time. Care must be taken that too much hurry is not used, as it is apt to lead to plucking the old, hard leaf to make up the task. One man will roll and superintend the drying of from 25 to

30 seers of green leaf per diem. In clearing forest, the cost must depend on the magnitude and number of the timber trees and the density of the jungle. At present, it is usual to have this done by contract by natives of the country, and the price paid for clearing and one deep hoeing is 18 rupees per acre; this is, however, for the imperfect and unsatisfactory manner already described. To clear and thoroughly prepare an acre in the manner described, as it ought to be, it is probable that the cost of clearing and cultivating will amount to 25 rupees per acre, or about 200 men one day to clear one acre. Light forest without timber will be much less. A coolie will clear fifteen to twenty nulls of heavy grass jungle per diem.

In clearing either forest or grass jungle, I advise the use of native axes, and a large, heavy knife, called a daw; they are less expensive, and the natives use them better, a few American axes being kept for special purposes.

The daily task for pruning must depend on the size and age of the trees, and no definite task can be given. The only implements used must be the ordinary pruning knife and small-toothed saw; the heavy hooks often made use of should be carefully avoided, as the greatest care must be taken not to bruise or split the stems of the tree. As future success so much depends on this operation, too much care cannot be devoted to it. With reference to hoeing, the greatest watchfulness is required. Such is the forcing nature of the soil and climate, that in an incredibly short space of time the weeds run up and injure the tea. As soon as the weeds are perceptible, the shallow hoeing should commence, and should be done as lightly as possible, so as to prevent raising more earth than is necessary; the weather being damp, the weeds, if they have much earth on their roots, will not die.

If there are no native sawyers available, it will be necessary to teach some of the coolies, who will readily learn the work of cutting up boards for flooring and tea boxes. A good carpenter will make two or three boxes per diem.

The kind of huts best suited for coolies are of mud walls, thatched, to contain four single coolies, or a man, his wife, and family: they should be high, and of good size. As mud walls are, however, expensive, and take time to build, the first lot of huts should be built with stout grass walls, the grass stalks being set on end and lashed together, or of split bamboo and thatch roofs; these walls will answer for immediate use, the coolies themselves will afterwards plaster them with mud and cow-dung; and when money and time become more abundant, mud walls may be substituted. The site should be carefully chosen, so as to secure thorough drainage and ventilation, and a good supply of water, a stream if possible, but this stream should be carefully watched as to the quality of water, as the water in the streams is often very pernicious, from the mass of vegetation it accumulates from the jungles through which it passes, and often produces fever and other diseases. It is generally necessary, in order to procure good drinking water, to sink wells, the stream being only used for washing and bathing purposes. The strictest attention must be paid to prevent the coolies from fouling the well by using it for washing, and to prevent them drinking from the streams. The health of the coolie is of vital importance, and the greatest care must be devoted to their houses, and drinking water, and cleanliness.

The planter's own house should consist of two rooms if he is a bachelor, three if married. Large rooms are not necessary, 20 ft. by 16 ft. being ample; a good verandah, 14 ft. wide, should be added all round, and the eaves of the house not more than 7 ft. from the floor. The walls may be formed of grass stalks or bamboo, plastered with a composition of clay and cow-dung, mixed with short chopped straw. As it is not usual to have ceilings, good lofty rooms are secured without the necessity of raising the walls very high, eight to ten feet being ample. The roof is generally built in the native fashion, with bamboos, and is sufficiently neat. The whole is generally fastened by strings of the split rattan cane, which is gathered in the jungle, a few large nails only being required for the larger beams and the flooring. The whole house should be raised on piles three or four feet from the ground; this will be found a great source of health, cleanliness, and comfort to the planter. In addition to the rooms, one or two good bath-rooms, and a good store-room will be added. The thatch should be thick and well fastened. A house of this description will last six or seven years, if the main-posts, which are in the ground, are of good wood, by which time the planter will be in a position to build a good permanent dwelling of brick or wood. There are numerous timber-trees in the forest, affording woods of great durability, the best of which are nahoar and kerai, but the best are well known to the natives.

With the building of the house, as in all other matters, the new settler must never lose sight of the necessity of economy of labour, on which his success entirely depends, and no more must be used in the first operations than is absolutely necessary to ensure health and comfort. I have known a single man live for years in a hut which did not cost twenty rupees; but this was going to the opposite extreme, and running great risk. In every part of Assam natives may be obtained who understand the work of building such a house as I have described.

The question of quantity of the tea consumption of the world, and how far competition may eventually affect the Indian tea grower, is of great interest.

The quantity of tea at presented imported into England is about 150,000,000 lbs.; by cultivating a moiety of the best land on the north-eastern frontier, of 400,000 acres, 400 lbs. per acre would give 160,000,000 lbs. of tea. Were such a quantity of tea grown in India, it would then become a matter of price as to whether India or China would succeed in competition. I have no hesitation in saying that in this India has nothing to fear. The Indian land and climate are far superior, and have the advantage over China that the soil is new to the crop, and will grow spontaneously far more than can be grown in China, by aid of a most expensive system of cultivation, on its old worn-out lands. This I have from the Chinese cultivators themselves, and I know that the deterioration, both in quantity and quality, of the tea crop in China, causes great anxiety in that country. The cost of land in India is much below that of China.

The food of the lower classes being much cheaper in India than in China, labour must be also cheaper. An Indian labourer will live well, and get rich, on wages that would starve a Chinaman. The comparative values of the China and India teas is now well ascertained, and is decidedly in favour of the latter. India tea is double the strength, and far more wholesome and nutritious, as compared with China tea of the same price; and when it is brought before the public in an unmixed state, there is no doubt it will be greatly preferred, both for cheapness and quality. The Indian tea-grower will not, however, be dependent on the English market. Russia has a vast and increasing consumption; and now a convenient road is opened to that country through the Suez Canal, it is expected that large quantities of Indian tea will be taken for that market. The colonies also offer a suitable market for the sale of Indian teas, but there is a better market than any of those mentioned springing up in India itself. When the tea districts are thoroughly opened, the taste for tea-drinking, acquired by the coolies imported from other parts of India, will gradually spread, as all the tea-garden labourers become tea-drinkers; and thousands of the upper classes drink it regularly, who, ten years ago, never tasted it. Being a temperate people, who seldom drink anything but water, tea is a beverage singularly well adapted to them. Should the use of tea become general, the tea-grower need look no further than India for the consumption of the bulk of his crop.

APPENDIX.

First Year.

Expenditure.

	Rs.
Survey and first instalment to government for 600 acres of land	200
One hundred imported coolies at 40 rupees per head	4,000
One year's wages, at 5 rupees per mensem per head	6,000
One hundred hoes or koodalies	75
One hundred native axes	150
Ten pairs of working bullocks	1,000
Ploughs and other implements	300
Coolies' huts, dwelling house, store house, &c.	400
Tea seed for 35 acres, 10 maunds at 35 rupees per maund	350
Thirty maunds of seed paddy	75
Garden seeds of sorts	50
Two ponies, saddles, &c.	300
Four water carts	200
Keep of two ponies	360
Two native overseers, at 10 rupees each per mensem	240
House servants and living	2,400
Furniture, &c.	150
Incidentals	950
	17,000

Cash in hand, Receipts, &c.

One hundred acres of rice, giving 30 maunds per acre, worth 2 rupees per maund	6,000
Two acres of vegetables, spices, &c.	500
Twenty-five acres of other crops, such as tobacco, jute, cotton, hemp, red pepper, arrowroot, ginger, &c.	2,500
	9,000
Balance in hand, after paying first year's expenses	3,000
	12,000

Second Year.

Expenditure.

	Rs.
Coolies' wages	6,000
Tea seed for 35 acres	350
Implements	100
Two overseers, at 10 rupees per mensem	240
Keep of horses	360
Household expenses	2,400
Repairs of houses, &c.	50
Incidentals	500
	10,000

Receipts.

Crops, as the first year, increased to	10,000
Balance in hand second year	2,000
	12,000

Third Year.

Expenditure.

	Rs.
Coolies' wages	6,000
Tea seed for 35 acres	350
Implements	100
Repairs of buildings	100
Two overseers, at 10 rupees per mensem	240
Keep of horses	360
Thirty-five tea boxes and lead, at 4 rupees	140
Household expenses	2,400
Incidentals	500
	10,190

Receipts.

Ordinary Crops	10,000
Thirty-five maunds of tea, at 80 rupees per maund net, being one maund or 80 lbs. per acre, at one rupee per lb.	2,800
Balance, cash in hand	2,610
	15,410

Fourth Year.

Expenditure.

	Rs.
Bonus for re-hiring 50 coolies, at 10 rupees per head	500
Fifty new coolies, at 40 rupees	2,000
Coolies' wages	6,000
Additional labour for tea-making, &c.	1,000
Two new bullocks	100
Two overseers, at 10 rupees per mensem	240
Horse keep	360
Repairs of houses, &c.	200
Hundred and forty boxes and lead, at 4 rupees each	560
Household expenses	2,400
Incidentals	600
	13,960

Receipts.

Ordinary crops	10,000
Hundred and five maunds of tea from fourth year's tea trees, being 3 maunds per acre, at 80 rupees per maund	8,400
Thirty-five maunds of tea from 35 acres of third year's trees, at 80 rupees per maund	2,800
Balance, cash in hand	1,450
	22,650

Fifth Year.

Expenditure.

	Rs.
Coolies' wages	6,000
Additional wages	1,000
Implements	100
Repairs, new buildings, &c.	200
Two new bullocks	100
Horse keep	360
Two overseers, at 10 rupees per mensem	240
Two hundred and eighty boxes and lead, at 4 rupees each	1,120
Household expenses	2,400
Incidentals	600
	12,120

Receipts.

Ordinary crops	10,000
Hundred and forty maunds of tea from 35 acres of fifth season trees, being four maunds per acre, at 70 rupees per maund net	9,800
Hundred and five maunds of tea from fourth year's tea, at 80 rupees per maund net	8,400
Thirty-five maunds of tea from third year's trees, at 80 rupees per maund net	2,800
Balance, cash in hand	10,530
	41,530

Sixth Year.

Expenditure.

	Rs.
Coolies' wages	8,000
Thirty new coolies, at 40 rupees per head	1,200
Implements	100
Repairs and new houses, &c.	500
Two new bullocks	100
Horse keep	360
Two overseers, at 10 rupees each	240
Four hundred and twenty boxes and lead at 4 rupees each	1,680
Household expenses	2,400
Incidentals	700
	15,280

Receipts.

Four hundred maunds ot tea, being an average of 4 maunds per acre, at 70 rupees per maund net	28,000
Ordinary crops	10,000
Balance, cash in hand	26,250
	64,250

ON THE ORIGIN OF PETROLEUM.

At a recent meeting of the Geological Society of Glasgow, Mr. Richard Anderson, of Uddington Oil Works, read a paper "On the Origin of Petroleum." He alluded to the different theories which had been propounded by geologists on the subject. There was, first, the distillation theory, that petroleum has been produced by the slow distillation at low temperatures of coal and other bituminous substances within the earth. Next was the theory which supposed petroleum to have been produced from decayed vegetable matter, by a process similar to that by which coal was formerly supposed to have been formed—namely, by the mineralisation of woody fibre, which evolves marsh gas, carbonic acid, and water. The next notable theory was that petroleum, in many cases, must have been of animal origin, from the fact of its being found in the lower palæozoic strata, which contain no traces of land plants. Then there was Mr. Wall's "special mineralisation" theory, that bituminous matter has proceeded from vegetable remains which have undergone a special mineralisation, not attributable to heat, nor of the nature of a distillation, but due to chemical reaction at the ordinary temperature, and under normal conditions of climate. Mr. Anderson then proceeded to state some of the difficulties attaching to each of these theories as a solution of the problem of the origin of petroleum. These difficulties seemed to him too great for geologists themselves to clear away, and he believed it was only when geology was studied side by side with chemistry that anything like a satisfactory conclusion on the subject could be arrived at. The first difficulty which the geologist finds on looking at it from his point of view is that all petroleum could not have had the same origin. In Pennsylvania and Ohio, the petroleum is found in the Devonian formation, while, in Canada, it is found in the Silurian limestone. In Europe and Asia, it is found, for the most part, in the rocks of the newer Secondary and Tertiary age. In Barbadoes, also, it occurs in Tertiary strata. The oil is very often found in fissures in the rocks; these fissures are more vertical than horizontal, and probably extend through many different strata. It has been noticed that the oil exists most plentifully in regions where the strata has been most disturbed, and where, as a consequence, the largest number of fissures occur. Another fact to be noted by geologists is that, in many cases, there is no apparent reason to infer that petroleum has been derived from coal, inasmuch as it is found in districts far removed from the coal measures. The Canada oil is a notable instance of this, as, according to the distillation theory, it evidently proceeds from the lower-seated Silurian and Devonian deposits. Again, a great objection to the distillation theory is, that when petroleum is found in the neighbourhood of bituminous coal, the coal itself does not appear to have lost any of its bituminous constituents. An instance is found at Ritchie, Virginia, where strata have been elevated by an upthrow from several hundred feet below seams of cannel and bituminous coal, which appear to have lost none of their bituminous qualities. As to the theory of petroleum being derived from organic remains, the following remarks by Dr. Dodds, of Pottsville, he thought, conclusively disposed of it:—"There is little probability that all the millions of mollusca entombed beneath the rocky crust of Verrango would produce the flow of a single great well like the Noble, the Sherman, or the Philips; a shoal of whales (he adds) would not produce such astonishing results. That these ancient inhabitants of the sea should accumulate in certain localities to produce our present reservoirs of oil is not only improbable, but impossible. Liberated oil or gas always rises to the surface of water, and this ancient life could only exist in water, and only be entombed beneath it, from whence the oil must have ascended to the surface almost immediately, as the result of pressure and heat; and it, therefore, could never again sink, or exist beneath the water in the shape of oil or gas." Finding so many weighty objections to the commonly received or purely geological theories of the origin of petroleum, Mr. Anderson said he had been led to inquire whether chemistry could throw any further light on the matter. In this inquiry he had found that a purely chemical theory had been offered to meet the difficulties of the case. The theory to which he referred had been advanced by Mr. S. H. Dodds, of Pottsville, who had worked it out with great care and fulness in his treatise on "Coal, Iron, and Oil," published in 1866. It is to the following effect:—Petroleum is essentially a compound of carbon and hydrogen. The lighter kinds, in their native condition, consist of nearly equal parts of each of these elements. Under a high degree of heat hydrogen unites with carbon, forming gas or oil; in fact they seem to exist in combination naturally in a state of gas, which can be maintained only by heat or confinement. If liberated, they part readily in the temperature of summer. Thus we find the hydro-carbons in many forms, ranging from the lightest gas to a very solid substance. Petroleum is only a heavier oil containing more carbon than naphtha, and less hydrogen, as we find exemplified in many oil wells. The oil found nearest the surface is always the thickest and most valuable; the second oils, found sometimes at a depth of 500 to 700 ft., are very light—less so when found at the depth of 200 or 300. The same oils in the great Canawha Valley, at a depth of 1,500 ft., exist as gas or light naphtha. Now, the vapours escaping from smouldering volcanoes, if passed up through water, form oil by condensation, as many instances bear witness. It was easily conceivable, then, that during the formation of the rocky crust of the earth, the vapour of carbon which issued, as it still does in some degree, from the internal heat of the earth, did not escape entirely in vapour, but became condensed whilst rising through the thickening crust, in connection with hydrogen, forming hydro-carbon oils, which, in localities having the requisite conditions, became bituminous shales, asphaltum, &c. After the formation of coal in our great basins, the production of those gases diminished, and those produced became condensed before reaching the surface in the form of oil; while the continual contraction of the rocky crust of the earth by condensation in cooling closed the fissures and sealed up much of the oil and gas in its deep cavities. The gases thus pent up would force themselves into and between the strata wherever a lodgment could be found, and rise to the surface in the form of gas or oil through every fissure or crack that presented the means of escape. In this way the origin of petroleum could be accounted for, and the circumstances and conditions under which it is found by the borer at the present day explained. He would only add that this theory, so far as the condensation of carbon was concerned, was by no means unreasonable or impossible according to chemical laws. In the case of making of steel, a similar process was seen to take place, by the charcoal imparting its carbon under heat to iron. And it was quite as reasonable to suppose that the vapours escaping from the smouldering internal fires of the earth, or from volcanoes, should unite with hydrogen as water or steam, and form those hydro-carbon products to which he had now called the attention of the society. The Chairman (Mr John Young) said he was not prepared to accept the theory that bitumen, petroleum, and other hydro-carbons were primitive compounds engendered within the strata of the earth's crust. He believed that, in nearly every case, these compounds could be shown, by strict examination, to have been derived from beds in which organic life had been entombed, and mentioned several instances within the Scottish coal-field corroborative of this view. The numerous cases in which bitumen, rock-oil, &c., could clearly be traced to strata containing the remains of plants and animals negatived, in his opinion, the few exceptional instances in which these products are found in rocks which do not indicate whence they were derived, and rendered it probable that in every such case the ingredients in question were transferred into these rocks by distillation from strata more deeply seated, containing organic remains.

THE NEW SOUTH DOCK, ISLE OF DOGS.

A description of the New South Dock, in the Isle of Dogs, forming part of the West India Docks, by Mr. L. F. Vernon-Harcourt, M.A., M. Inst. C.E., was recently given at the Institution of Civil Engineers. The works referred to in this communication were constructed on the site of the City Canal, the timber pond, and adjacent land. They comprised a dock of $26\frac{3}{4}$ acres, joined to a basin of $54\frac{1}{4}$ acres, by a passage with reverse gates. The western entrance to the canal from the River Thames was retained, but at the eastern extremity a new entrance had been formed, leading from the basin to the river. On the south side of the dock foundations for five warehouses had been prepared, and the superstructure erected on three of them, with a quay shed in front. The main dock was 2,650 ft. in length, 450 ft. in breadth, and had quay walls all around it. The bottom of the dock, which was covered throughout with a layer of puddle, was 29ft. below Trinity high-water, and the surface of the quay was 5ft. $10\frac{1}{2}$in. above the same level. On the north side of the dock there were 16 timber jetties, affording accommodation for 32 vessels, and opposite each jetty, in the line of the centre of the dock, were buoys for mooring the vessels. The dock walls were composed partly of brickwork and partly of concrete. Upon a concrete foundation, front, cross, and back walls were built of brickwork, the intermediate pockets being filled with concrete. The back wall was only 14in. thick, its chief use having been to keep the concrete in place until it became consolidated. The walls were built up about 4ft. 6in. at a time, and the pockets were then filled with concrete, to the level of the walls, before another stage was commenced. The passage between the dock and the basin was 176ft. long and 55ft. wide; and having two pairs of reverse gates, the level of the water, either in the dock or in the basin, could be raised or lowered independently of one another. This was important for the satisfactory working of the two entrances, as high-water did not occur at both at the same time. The foundations of the walls and of the floor of the passage consisted of concrete, the walls themselves being generally composed of solid brickwork, and the bottom of the passage being paved with ashlar masonry. The heel-post stones, the hollow quoins, and the cills were of granite; while the remainder of the stonework was of Bramley Fall. The gates in the passage were of iron, with the exception of the heel-posts, the meeting-posts, and the cill-pieces, which were of green-heart timber. The gates were cellular, having two skins, formed of iron plates, separated by, and rivetted to, horizontal and vertical ribs. The skins were curved outwards, being arcs of circles whose radii were 60 ft. and 120 ft.; but the cill-pieces were straight, and met at an angle of 126 degs. in the centre of the passage. Each gate was erected on the floor, only a few feet from its ultimate position, and was tested by being filled with water. After being moved into their places, sufficient water was introduced into the gates to counterbalance their tendency to float. The basin was 600 ft. long and 370 ft. wide, and was surrounded by a quay wall precisely similar to a dock wall. The principal object of the basin was to serve as an immense lock during a rising tide; the water-level being drawn down to that of the river, when the tide had risen sufficiently, the gates were opened, and the vessels brought in, or *vice-versa*, until high water, when the gates were closed, and the vessels in the basin could be passed into the dock at leisure. By this arrangement, the water in the main dock could be kept at a uniform level. The New East Entrance Lock, connecting the basin with the river, was 300 ft. long between the gates, and 55 ft. wide. The bottom consisted of a segmental brick invert, laid on a concrete foundation, with springing stones of Bramley Fall; while the gate floors, and aprons outside the gates, were of ashlar masonry. Being constructed upon the site of the old lock, the north wall of that lock was allowed to remain, and a new wall, 9 feet thick, was built in front of it. The brickwork of the south wall of the old lock was so solid that blasting had to be resorted to for removing it. For the purpose of filling and emptying the lock, and also for lowering the level of the water in the basin, there were sluices in the walls, of each side, at both pair of gates, in addition to sluices in the gates themselves. Beyond the entrance gates there were four outlets on each side, distributed along the walls so as to serve for clearing away any mud which accumulated on the apron. The portion of the Blackwall and Millwall Extension Railway which passed through the land belonging to the West India Dock Company was carried out during the period of the execution of the other works. In this short distance, three swing bridges had to be constructed; two over the Blackwall Basin locks, being for two lines of way—one line being for the use of the East and West India Dock Company; the other belonging to the Blackwall and Millwall Extension Railway, and going over the passage bridge, which was therefore only constructed for one line of way. The width of the Blackwall Basin locks was 43 ft.; as, however, the line crossed the locks on the skew, the portions of the bridges spanning the locks had to be made 66 ft. 6 in. and 80 ft. in length respectively between the pivots and the ends. A new roadway swing-bridge was also erected over the east entrance lock. The whole of the swing bridges, gates, capstans, shuttles, and cranes were worked by hydraulic machinery. The works were commenced in October, 1866. A cofferdam was made across the opening between the timber-pond and the canal; the water was then drawn off from the timber-pond, so that the foundations for the warehouses and the excavation for the new dock could be proceeded with before the water was excluded from the canal. In July, 1867, the foundations of the warehouses were completed, the tide was excluded from the canal, the greater part of the water in it was run off, and the foundations for the south wall of the dock were begun. In the following month, the cofferdam on the river side of the old east entrance lock was set out. Considerable difficulty was experienced in driving the piles, owing to the hard nature of the ground a few feet below the surface, a stratum of natural concrete having been probably formed by the mixture of gravel, sand and shells, such as was met with in other places on the works, through which the sheeting piles, though fitted with heavy cast-iron shoes, were in most instances unable to penetrate. Soon after the dock walls had been commenced, the influx of water into the foundations was greatly increased by the filling of the adjacent Millwall Dock, from which the water percolated through the adjacent gravel. To keep down the water it was necessary to employ three pumps, capable, together, of lifting about 10,000 gallons per minute, with, in addition, the occasional use of a centrifugal pump capable of raising 1,500 gallons per minute. The dock and basin were carefully puddled, to prevent leakage when they were filled with water. The foundations of the walls rested partly on gravel, and partly on stiff blue clay, mixed, in some places, with a good deal of sand. Along a portion of the site of the north wall of the dock there was such a firm and thick bed of conglomerate that the concrete foundation was dispensed with, and the wall was commenced on the conglomerate. The first stone of the passage was laid on the 4th of April, 1868, when considerable progress had been made with the dock walls and excavations. In June, 1868, the cofferdam outside the east entrance lock having been completed, the water was removed from the second portion of the works, and, from this period, all the works were proceeded with simultaneously. On the 5th of November, 1869, the dock walls and excavations being completed, and the gates of the passage finished, water was let into the dock from the river; in December, water was admitted into the basin and east entrance lock; in January, 1870, the new roadway bridge was ready for traffic; and on the 5th of March in the same year the dock was formally opened. The dock wall, as constructed, had cost only £12 2s. per lineal foot, a result which was chiefly due to the large employment of concrete. The total outlay on the works had been £571,139, viz., for the Dock, Basin, Passage, Entrance Lock, and Warehouse foundations £467,639, for the warehouses £60,000, for the railway, £24,500, and for the hydraulic machinery, £19,000. The designs for the several works have been furnished by, and the works were erected under the direction of Mr. Hawkshaw, past President Inst. C.E., the resident engineer.

OBITUARY.

Mr. Richard Westmacott, the Royal Academician, who died a few days since, at his residence at Kensington, in the 74th year of his age, inherited his artistic taste and powers from his father, the celebrated sculptor, the late Sir Richard Westmacott. Born in London in the year 1799, he was brought up under his father's eye, and in 1820 he went to Italy, where he spent some five or six years in studying the galleries of ancient art. Soon after his return to England, in 1827, he began to exhibit at the Royal Academy. In 1838 he was chosen an Associate of that body, to the full honours of which he was admitted in 1849, and ten years later he was appointed Professor of Sculpture. He had retired some years from the active work of his profession, but was well known both as a lecturer and a writer on artistic subjects, upon which he contributed largely to our cyclopædias and other serial publications. He was also well-known as the author of an essay "On the Colouring of Statues," and of a "Handbook of the Schools of Sculpture." Among his more purely ideal works are:—"Venus and Ascanius," "The Cymbal Player" (in the collection of the Duke of Devonshire), "The Girl and Faun," "Venus teaching Cupid," "Paolo and Francesca," "Blue Bell," and "Angels Watching," the latter forming part of a monumental group. To these, however, should be added a bas-relief, "Go and sin no more," the recumbent monumental figure of Archbishop Howley in Canterbury Cathedral, and another to the late Lord Hardwicke at Wimpole, in Cambridgeshire. He was a Fellow of the Royal Society.

GENERAL NOTES.

Room Paper.—Carbolic acid is recommended by the *Journal of Applied Chemistry* as an ingredient in the paste used, for it will prevent the annoyance of insects and the sour smells frequently experienced in rooms newly-papered.

Mortality of Infants.—Some important facts upon this subject have been brought before the Municipal Council of Paris. According to the Secretary-General of the Prefecture, there are 55,000 infants born in the Department of the Seine on an average annually, and of these 20,000 are placed out to nurse by the authorities. The nurses are drawn from three departments, and are under the charge of 70 inspectors and 87 medical men. The average mortality of infants in France is 17 to 18 per cent.; in Paris it is about 26 per cent.; and that of natural children is always in excess of others. Thus, of the infants placed out to nurse by the authorities of the city, the mortality amounts to 27 per cent. in the case of legitimate, and to 33 per cent. in the case of illegitimate children. The mortality amongst infants placed out with private persons is, according to the same authority, about 50 per cent.; in other words, the chances of life or death are nearly equal. This excessive mortality gave rise to a serious discussion in the Academy of Medicine some time since, and a bill was drawn up by a late Minister of the Interior in conformity with the views of the Academy. It is said that the subject is about to be revived and brought before the National Assembly.

The Ham and Gingerbread Fairs of Paris.—One of the most curious sights of the year in Paris is that of the *Foire aux Jambons*, which is held on the boulevard by the side of the Canal St. Denis, commencing at the Place de la Bastille. All the pork-dealing world assembles at this *fête*, and the concourse is prodigious. Each merchant has his or her *boutique*, or little hut, made of rough planks, like those which are erected on the boulevards of the city for the New Year sales. There are this year no less than 270 *boutiques*, and the owners of them speak nearly all the dialects of France; but the Meuse, the Moselle, and the Rhine are always the most prominent, and they are peculiarly so this year, in spite of, or perhaps on account of, recent events. These and the neighbouring departments occupy nearly one-third of the number of stands. The provincial dealers bring immense supplies; it is for them a real commercial fair; they sell to the small shopkeers of Paris; but the pork-butchers and bacon and ham-curers of Paris and the surrounding districts do not allow such a capital opportunity of sale to escape them; they occupy 135 stalls, and sell to private customers, who fancy they are purchasing rare bargains, and carry them home with satisfaction, while they would not take the trouble to buy and carry home anything of the kind from a Paris shop; but opportunity creates business, and as the supply is immense, the noise great, and the crowd large, much money is laid out in hams, pork, lard, and sausages of every imaginable form, size, and constitution, from the great Lyons sausage to the penny saveloy. The quantity of stock at the fair this year is roughly estimated at about two hundred tons, and in three days scarcely a remant will be left, in fact, an hour or two before closing the fair, dealers become perfectly frantic, and remainders are almost given away. The police, even in the Imperial time, allowed great license at this fair, and the din created by the loud-tongued country dealers, who almost compel people who ventured within their reach to purchase something of them, and who have each their characteristic mode of comic appeal to the throng of visitors, is positively distracting. The stalls are decked out with laurel or other branches, and all kinds of paper finery, and many of them exhibit very comic, and some of them not the most refined, inscriptions and pictorial designs. York hams are announced in fifty places, as are the products of Westphalia, Holland, and every other country or town famed for pig-meat, salted, dried, smoked, or minced up into sausages, and some of them, doubtless, come from their native homes. Preparations of horse-beef—*charcuterie hippique*, as they are somewhat grandly denominated—horse, donkey, and mule sausages, make a great show, and the experience of the seige seems to have given popularity rather than otherwise to these commodities. In the boulevard which touches the former at right angles, is the *foire au pain d'épices*, where every conceivable form of gingerbread, plain and gilded, is exhibited and sold in enormous quantities. For those who delight to study the characteristics and dialects of the provinces, the ham and gingerbread fairs present a real anthropological treat.

Business in Paris.—The *Moniteur Universel*, one of the best-informed journals of Paris, says that it has instituted an inquiry on the commerce and most of the industries of Paris, and the result shows that the situation is, at the present moment, as good as it was during the best epochs of the Empire. Landed property has certainly been seriously deteriorated, and this has had an effect on sales, but business is so lively that, in spite of that, its extension becomes greater every day. Those who doubt this view of the state of affairs are invited to visit the Quartiers Sentier and Poissonnière, where nearly all the great commission agents live, and they will find that the packers there are employing a considerable number of workmen. The trade in paper boxes, which furnishes an excellent indication, is also said to be very busy, so much so that the makers of those pretty decorated boxes in which delicate French wares are put up, are working overtime. These two trades of packers and *carton* makers are specially cited, because they are the indispensable agents of commerce for exportation. It is well known that robes, bonnets, silks, ribbons, gloves, and nearly every article of French export is put up in its own special kind of pasteboard case, sometimes plain, but often very tastefully ornamented.

Naval Instruction in France.—Some weeks since, Admiral Pothuan sent instructions to the maritime prefects for the organisation of conferences to be held amongst naval officers. The consequence has been that at Toulon and Lorient lectures and conferences have been held in artillery, tactics, and practical hydrography, and the attendances have been numerous and constant. In a short time, similar meetings and lectures will be established at all the seaports of France. Another object in view is the creation of courses of study of the modern languages in the various ports. At the same time, a number of works in English, German, Prussian, Italian, Swedish, and other languages, treating of subjects connected with the navy, have been placed by the Minister in the hands of the maritime prefects, to be distributed amongst officers who will undertake to translate, analyse, review, and comment on them for the official journal, the *Revue Maritime et Coloniale*. More than a hundred and fifty officers answered the appeal of the prefects, and it is hoped that nothing of interest that appears abroad in reference to maritime science, naval construction, artillery, and cognate subjects will escape attention in France. The public libraries of the ports of Cherbourg, Brest, Lorient, Rochefort, and Toulon, are now open in the evening for the special convenience of naval officers. Lastly, the young naval ensigns, who, in consequence of the reduction of the number of vessels afloat, find it difficult to get ships, and are in danger of losing their taste for the profession, are, as far as possible, sent on board vessels in commission, while those who remain on shore are attached in turn to the observatories, or are engaged in the study of machinery. All, in fact, seems to be done which promises to keep up the traditions of the navy, and to raise the standard of nautical education.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

May 1st.—"On Telegraphy without Insulation, the means of cheapening International Communication." By H. Highton, Esq.

May 8th.—"On the Use of a Revolving Rabble in the common Puddling Furnace." By F. A. Paget, Esq., C.E.

May 15th.—

May 22nd.—"On Machinery for Stone Breaking." By F. M. Pollock, Esq.

CANTOR LECTURES.

The Third Lecture, on "Silicates, Silicides, Glass, and Glass Painting," by Professor Barff, was delivered on Monday evening, April 22nd. The remaining lectures will be given as follows:—

Lecture IV.—Monday, 29th April.

Glass Painting (continued)—Mosaics—Enamels.

[In this lecture methods of staining and painting glass will be explained and illustrated, and the mechanical processes employed in the manufacture of stained glass windows will be shown.]

Lecture V.—Monday, 6th May.

Styles of Glass Painting—Illustrations with the Electric Light, illustrative of the Nature of Colour.

Lecture VI.—Monday, 13th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose have been issued.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon. ....**SOCIETY OF ARTS, 8.** Cantor Lectures. Prof. Barff, "On Silicates, Silicides, Glass, and Glass Painting."
London Institution, 4. Professor Bentley, "Elementary Botany."
Royal United Service Institution, 8½. 1. Capt. C. B. Brackenbury, R.A., "On Autumn Manœuvres." 2. Capt. Tottenham, "Soldier's Scoop, Pick, and Rifle Rest."
Medical, 8.
Asiatic, 3.
Zoological, 1. Annual Meeting.
Actuaries, 7. Mr. J. G. P. Neison, Jun., "On the Influence of Occupations upon Health."
National Society for Women's Suffrage, at St. George's Hall, 8.

Tues. ...Civil Engineers, 8. Discussion, "Heavy Artillery."
Royal Institution, 3. Mr. Edward B. Tylor, "On the Development of Belief and Custom amongst the Lower Races of Mankind."
Royal Colonial Institute, 8. Mr. F. Lynn, "The Comparative Advantages of the Far West of Canada and of the States."

Wed.....**SOCIETY OF ARTS, 8.** Mr. H. Highton, "On Telegraphy without Insulation, the means of cheapening Internal Communication."
Microscopical, 8.
Royal Institution, 2. Annual Meeting.
Obstetrical, 8.

Thurs...Royal, 8½.
Antiquaries, 8½.
Chemical, 8. Mr. E. Riley, "The Manufacture of Iron and Steel."
Royal Society Club, 6.
Artists and Amateurs, 8.
Royal Institution, 3. Prof. Tyndall, "On Heat and Light."
Society for Encouragement of Fine Art. Conversazione.
Linnæan, 8.
London Institution, 7½. Musical Lecture.

Fri.......Geologists' Association, 8. 1. Mr. John Curry, "On Columnar Basalts." 2. Mr. John Paterson, "On a Visit to the Diamond Fields of South Africa, with Notices of Geological Phenomena by the wayside."
Royal Institution, 9. Dr. Wm. Spottiswoode, "On Optical Phænomena produced by Crystals when submitted to Circularly Polarized Light."
Philological, 8¼.
Archæological Institute, 4.

Sat.......Royal Institution, 2. Mr. R. A. Proctor, "On the Star Depths."
Royal School of Mines, 8. Swiney Lecture. Dr. Cobbold, "On Geology."
Royal United Service Institute, 3. Captain C. W. Wilson, "Our own Maps and those of other Countries, and their Use in War."

Journal of the Society of Arts.

No. 1,015. Vol. XX.

FRIDAY, MAY 3, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts & Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

The *Engineer* of April 26, has the following:—

"The Society of Arts is one hundred and eighteen years old; it has had its seasons of enthusiasm, of comparative inaction, and of steady, useful labour; and it makes an appeal in its old age for contributions from the public. Few who ask for aid have such a strong case as the Society of Arts, or, to use its full title, the Society for the Encouragement of Arts, Manufactures, and Commerce.

"It does not plead age, sickness, or misfortune, but, on the contrary, health, a good income, and success; it has done an immense deal of service, and it wants to do more; it handles a considerable sum of money, but it wants to handle a great deal more. The Society of Arts is not exactly a learned Society, it is not a public body, it is neither governmental nor opposition—it is simply a kind of association of watchmen, which is peculiarly well placed, in a social point of view, for learning the wants of the arts, sciences, and commerce, and for fixing attention upon them; its ears are ever open to the complaints of the public; and its rooms for the meetings of the discontented, the pleading, or the benevolent; it takes under its wing equally the great merchant class and the cabmen, the youth and the women of England. It has been at times the friend and advocate of all classes, and has never taken a fee or given rise to a scandal.

"Before the Royal Academy was formed it aided art; before schools of design were thought of it encouraged drawing and painting by medals and other rewards; it commenced public exhibitions before one had been held in France; in its bosom was hatched the idea of exhibitions of all nations. In short, in every movement which has had for its object the improvement of education and the furtherance of art, science, and commerce, the Society of Arts has generally been prominent, and often the hard-working pioneer as well as the triumphant conqueror.

"Its income is derived from the subscriptions of from 3,000 to 4,000 members, but it is bespoken every year; the demands upon it are incessant, and it is eager to meet them. It comes, therefore, boldly before the public, and says: 'I have done a great deal, I am full of life and energy, I see infinitely more good work to be done, and I want to be about it; but I must have more money. My annual subscriptions, though large, are not nearly large enough, and besides they are not secured; I want a good big sum always at my banker's, that I may undertake permanent duties and not be bothered by paltry considerations. I appeal to the wealthy of every class to give me an endowment for use in the public service, and, in order to place the demand on a clear and practical footing, I want not less than £100,000!'

"Nothing succeeds like success, is an old saying, and we feel sure that the past successes of the Society of Arts will secure that of the present appeal.

"Those who desire to give their hundreds, thousands, or tens of thousands, will find a complete set of forms, adapted to all cases, in the *Journal of the Society of Arts*, of the 12th of April, together with the arguments upon which the appeal is founded."

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal early in May next. This medal was instituted to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

The Council invite members of the Society to forward to the Secretary, on or before the 29th of April, the names of such men of high distinction as they may think worthy of this honour.

MOSCOW POLYTECHNIC EXHIBITION, 1872.

The Committee of the above Exhibition are desirous of forming, for reference in Moscow, a collection of catalogues or price lists of makers of machines and tools of all kinds, and of mathematical instruments. Parties willing to assist are requested to send at once to the Secretaries of the London Committee for the Moscow Exhibition, now sitting at the Society of Arts, Adelphi, London, two copies of each such catalogue or list (illustrated preferred), and the same will be forwarded to Moscow, free of expense.

Members of the Society are requested to give publicity to this notice, as it is very desirable to render the collection as complete as possible.

SEASON TICKETS FOR THE EXHIBITION OF 1872.

A letter from General Scott appeared in the *Journal* a few weeks since, stating that in consideration of the aid given by the Society of Arts to International Exhibitions, her Majesty's Commissioners had decided upon permitting members of the Society to purchase, for each £2 2s. subscription paid by them, a season ticket for the London International Exhibition of 1872 at £1 1s., being half the price charged to the public. Members desirous of taking advantage of this privilege are requested to communicate at once with Mr. Le Neve Foster, the Secretary of the Society.

SERIES OF 18 CONCERTS AT THE ROYAL ALBERT HALL.

Single tickets for the concerts to be given at the Royal Albert Hall on the 8th May, can now be obtained of Mr. Samuel Thomas Davenport, at the House of the Society, at the following prices:—Amphitheatre, 10s. 6d.; arena, 7s. 6d.; balcony, 5s.; ditto, 4s.

BARRY'S ETCHINGS.

The Council, having been requested to exhibit a series of Barry's etchings at the forthcoming Exhibition of Art and Industry in Ireland, have had a limited number of sets of the 29 plates etched by the late James Barry, printed. A set has been hung in the Society's meeting-room for the inspection of the members previous to its dispatch to Ireland. The impressions are taken upon elephant and double elephant sheets, and bound in boards elephant size. The plates etched by Barry have never before been issued in so complete and extended a form; many of them are almost unknown, sixteen of them having come into the possession of the Society, by gift, in the year 1851. Members desirous of subscribing for sets may do so by sending in their names to the Secretary. The price of the set, bound in boards, with letter-press, descriptive of Barry's pictures in the Society's Room, is £10 10s.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

TWENTIETH ORDINARY MEETING.

Wednesday, May 1st, 1872; Hyde Clarke, Esq., Member of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Christian, Charles Ladd, Norfolk-lodge, Barnet.
Fewster, C. E., Hull-street, Spring-bank, Hull.
Fitz Gibbon, A., the Rookery, Great Stanmore.
Galindo, R. E., 1, Augustus-road, New-road, Hammersmith, W.
Gill, Richard Marmaduke, Orme-field, Finchley, N.
Grimwood, G. A., Shern Hall, Walthamstow, N.
Holland, E. R., 37, Stoke Newington-green, South Hornsey.
Johnson, Samuel W., Kenward-house, Downspark-road, Clapton, E.
Lawson, Lionel, 2, Brook-street, Hanover-square, W.
Spowers, Allan, 33, Queensborough-terrace, W.
Thompson, H. H., 12, Copthall-court, E.C.,

The following candidates were balloted for and duly elected members of the Society:—

Armitage, Benjamin, Halton-bank, Pendleton, Manchester.
Beeton, Henry Coppinger, 108, Adelaide-road, N.W.
Campbell, Rev. William, 30, Westbourne-park, W.
Cole, Walter B., St. John's-terrace, Weymouth
Harvey, Augustus John, 1, South-bank, Regent's-park, W.
Mappin, John Newton, jun., Conduit-lodge, Blackheath-park.
McLaurin, Peter, 324, Camden-road, N.W.
Sheppard, William John, 7, Addison-gardens South, Kensington, W.
Swan, Patrick Don, Provost of Kirkcaldy.
Williamson, George, 2, East India-avenue, E.C.

The paper read was:—

TELEGRAPHY WITHOUT INSULATION—A CHEAP MEANS OF INTERNATIONAL COMMUNICATION.

By H. Highton, M.A.

I have for many years been convinced of the possibility of telegraphing for long distances without insulation, or with wires very imperfectly insulated; but till lately I had not the leisure or opportunity of trying sufficient experiments bearing on the subject.

After the failure of the first Atlantic cable, and shortly before the laying of the present ones, when it was very doubtful whether funds could be procured for the laying of a fresh cable, I wrote to the secretary of the Atlantic

Telegraph Company, proposing to try experiments for the purpose of ascertaining whether it would be feasible to use a cheap form of imperfectly insulated wire. After some correspondence on the subject, the matter ended by my being informed that the company had succeeded in procuring sufficient capital for a new wire thoroughly insulated.

I need hardly say that the idea has been pronounced on all hands to be entirely visionary and impossible, and I have been emphatically warned of the folly of incurring any outlay in a matter where every attempt of the kind had hitherto failed. But I was so thoroughly convinced of the soundness of my views, and of the certainty of being able to go a considerable distance without any insulation, and any distance with very imperfect insulation, that I commenced some three or four months since a systematic series of experiments, with a view to test my ideas practically. I accordingly began by trying various lengths of wire, dropped in the Thames from boats, and soon found that I could, without the slightest difficulty, exceed the limits mentioned by practical men as the utmost lengths through which it was possible to succeed. This method of experimenting, however, was attended with much difficulty and inconvenience, in consequence of the rapidity of the tides and the motion of the boats.

I next tried wires across the Thames, but had them broken five or six times by the strength of the tide rushing against the pieces of weed and floating rubbish, such as cotton-waste, &c., which became entangled in them, and by barges dragging their anchors across them. I then put my instruments in my own room, on the banks of the river, and sent a boat down the stream with a reel of wire, and a battery to signal to me at different distances, in order to obtain some idea of the law of decrease of power according to distance. The success was so much beyond my expectations, that I next obtained leave to lay down wires in Wimbledon Lake, in order to study more at my leisure the laws and phenomena which attended the transmission of currents through uninsulated wires. I found, to my surprise (as I shall show you presently by experiment), that water itself is so perfect an insulator for electricity of low tension, that wires charged with electricity of either name retained the charge with the utmost obstinacy; and, whether from the effect of polarisation (so-called), or, as I am rather inclined to suppose, from the electrisation of the successive strata of water surrounding the wire, a long wire, brought to a state of low electrical tension, will retain that tension for minutes, or even hours. Notwithstanding attempts to discharge the tension every five seconds I have found that a copper surface of ten or twelve square feet in fresh water will retain a very appreciable tension for a whole quarter of an hour; and even when we attempt to discharge it continuously through a resistance of about thirty units it will retain an appreciable though gradually decreasing tension for five or six minutes. When I show you this, as I shall do presently, you will see that there is no such thing in reality as what telegraphists call dead earth, and that the idea of it is due entirely to imperfect observation with instruments not sufficiently sensitive. What the true theory of this may be matters but little; the fact remains the same, that, in some way or other, every liquid is for currents of low tension a very good insulator; in fact, there is no such thing as a perfect insulator—copper, water, earth, glass, gutta-percha, ebonite, &c., are all partly conductors and partly insulators. Water and earth occupy an intermediate position between copper and the best insulators, such as glass or gutta-percha, and may be used as we wish, either as conductors or insulators. The question between all substances is merely one of degree.

Since that time, in order to gain a greater insight into the subject, I have constructed an artificial line, consisting of resistance coils, condensers, and plates of copper in liquids, acting at once as faults and as condensers (for, in fact, they are by far the most simple and effectual condensers that can be used), so that I might learn as far as possible to what extent and for what distances the principle of non-insulation can be carried, and I have satisfied myself that, though there are difficulties in very long lengths absolutely uninsulated, yet that it is quite feasible to telegraph even across the Atlantic with an insulation even amounting to a single unit, instead of the 170,000 units of the present cables.[*]

I should add, too, that there is this peculiarity about faults, where the current is conducted away by a liquid conductor, that the passage of the electricity from a metal to a liquid creates of itself a reaction on the metal, which is felt more or less in every part of the wire, and which may be appreciated by instruments of sufficient sensitiveness.

The instrument with which I propose to work is the gold-leaf instrument, adapted by me for telegraphic purposes twenty-six years ago, acted upon by a powerful electro-magnet, and with its motions optically enlarged. The exclusive use of this instrument in England was purchased from me by the Electric and International Telegraph Company, but it was never practically used, except in Baden, where a government commission recommended it as the best instrument; but to work it properly requires a good deal of care and adaptation to circumstances, and presents certain difficulties which probably no one but the inventor would take the trouble or have the requisite practical experience to overcome; and as for many years I was fully occupied otherwise, and had no personal interest in the matter, the value and capabilities of the instrument were never recognised. I propose now to exhibit to you the instrument, as adapted for the use of imperfectly insulated wires, and point out to you some of its merits.

One of its chief merits is its extreme lightness. Judging by the resistance it presents to the electrical current, it would appear that the piece of gold in the instrument I am now showing to you does not weigh more than $\frac{1}{2000}$th part of a grain, but as probably a considerable part of the resistance lies in the junction of the gold with the brass, and the leaf is full of holes, resembling a wire-gauze, and so increasing the resistance, it may be safer to estimate its weight by its size, and reckon by the number of square inches which it is said a grain of gold is made to cover by the gold-beater, which would make it come to about four times that weight, or $\frac{1}{500}$th part of a grain. But, at any rate, in order to make a visible signal, we only have to move a very, very small fraction of a grain through a very, very small fraction of an inch. You may judge of its delicacy when I show you that the warmth of the hand, or even a look, by means of the warmth of the face turned towards a thermopile, can transmit an appreciable signal through a resistance equal to that of the Atlantic cable. On mentioning this to a young lady of my acquaintance, she inquired whether a kiss could not also thus be transmitted to America. I assured her it was perfectly possible; a kiss imprinted on a thermopile in England will signal itself in America; and a modern Pyramus and Thisbe, instead of kissing through a hole in a wall, may exchange a grasp of the hand, a kiss, a glance, across the broad surface of the Atlantic. I put on the resistance of the Atlantic cable, still you will see a look at this thermopile gives enough power for a signal, a grasp of the hand a greater signal still, and a kiss gives abundant evidence of the warmth of the lips, which are at once separated and brought near by a wire, whose resistance is equal to 2,000 miles of the Atlantic cable. Another great advantage of this gold-leaf instrument is its ready adaptability to the circumstances in which it may be placed. According to the conditions in which it may be used it is extremely easy to increase or diminish its length or breadth or tension. Thus, increase of length or diminution of breadth increases the resistance, but increases the sensitiveness; and again, partaking as it does partly of the character of a pendulum and partly of a musical string, the rapidity of vibration is increased by giving it greater tension and greater shortness, though the sensitiveness is diminished; so that, in fact, you can accommodate it to the peculiar circumstances of any cable. Again, you notice the deadness of the motion, and the total absence of swing, which, whenever a needle is used, always more or less tends to confuse the signals. It is true that in long lines this is not so observable; because, from the electro-static capacity of such lines, the effect resembles rather that of a gradual push of the needle than of a blow; but still, in the gold leaf, owing to the resistance of the air, vibration is, under all circumstances, almost entirely prevented, and as the resistance of the air varies probably about as the square of the rapidity of the motion, when the power and consequently the motion is but small, we only get a very small resistance. But the greatest advantage of all is that we can increase the sensitiveness without increasing the resistance, simply by increasing the power of the electro-magnet.

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[*] 170,000 or 180,000 units was about the insulation of the Atlantic cables before laid; when laid, the insulation was said to reach more than 2,000,000 units, but these details are very much kept as secrets.

Wherever there is a fault, that is, wherever there are two or more courses open to the current of electricity, we know the current divides itself in an inverse ratio to the resistance of each path open to it. But in all ordinary galvanometers, if we want to increase the sensitiveness, we must increase the length, and consequently the resistance of the wire, but in this instrument we can increase the sensitiveness almost to any extent by simply increasing the power of the electro-magnet, without in the slightest degree increasing the resistance of the instrument to the current. Thus for ordinary purposes an ordinary magnet is sufficient; but when we want to detect very small amounts of electricity, then, by increasing the power of the magnet and the power of the microscopic contrivance for making visible very small motions of the gold-leaf, we may arrive at almost any degree of sensitiveness—there is in fact, scarcely a limit to the instrument in this respect.

But now that I have explained to you the construction of the instrument, perhaps it is the best time to show you by experiment how tenaciously a piece of copper in water will retain a state of electrical tension.

Here is a tub of fresh water, with copper plates presenting to each other altogether about fourteen square feet of surface. I charge these plates with electricity from a battery of about the tension of a Daniell, and you see how tenaciously it retains the electricity I impart to it; in fact, it will go on gradually discharging itself for five or six minutes through the small resistance of this piece of gold leaf. I charge it with electricity of the opposite name, and the result is the same.

I now do the same with a tub of salt water, and the result is still the same, though less marked. In fact, these plates, with the water between, represent the two metallic plates of a Leyden jar, and the water retains the electricity of this small tension with much more obstinacy than the glass of a Leyden jar does the electricity of a higher tension.

Indeed, it is a fact of the highest importance in telegraphy that when there is a fault, electricity of a high tension, say of 20 or 30 Daniells, will almost wholly escape by it, and leave none for the instrument; whereas electricity of a small tension, with a large battery surface, will pass through the instrument with very little diminution of power. This is most strikingly shown by the use of an ordinary tangent galvanometer.

I cannot well show it to a large audience like the present, therefore I will only inform you that, when I have taken two currents, each marking 30° on the galvanometer, the one of high tension proceeding from about 30° Daniells, and the other from a single cell of the tension of one Daniell, but presenting small internal resistance, a fault equivalent to the exposure of a mile of No. 16 wire in sea-water will annihilate all appreciable effects on the galvanometer with the current of high tension, whereas the current of low tension will still show on the galvanometer as much as 20°.

In fact, the general law that a current divides itself in inverse ratio to the resistances is very deceptive, unless when modified by a consideration of the character and source of the currents. You will see then the extreme importance of the use of currents of low tension proceeding from a large surface, and how a faulty cable can be used with such currents when it is absolutely useless for currents of a higher tension.

There are three ways of telegraphing without insulation; one, only feasible for short distances; a second, which I think will be found the most practicable; and a third, in the practical working of which, for very long distances, several difficulties (though I by no means say insuperable difficulties), present themselves.

To explain the first plan we will take the case of a river, and in the water near one bank place the copper plates A and B, and connect them with a wire, in which is placed a battery, P. Near the opposite bank take similar plates, C and D, connected by a wire in which is placed a galvanometer. Between A and B the current will pass by every possible route, in quantities inversely proportional to the resistance of each. Consequently, part will pass from A to C, from C to D, and from D to B, and some part also from A to D, from D to C, and from C to B. (Diagrams exhibited.)

Now, if the plates be large, and A and C and B and D (respectively) comparatively near to each other, a very appreciable current will pass from A to C and from D to B; but if the plates be small, the power of the battery small, and the distance from C to D and from A to B comparatively short, no appreciable amount will pass from C to D—indeed, about as much will pass from D to C. I do not hesitate to say that it would be physically possible, by erecting a very thick line of wire from the Hebrides to Cornwall, by the use of enormous plates at each extremity, and by an enormous amount of battery power, to transmit a current which would be sensibly perceived in a similar line of very thick wire, with very large plates, on the other side of the Atlantic. But the expense and trouble would probably be much greater than that of throwing a wire across. I tried the experiment by taking out two boats, hanging plates out at the bow and stern, and placing a battery in one and a sensitive galvanometer in the other, and mooring them at different distances. In this way I saw how rapidly the perceptible current in the second boat diminishes when the distance between the boats very much exceeds the length of each.

I scarcely know a more instructive experiment than this one. I will show it you on a small scale in a tub of water.

The next is the simplest and most feasible plan, namely, throwing across the sea two wires kept from metallic contact with each other, and then working with that portion of the current which prefers to pass through this metallic circuit instead of passing across the liquid conductor. Use currents of low tension from large surfaces, and it is astonishing how large a portion of the current will pass through a metallic circuit in preference to crossing the water. The arrangement of the battery must be varied according to the amount of insulation given to the wire and the position of the principal faults.

I should again observe that the electricity itself which passes from wire to wire through the faults creates a reacting current through the metallic circuits, of feeble tension, it is true, but still sufficient to give adequate signals for very long distances; so that if we extend across the Atlantic two wires kept from metallic contact with each other, but so inadequately insulated from the water as to present throughout their length only a single unit of resistance as insulation (and this is not a very difficult problem), we have a telegraph sufficient for all purposes. We have nothing to do but to work with a low tension through an instrument of sufficient delicacy, and by increasing the magnetic power acting on the gold leaf we can increase the sensitiveness, almost without limit, without adding to the resistance. By using a wholly metallic circuit we escape all the effects of earth currents, which otherwise I should suspect would cause considerable inconvenience with an instrument of such great delicacy.

The third method is to throw a single wire imperfectly insulated across the sea, to place at the opposite end a very large earth plate, and possibly (in order to diminish the resistance) to place it in a salt pond of hot water, kept hot by artificial means.

Now any electrical tension thrown on this wire transmits itself more or less, even to its opposite extremity, and will show itself on any instrument of small resistance placed in the length of the wire.

There are certain difficulties in this way of working, such as the effect of earth currents; or when the earth-plate, either from a difference in the quality of the copper, or of the character of the water in which it is placed, is in itself in a state of tension somewhat different to that of the wire, and so keeps the instrument permanently deflected from zero, necessitating special means of counteraction; and again the necessity of working principally with zinc currents, to prevent the destruction of the wire.

I have no doubt, from my experiments, that these difficulties may be all overcome, but still I think the simplest and most feasible, and not more expensive plan will be to work with two wires kept from metallic contact, and with electricity of a very low tension.

Perhaps I ought here to say a few words about that bugbear to submarine telegraphists, electro-static induction, or the Leyden jar action. I will try to explain this very simply, as there is really nothing abstruse about it. Every long wire, and especially a wire under the sea or earth, is, in reality, a prolonged Leyden jar. The instant, therefore, that a current is sent into it, it diffuses itself over the whole surface of the wire. This action (as far as we know, and no proof is given to the contrary) is perfectly instantaneous. The electricity contained in the wire also instantly begins to discharge itself through any leak; and the signalling instrument is but a leak in the jar. But as a small quantity of electricity diffused over a large space has but a small tension, time is required before the wire is charged sufficiently to produce any great effect by its discharge. If, therefore, an instrument like a Morse be used, or indeed any instrument in which there is friction, a considerable time will elapse before sufficient electricity is accumulated to give a signal. But with an instrument so delicate as the gold-leaf instrument, an appreciable effect is instantaneously produced, that is, instantaneously as far as we can perceive, and though no doubt, if a current be continued to be sent into the wire, the effect accumulates, still practically I do not think any real difficulty will be found from retardation. A little practice and a due knowledge of the real scientific character of the problem, so far as I can judge from experiments, will easily enable us to deal with the special difficulties which may arise. I will presently show you the practical working of this Leyden jar action very strikingly. You will see that with a needle where there is friction, the charge accumulates till the power is sufficient to overcome the initial friction, which is always greater than the subsequent friction. The needle then gives a jump; then, after a few seconds, another jump, and so on. This has been attributed, erroneously I think, to a wave-like motion of the electricity. I believe it is really nothing more than the accumulating charge at intervals acquiring sufficient strength to overcome the initial friction for a fresh jump. The gold leaf, you will see, moves equably forward, except when the unfolding of a crease adds occasionally a little more velocity.

I will conclude by saying that the saving of expense on this plan of being able to use cheap and comparatively imperfect insulation, and neglecting faults which may arise from time to time, will, I trust, enable us to reap the advantage of cheap telegraphy over the world, and to bind the various parts of the earth together by a communication which will be available for the poor emigrant to communicate with his family, no less than it is now for the rich merchant, or speculator, or government ambassador, to send their instructions and get their information from the most distant parts of the earth. In fact, I trust it will open out a new era of easy and cheap telegraphy, and put an end to the necessarily almost prohibitory rates which at present prevail.

Perhaps I may be allowed to add, that for keeping up a continued stream of electricity necessary for maintaining a powerful magnet or for electro-plating, I find none equal to those which I introduced a few months ago. My patent has been purchased by a company, and I have a few prospectuses here (of the batteries—not of the company) which I shall be happy to give to any one present. Their success, in electro-plating especially, has been very remarkable; and in a modified form they must, I am convinced, take the place of the Daniell for telegraphy. The various experiments referred to in the paper were performed after it had been read.

DISCUSSION.

Mr. Hancock said, as Mr. Highton had traversed the entire field of electrical physics, it would be presumptuous to attempt to follow him through the various points which he had brought forward, but he should like to ask him what was the extreme length up to which he at the present time had succeeded in practicably obtaining readable signals. It was well known to those who had devoted, as he had, 25 years to telegraphy, that there was a great difference between sending signals through coils of wire placed in a tank, and through artificial resistance, and telegraphing for actual long distances.

Mr. Highton said that he could only repeat that he began by laying two miles of wire wholly uninsulated, through which he obtained signals with extreme ease; and that he saw it might be carried much further. He had not had an opportunity of using cables, and had, therefore, only been able to experiment through coils and artificially. Mr. Siemens had kindly promised to allow him the use of some of his cables, and he hoped to be able at a future time to report the results.

Mr. Hancock said there had been a great many experiments made with regard to telegraphy without any conducting wire at all, which, as far as his recollection served him, had succeeded up to from 200 to 400 yards.

Mr. Highton said they had succeeded in America to a full mile.

Mr. Hancock said it might easily be imagined that it would be possible to telegraph for a considerable distance without any conductor at all, by a vast expenditure of energy, and, of course, through a much greater distance by means of an uninsulated wire, but unless the experiment was tried practically through a direct long line, and not through artificial resistance, it would not present those features which must always be borne in mind before such a system could be carried out to a practicable result, the conditions being so materially different. Of course, as to the question of cheap telegraphy, it was perfectly unnecessary at this time of day to offer any opinion upon it. The question was as to the comparative beneficial result from the application of the system Mr. Highton proposed, and the cheapening of that now in use. The last occasion on which the subject was discussed in that room was 9 or 10 years ago, when he ventured to speak very strongly indeed on the considerations which he thought ought to weigh with companies desiring to lay lengths of cable. At that time the Atlantic Telegraph Company had laid the cables of 1857 and 1858, and they were seeking subscriptions for a new line. The lines which they then proposed he felt it his duty to speak as strongly as possible against, since they proposed to lay them with about 400 lbs. of copper and 550 lbs of gutta-percha for something under 2,000 miles in length. He at that time brought forward estimates, founded on the quantity of insulating materials then at command, showing it would be impossible to carry on telegraphic operations throughout the globe if cables of such proportions were adhered to, and he had then advanced the opinion that it was perfectly possible to lay a cable across the Atlantic, at the then prices of materials, for about £250,000 ; and he did not despair of one being laid from £150,000 to £200,000. It was simply a question of the amount of conducting wire, the amount of insulating material, and the external covering put upon it ; and if it were possible so to reduce these qualities respectively as to bring the cost within £250,000, or, at the present time, allowing for the tremendous advance in raw materials, of about £350,000, it would be a question of comparative expense between such a cable and the method suggested by Mr. Highton. After the ten years which had elapsed since then, he still believed it was possible to lay a working cable for £350,000. It was as yet *res non probata* as to the number of words which such a cable would transmit, but he had no doubt it would transmit as many, and perhaps more, words per minute than those at present in use. He knew of no scientific considerations which would induce him to alter the opinions he had formed on that subject.

Mr. Highton said he hoped on some future occasion he should have an opportunity of saying how many miles he had actually traversed, with what amount of power, and at what speed.

The Chairman said the subject brought forward by Mr. Highton was one of great importance, and, though there had been very little discussion, what had been said by Mr. Hancock was so far an encouragement to persevere in the endeavours to cheapen the telegraphic system. It had been all through one of experiment and progress, for it was now about 100 years ago since Bishop Watson first tried the electric telegraph across the Thames. Yet it was only at the present day that the system was beginning to be practically developed. Of course, there were always practical difficulties in the way of any new process, and practical experiments were required to satisfy men of business, and those who invested their money in such like undertakings, in order that the difficulties which would have to be overcome might be provided against. There was no doubt, as a scientific question, that the way Mr. Highton had pointed out was one in which it was possible to obtain very great success, and anything coming from Mr. Highton would, of course, carry much weight. A quarter of a century ago, he had in that room discussed the same subject, and since that time he and his brother had laboured at it with great success. He had himself explained the reason why some of the inventions, although practicable in their nature, had not been carried out to a commercial result, and it was evident that various circumstances exercised a great influence upon the practical application of any invention of this kind. The consideration of the money result necessarily affected the minds of many persons. When even small amounts of money had to be supplied persons hesitated before embarking in anything new, and the consequence was that trade influence and vested interests grew up, which sometimes stood in the way of a material improvement. It therefore did not necessarily follow, because an invention was not taken up commercially, that it was not practicable. Even the railway system was a long time being brought into anything like general use ; and, with regard to telegraphy, although the germs of it were laid a century ago, its benefits were only now being generally adopted. He concluded by proposing a cordial vote of thanks to Mr. Highton, which was carried unanimously.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The Exhibition of 1872 was inaugurated on Saturday, the 27th April, by a reception held by his Royal Highness the Duke of Edinburgh.

The following account of the proceedings is taken from the *Times* :—

The invitations to the reception of Saturday must have numbered many thousands, how many we are afraid to say. In the first place, there were the season ticket-holders, a whole army ; then there were the seatholders of the Albert-hall, then the official invitations. These were issued to the Ministers, to all committees, commissioners, and officials connected with the Exhibition, to the Councils of the Society of Arts and the Horticultural Society, to the Lord Mayor and Corporation of London, and to a great number of provincial Mayors, Provosts, and High Bailiffs. Foreign Ambassadors, and the host of distinguished and fashionable personages and persons who on all these occasions have the *entrée* as a matter of right, of course were not forgotten, so that altogether we should not be surprised if the Lords Commissioners' invitations to their reception exceeded those of the Lord Chamberlain for the Thanksgiving service. The doors of the Albert-hall and of the other entrances were opened at half-past seven, and, though the Duke of Edinburgh was not expected till half-past eight, those very punctual persons who love to leave one thing, in this case their dinner, half-done, in order that they may begin another half an hour before its time, began at once to pour into the great hall, which, as we look round upon its crowded tiers and up towards the great spread of the velarium, may remind us in some feeble manner of what must have been the aspect of the Coliseum when all was ready for the show, and the lions were about to be let loose into the arena. There is an arena at South Kensington as well as at Rome, but its lions are of another order, being, on Saturday evening, Royal dukes and noble lords, Eastern princes, even an Eastern princess, mayors and sheriffs, and a whole mob of "personages." The galleries on either side of the great organ were filled with plants, and in the centre of the arena a tall fern-tree sprung from the apex of a cone of flowers. As the Hall filled, the spectacle became one worth seeing, and the best place from which to see it was from a seat in the stalls opposite the organ, near the slope of the centre pathway by which the Duke of Edinburgh and the Commissioners were presently to descend to their place in the arena. Where that place would be it was hard to guess, for people had flown into the arena till it was crowded, but in good time a party of Engineers, in their red uniforms and black busbies, cleared a walk for the procession, and, standing at intervals, made themselves into balusters, holding each of them the red cord which was soon stretched on either side of the pathway. No building in London lights up better than the Albert Hall. The red upholstery seems to tone down the glare of the gas, making it soft and agreeable, and on Saturday the light was *au jour*. The stalls never quite filled, but the red furniture of those which remained vacant contrasted well with the white draperies of the ladies' dresses. Many of the boxes were empty, but there was no lack of gay groups in either the *loggie* or the boxes proper, while the balcony and upper gallery were crowded.

At half-past 8 all waited for the Duke of Edinburgh, the host of the evening, as Royal Commissioner next in rank to the Prince of Wales. A quarter of an hour or so late his Royal Highness arrived, the Commissioners repaired in a body to the grand entrance, the usual flutter passed through the crowded hall, faces turned one way, everyone stood up, the Artillery band broke into the tune which is never out of fashion, and the Duke entered with Princess Louise on his arm, and passed down the inclined plane leading to the arena. A space had been reserved round the fern-tree and the flowers in the centre, and a sofa or two, the only seats in the arena, were here set. The Duke was conducted to the arena by Mr. Cole. Princess Louise wore a green dress, and looked exceedingly well, but more matronly than when she entered the same hall, still wearing the white raiment of a bride, a year ago almost to a day. Next to the royal brother and sister walked the Duke of Cambridge, then Lord Lorne, then the ladies and gentlemen in waiting, and the Commissioners. As the assemblage stood up when the Duke entered they seemed to re-people the hall, and they remained standing till the royal procession left by a door near the orchestra to make the tour of the picture galleries. This was after a few minutes, which were filled up by music from the band, by some shakings of hands and some conversation among the inner circle in the arena, and by the busy use of a thousand opera-glasses and several thousand pairs of unaided eyes on the part of the guests in arena, stalls, balcony, and gallery, for was not the invitation to a private view of Princes as well as pictures? Altogether, however, if it be permissible to congratulate the guests at a "Reception" upon their behaviour, they behaved very well, no less in the galleries than the Hall. If they crowded upon the procession and themselves, their vast numbers (reaching their climax by 9 o'clock, when that part of society which had taken its dinner comfortably arrived and completed the crush) and not at all their individual conduct is to blame. There were no regulations or obstructions whatever. People were left entirely to themselves, and, as is usual on such occasions, did their best to make themselves uncomfortable by meeting in passages and keeping to the wrong side of staircases.

The Royal party had no sooner left the hall for the picture galleries than, of course, the majority of the audience must needs do the same, preferring the pictures and the princes to even Mr. Best, at his best, on the grand organ; to Mr. Smyth and the music of his enchanted wand; to Mademoiselle Philippine; or to an "Orpheonic Octett," who between them gave all those who stayed to listen an excellent concert, which lasted till about eleven o'clock. The crowd was so vast, that though it seemed to swarm into the galleries by the thousand, there always remained a good audience in the hall. The Duke of Edinburgh, having, as before, the Princess Louise on his arm, and followed by the Duke of Cambridge, by Lord Lorne, and the Commissioners, set out, under charge of Mr. Cole, on their long and much-impeded tour of the galleries in little more than ten minutes after entering the hall. The Royal party then returned to the hall, and entered the Royal box, and after a short stay, during which some music was performed by Mr. Best on the great organ, the artillery bands, and the Orpheonic Octett, took their departure.

On the 1st inst. the Exhibition was opened to the public by payment of 10s.; to-day and to-morrow the admission is 5s. The first shilling day is on Monday next.

Official Publications.—The following publications in connection with this year's Exhibition have been printed and published for the Commissioners by Messrs. J. M. Johnson and Sons:—The Programme of the Opening Ceremonial, the Official Catalogue, which, as last year, is divided into two volumes, comprising respectively the Fine Arts and Industrial Divisions, and the Key, printed in the Exhibition daily, containing the programme of the music performed in the Royal Horticultural Gardens and Albert Hall. It is not intended to publish any Reports this year, but an Official Guide is in course of preparation, and will shortly appear. Besides being much more methodical and complete in the details of the exhibits than last year, the Catalogue numbers are given as nearly as possible in the consecutive order in which the articles stand in the exhibition. Throughout the Catalogue are also interspersed short directions and references that will be found exceedingly useful to visitors. The following statistical information may possibly be of interest with regard to the number of exhibits in the industrial division:—

Cotton, raw materials,	about	120
,, products	,,	1,120
Jewellery	,,	1,430
Paper, stationery, and printing	,,	1,550
Cotton machinery, &c.	,,	40
Printing and paper, do.	,,	150
Scientific inventions and new discoveries	,,	80
Prime movers, and objects lent	(entries)	40
		4,530

Mr. Buckmaster has been appointed by her Majesty's Commissioners to visit the principal seats of manufacturing industry and other towns, for the purpose of delivering addresses explanatory of the objects of the series of Annual International Exhibitions. Mr. Buckmaster will make arrangements to visit any town desirous of receiving his services.

EXHIBITIONS.

Exhibition of Ancient Musical Istruments.—A meeting of the General Committee for promoting this exhibition was held on Thursday last, at the South Kensington Museum. His Royal Highness the Duke of Edinburgh presided, and there were present the Duke of Leinster, the Marquis of Exeter, the Earl of Warwick, the Lord Gerald Fitzgerald, the Hon. Seymour Egerton, the Right Hon. Sir John Pakington, Sir George Elvey, Mr. S. Arthur Chappell, Mr. C. H. H. Cheque, Mr. Cole, Mr. Henry Leslie, Mr. P. C. Owen, Mr. R. Redgrave, Dr. Rimbault, M. Vuillaume, and Mr. Alan S. Cole, secretary to the Committee. The various possessors of instruments who have expressed their willingness to lend instruments for the Exhibition are to be invited to send in at once. The Committee determined that the last day for receiving contributions should be the 23rd of May.

Paris Fine Art Exhibition Postponed.—The authorities have announced that, on account of the time required to convert the central space of the Palais de l'Industrie, lately occupied by a horse show, into a garden for the sculpture, as usual, the Salon will not open its doors this year until the tenth instead of the first of May. It would have been a great mistake to have left the garden out of the plan, for certainly sculpture was never more admirably exhibited than here, amid shrubs and flowers in a large space with plenty of air, where the eye and brain, instead of being fatigued, are actually refreshed after a long day in the picture galleries. It is a new proof of the fact that opportunities almost create production, for ever since the plan of showing the sculpture in a garden has been in vogue, the contributions have not only been large in number but superior in quantity. The size of the garden allows also of the exhibition of large monumental works, which could scarcely be shown at all in a gallery.

DIEPPE FINE ARTS EXHIBITION.

SIR,—Having noticed a paragraph in your valuable *Journal* relative to the Dieppe Fine Arts Exhibition, may I beg a small space to assure you that if the committee have determined not to defray the cost of carriage of works to and from the exhibition, which is to be held in

July, it is from no niggardly spirit, but, on the contrary, in order to extend as far as possible the object they have in view, viz., of enabling exhibitors to dispose of their pictures to the best advantage.

To this effect, the rules announce that the whole of the money received at the door of the exhibition and by the sale of the tickets will be devoted to purchases, the expense being defrayed by the subscriptions of members, and the balance of this fund being also applied to the same object.

It is hoped that the advantages of these sales, and the opportunity of bringing works before an essentially cosmopolitan public, will more than compensate for exhibitors the expense of transit of their pictures, a cost of trifling amount individually, but which in the aggregate would prove most onerous, and considerably diminish, if not entirely exhaust, the resources available for purchases.

May I, in conclusion, add that the committee have already been assured by their friends of the nucleus of a successful exhibition, and are very desirous that the British school should be largely represented. In fact, to this reason I am of opinion that, as an Englishman, I owe the honour of subscribing myself—Yours, &c.,

Fredk. Chapman,
Vice-President of La Société des Amis des Arts.
Dieppe, April 26th, 1872.

CORRESPONDENCE.

ENDOWMENT FUND FOR THE SOCIETY OF ARTS.

Sir,—In 1866-7 an appeal was made to the army, navy, and the public generally for funds to restore the garrison chapel at Portsmouth. The chapel formed originally a part of the *Domus Dei*, or "God's House Hospital," founded early in the thirteenth century by Peter de la Roche, Bishop of Winchester. It was one of the earliest buildings set apart in England for the reception of the sick and afflicted. Hospitals of a like character existed in other countries, and in France they were called "Maisons de Dieu." These institutions derived their origin from similar institutions in Jerusalem, founded for the relief of the poor and suffering crusaders.

Pierre des Roches, or de la Roche, was the founder of the Domus Dei at Portsmouth, and was the regent appointed by King John during the expedition to Poitou in 1214, and it was greatly owing to his illegal administration that the barons formed the combination which ultimately extorted from King John the charter of liberties, and laid the foundation of the English constitution. Some two centuries after the establishment of the Domus Dei several of the most important hospitals now existing in London were established, and I do not know that I can do better than quote the following passage relative to the origin of Christ's Hospital, now known as the Blue Coat School, established in the reign of Edward VI. The story of its origin, as related by Stow, is, that Bishop Ridley, in a sermon preached before the King, exhorted the rich to be merciful unto the poor, and also urged such as were in authority to acts of charity. The King, after the sermon, sent for the Bishop, and ultimately gave him a letter. The Bishop was "so joyous of having the said letter," and so "marvellous zealous, that he had an interview that same evening with the Lord Mayor, Sir Richard Dobbs, who, on its receipt, exhibited a like pleasure and eagerness to carry into effect the King's wishes. The Bishop dined the next day with Sir Richard by appointment, when two aldermen and six others of the city were present, and the matter was earnestly talked over. The citizens did not shame the character Ridley had given them for wisdom and humanity." A very comprehensive and business-like plan was soon laid before the King. The poor were divided into three classes:—1. The poor by impotency, consisting principally of orphans, the aged, blind and lame, and lepers. 2. The poor by casualty, comprising "the wounded soldier, the decayed housekeeper and diseased persons." 3. The shriftless poor, including "the rioter that consumeth all," "the vagabond that will abide in no place," and "the idle persons, as strumpets and others." Such were the people for whom provision was now to be made. Bridewell was prepared for the last-mentioned class, the hospitals of St. Thomas and St. Bartholemew for the second (the decayed housekeeper being relieved at home), whilst as to the first—the leper—having been comfortably housed in proper places, so as "to keep him out of the city," and "from clapping of dishes and ringing of bells" (the mode in which these unhappy creatures were accustomed to call attention to their wants), and the poor having been accommodated in an almonry, belonging originally to the Priory of St. Mary Overies, there remained only the destitute children to provide for, the largest, however, and in every way most important class. For these they set apart the most memorable of the old religious houses of London, the Grey Friars. In June, 1553, the children, with the Corporation at their head, were received by the King and Ridley, in the same place where a few months before they had held their memorable conversation, and the charter of incorporation of the different hospitals mentioned above was delivered by the gratified king. Ridley endowed Christ's Hospital to the extent of 4,000 marks by the year, benefactions flowed in, and Richard Castella, a shoemaker, of Westminster, with the consent of his wife, they having no children, "gave lands of the yearly value of £40,000 wholly to Christ's hospital, to the relief of the innocent and fatherless children, and for the succour of the numerable sore and sick harboured in the other hospitals about London." The objects of this institution have, however, in the course of time, become materially changed.

The establishment of parochial relief, by taxation, in the reign of Elizabeth, was a great step towards providing for the deserving and necessitous poor in all parts of the country; but an addition to the relief required by the destitute, aged, and infirm was that needed by such as are overtaken by injury to health, the result of accident while pursuing their various industries, by disease, or mental incapacity, and for many years after the establishment of workhouses they were the only places of relief for the latter classes.

The provision thus made was ultimately found to be quite inadequate to the requirements of the population, to say nothing of the ignorance and want of skill with which many of the persons seeking relief were treated. This ultimately led to the establishment, in more recent times, of some of the large hospitals now doing so much good throughout the metropolis and country, not merely by the immediate relief which they afford to the poor, but also to the upper and middle classes, by the superior medical skill and knowledge which has been induced by hospital practice, and rendered available, owing to the superior medical education which has been acquired by the students who have passed through the medical schools and colleges connected with the hospitals.

I am glad to be able to add that the original founders of the Society of Arts, soon after its establishment, did not overlook the great good which was calculated to result from the multiplication of hospitals, and out of the action inaugurated at our Society arose one of the hospitals of London, which has ever since been devoted to the treatment of one of the most loathsome forms of disease.—I am, &c., H. G. H.

HINDRANCES TO APPLIED ART, OR DECORATIVE ART AND UTILITY.

("La critique est aisée, mais l'art est difficile.")

Sir,—At all epochs men have existed who, generally unable to create anything worthy of notice themselves, have given their own prejudiced opinions (not forgetting due praise to their personal merits) under the cloak of a disinterested criticism, intended to benefit the minds of their fellow-creatures less endowed than themselves, and at a single glance, determine what is good from what is indifferent—what is sublime from what is ridiculous. The fate of these men, who, as a rule, have filled but an unenviable place in history, and many of whom have remained in that profound obscurity from which they should never have attempted to issue forth, has not even been useful as a lesson to those modern babblers, who tear with most wonderful ferocity what they are not capable of replacing, and who condemn what they cannot alter for the better.

Some days since, in a paper entitled "Hindrances to the Progress of Applied Art," by Dr. Christopher Dresser, this gentleman, whilst attacking fiercely the present system of schools of ornamental design in this country, after dissertating at length on the propriety of ornamentation being blended in every particular with strict utility, reinforcing his opinions by illustrative remarks on pokers, tongs, kettles, &c., condemning the designs of carpets in general, as most inferior in an artistic point of view, attempts, at length, to explain what he considers a good remedy to this vicious organisation in the later mode of applying decorative art.

I shall attempt a few remarks on these different subjects.

The schools of ornamental design now existing in England, both in London and other towns, are (says the lecturer) "generally deficient in their intended object, inasmuch as utility is sacrificed to an immoderate amount of ornamentation of the most frivolous class;" thus, whilst in every one of these schools copies and models of the masterpieces of Greek and Italian architecture are freely placed before the student, yet he cannot appreciate true art. It were sad for our country were it so. Fortunately, having abundant proof to the contrary, we are not all of Dr. Dresser's opinion. I feel confident that since the establishment of these schools, art has been so developed amongst our countrymen, that we may look forward to the approaching period when our own productions in decorations will bear comparison with those of our still successful foreign competitors.

But what does Dr. Dresser mean by "combining art and utility?" We are all well aware that the two are most difficult to associate. If artists contented themselves by designing (especially in furniture) articles strictly useful, we should have to do away with almost every style of ornamentation—we should preserve the straight line, never attempt arches or curves in wood, as it necessarily interferes in some measure with its solidity, and never place a pillar where it has in reality nothing to support, in which case we should disturb the grace and elegance, and our specimens of art furniture would become, in reference to the masterpieces of bygone ages, what mediæval is to Gothic, which former style would, we should think, meet the lecturer's entire approbation, as combining simplicity and utility with strict ugliness.

But it would be too great a task to attempt refuting everyone of Dr. Dresser's remarks. I will, however, say a few words on the South Kensington Museum and on the renaissance style, which he deals with so severely. He says:—"My opinion of the renaissance is not so favourable even as Mr. Redgrave's, for I fail to see in its best works more than a recast of the Roman spirit, with which I have no sympathy; its forms utter no sentiments—they are cold and dead. The best forms produced in the time of renaissance are graceless when compared with Greek ornaments, and poor in both colour and form when contrasted with the rich Eastern styles or our own Gothic." Thus is one of the richest reproductions of ancient art, the most beautiful style inaugurated within the last thousand years, depreciated. Dr. Dresser says renaissance is but a recast of the Roman spirit; in this he is not correct. I will show that Greek architecture had a great influence in its formation.

Renaissance, or renovations of art and literature, commenced immediately after the fall of the empire of Constantinople, about the middle of the fifteenth century, when a large number of Greek artists and literary men, escaping Turkish barbarity, fled to Italy, some of the most distinguished being Theodore Gaza, Bessanon, Demetrius, Constantine, John Lascaris, &c. They received at the Court of Cosmo di Medici a brilliant and enlightened hospitality, and caused Florence to become the cradle of the resurrectionary movement. Thus was that admirable style innovated, some of its nobler specimens existing now in Florence, Pisa, Milan, &c., and also in France, designed and executed by those great architects, Jean Goujon and Pierre Lescot.

Dr. Dresser complains of renaissance being cold, both in form and colour, and seems to have, at the same time, a deep admiration for Greek art. I certainly most sincerely share his love for Grecian decoration, but yet I do not think it should be imitated too strictly. Its heavy projecting ornaments and groups have certainly a lovely effect under a warm and genial sky; but with our atmosphere the effects of light and shade would be totally different. Suppose the Parthenon placed on some height outside London, I feel certain the lines would appear harsh and cold also.

As to the Kensington Museum, I can only say that all classes of the population have reason to congratulate themselves at possessing the most useful and complete collection of its kind in Europe; nothing seems to have been spared, and nothing, in fact, is spared at present to make this magnificent institution a great School of Art in itself. There may certainly be some inferior works of art in it; but by their side are also some lovely specimens. It is not necessary to enumerate them; the present generation is quite capable, I think, of noticing or detecting the difference between those different works. The cabinet of Fourdinois, though perhaps not so useful as an ordinary chest of drawers, is still a splendid work, both for its beautiful designs of ornamentation and exquisite carving. This work was never intended to illustrate utility and decoration blended together. We can plainly see this. Its chief object is to show what difficulties may be overcome in wood carving. It is certainly not without defects; it is perhaps over-crowded with ornamentation, but then what delicacy of design and form, what exquisite and almost aerial carving! Every moulding, every figure, every scroll of foliage is in itself a masterpiece of finish and patience.

One of the chief "hindrances to the progress of applied art" is, said Dr. Dresser, the complete ignorance of artistic manners, the utter want of artistic taste, exhibited by those retailers of goods, who, not being actual manufacturers, are not capable of appreciating art, and, of course, thereby prevent its extension. I shall not comment at length on this erroneous statement, at least, taken in a general sense. I could refer the lecturer to several firms who manufacture but little, if at all, and where excellent taste is displayed; but I may observe, *en passant*, that the very fact of art being made a commercial speculation contributes more especially to stifle it than any other cause I know of; the most wonderful masterpieces of ancient art, in every branch, having been executed regardless of time, trouble, or cost.

However, the fact that a man may be a good critic of pictures without being an actual artist, is sufficient in itself to explain my purpose and to overthrow Dr. Dresser's assertion regarding "middle men," as he choses to term them. At the same time the aristocracy of this country (thanks to travels in Italy and France) has got familiarised with what is acknowledged as good art. Very few of "Lady Weakmind's" class would be found at present, and also very few would be blindly led to purchase articles in bad taste, simply because the said "Lady Weakmind" had chosen the same before.

I am certainly as bitter as Dr. Dresser against those men who appropriate to their own use patterns and designs composed by others with skill and patience; but yet which of us is not an humble imitator; are we not all copyists in every branch of art. Can any artist of the present century flatter himself that he has innovated a style totally unknown before him. The arrangements of ornaments may be formed with more or less skill according to the artist's taste, and such efforts should not only be respected, but all the honour of their work left them.

That art is more calculated to please the eye than to give material comfort is undeniable; that ornamentation of almost any kind is contrary to strict utility is also plain. Strict utility would dispense with every style of decoration other than painting, every projecting ornament being, as a rule, uncomfortable, unless placed out of reach. As to the question of durability and solidity which Dr. Dresser (quoting Mr. Redgrave's remarks on the matter) states, cannot exist in wood-curves or arches. We have such abundant proof of the contrary in the South Kensington, and other museums where articles of furniture are found in a very good state of preservation after several centuries, that I do not think it worth while commenting on this assertion. That an arch made from wood must, in a certain measure, weaken this material, is, of course, incontestible; but yet if the said arch is capable of resisting the injuries of time for nearly five hundred years, and is, moreover, capable of bearing the burden put upon it, what more would we have?—I am, &c.,

W. Middleman.

NOTES UPON PAINTED GLASS, FROM THE APPENDIX TO REPORT OF COMMISSIONERS ON THE FINE ARTS.

Sir,—At a time when the appropriateness of painted windows for St. Paul's is being discussed, the few following notes from the judicial pen of the late Sir Charles Eastlake, who had consulted all the best authorities in Europe on the subject of monumental decoration, may be useful.

"The more florid style of Gothic may be acknowledged to be unfit for pictorial decoration on a large scale; its surfaces being so crowded with ornamental panelling that little space remains for pictures."

"Another objection to the application of painting to Gothic architecture, is the use of stained glass. A decoration so suitable in many instances to Gothic windows, is incompatible with the due effect of paintings on the walls, the colours of which require to be displayed by a colourless and at the same time a sufficient light. This objection is met by the consideration that stained glass is not desirable nor usual in all Gothic buildings to the extent to which it was employed in those of a sacred character. Its application elsewhere was generally less profuse, and might be so contrived as not materially to interfere with the quantity or quality of the light."

And in a note he adds:—

"Without reference to the style of the architecture, the highest authority for the union of stained glass to a certain extent with paintings on the walls, is that of the Stanze of the Vatican, the windows of which were enriched with figures of angels supporting the Papal arms (those of Julius II. and Leo X.), by the glass painter, William of Marseilles, at the very time when Raphael was painting the frescos of the same rooms."

"To a certain extent" represents the condition which should, if painted glass be used at all, be complied with in St. Paul's. The arms of the City companies, or of towns contributing windows, executed in moderated colour, and occupying a small proportion of the space in a field of ground glass, is the kind of window adapted for the Cathedral, where mural painting on an extensive scale is contemplated. If such a suggestion were to be adopted and made generally known, the Cathedral would soon be supplied with new windows, and we believe the effect of lighting the building from the mass of ground glass would be marvellously beautiful—certainly nothing could well be more incongruous than pictures on glass and in fresco, encaustic, or mosaic, in juxtaposition.—I am, &c.,

W. Cave Thomas.

DESCRIPTION OF THE PICTURES AND ETCHINGS BY JAMES BARRY.

The object of the late James Barry, the artist to whose exertions the world is indebted for the valuable collection of works now the property of the Society of Arts, was to offer to the public a practical illustration of the arguments he had occasion to adduce against opinions generally advanced by such men as the Abbé du Bois, Montesquieu, and the Abbé Winckelman, and which were highly derogatory to the honour and genius of the British nation. They assert (Barry says) that we have no imagination, no taste, no sensibility; that we are cold and unfeeling to the powers of music; that we succeed in nothing in which genius is requisite; and that if we merit admiration, it is for the hand and execution of the workman, not for the design of the artist; that we partake so much of the distempers of our climate as to disrelish everything, even life itself; that our poets are devoid of true taste and true imagery; that they make a great noise, but present nothing to the mind; and that our natural capacity for fine arts amounts to very little, or nothing at all.

The series of six pictures, the originals of which are in the possession of the Society of Arts, and the etchings of which by the artist are now exhibited and numbered 1, 2, 3, 4, 5, and 6, are on subjects intended to illustrate this great maxim of moral truth, "That the attainment of happiness, individual as well as public, depends on the development, proper cultivation, and perfection of the human faculties, physical and moral, which are so well calculated to lead human nature to its true rank, and the glorious designation assigned for it by Providence." To illustrate this doctrine, the first picture exhibits mankind in a savage state, exposed to all the inconveniences and misery of neglected culture; the second represents a harvest-home, or thanksgiving to Ceres and Bacchus; the third, the victors at Olympia; the fourth, Navigation, or the Triumph of the Thames; the fifth, the Distribution of Rewards of the Society; and the sixth, Elysium, or the state of final retribution.

The pictures are all of the same height, viz., eleven feet ten inches; and the first, second, fourth, and fifth, are fifteen feet two inches long; the third and sixth, which occupy the whole breadth of the room, at the north and south ends, are each forty-two feet long. The pictures were completed and publicly exhibited in 1783, and were presented to the Society in 1784.

1.—Orpheus.

The scenery of this picture exhibits a view of the mountainous and desert country of Thrace; near the centre of the piece is Orpheus, in an action of great energy, enthusiastically singing his divine poems, his right-hand rapturously stretched towards heaven; and for the harmonious accompaniment of his instructive song, the several fingers of his left hand are employed upon the various strings of the lyre suspended from his shoulder, representing him, according to his own assumption, as the inspired messenger and founder of the Grecian theology.

2.—A Grecian Harvest Home.

The warm glow of colouring spread over this picture, and the elegance of the figures in the more conspicuous part of it, form a beautiful and striking contrast to the picture already described. The season is, as the title expresses, that of harvest; and as most of the persons represented are employed in rural sports, the evening is chosen as the most proper time for such relaxation from the labours of the field.

In the foreground is a double terminal figure of Sylvanus and Pan, with their proper attributes; round which young men and women, in beautiful forms and lightly habited, are dancing to the music of a rural pipe and tabor, and seem, in the language of the poet, to

> " ————trip it as they go
> On the light fantastic toe."

Behind them are oxen with a load of corn, and other characteristic marks of the season of the year.

The distant parts of this pleasing picture exhibit a view of a fertile cultivated country, with a farm-house, near which are men wrestling, and engaged in other manly exercises which strengthen the body and elevate the mind to heroic actions; aged men are sitting and lying along, discoursing, and enjoying a view of those athletic sports in which they can no longer engage.

A marriage procession is advancing from a distant temple; and the joy of the accompanying figures expresses the happiness arising on such occasions, the labourers even suspending their work to hail the happy pair.

3.—The Victors at Olympia.

In this picture the artist has chosen that point of time when the victors in the several games are passing in procession before the judges, where they are crowned with olive in the presence of all the Grecians. At the right-hand corner of the piece, the three judges are seated on a throne, ornamented with medallions of Solon, Lycurgus, and other legislators, and with trophies of the victories of Salamis, Marathon, and Thermopylæ. Near the foot of the throne is a table, at which the scribe appears writing in the Olympic records of noble deeds, the name, family, and country of the conqueror; near this table, a victor in the foot-race, having already received a branch of palm, which he holds in his hand, is being crowned; next him is a foot-racer, who ran armed with a helmet, spear, and shield. Close following is seen a manly group, formed of two athletic figures, bearing on their shoulders their aged father; one of these represents a pancratiast, the other the victor at the cestus. The old man is Diagoras of Rhodes, who, having in his youth been celebrated for his victories in the games, has, in his advanced age, the additional felicity of enjoying the fruits of the virtuous education he had given his sons, amidst the acclamations of the people of Greece, some of whom are strewing flowers around the old man's head, while one of his friends is grasping his right-hand, and supposed to be making the celebrated speech recorded on this occasion, "Now, Diagoras, die, for thou canst not be made a god." The climax of this domestic felicity is well pointed out by a child holding the arm of one of the victors, and looking up with joy in his countenance at the honours conferred on his grandfather. Near this beautiful group are seen a number of persons, the chief of whom represents Pericles speaking to Cymon. Socrates, Euripides, and Sophocles, are earnestly attending to what is said by Pericles, whilst the malignant buffoon Aristophanes is ridiculously laughing, and pointing to the deformity of the cranium of the speaker, which was unusually long.

As at one end of the picture there is represented a statue of Minerva, so at the other is that of Hercules trampling on Envy, which are comprehensive exemplars of that strength of body and strength of mind which were the great objects of Grecian education. Sitting on the base of the statue of Hercules, the artist has introduced his own portrait, in the character of Timanthes, holding in his hand a picture of the Cyclops and Satyrs, as related by ancient writers.

4.—The Thames.

The practice of personifying rivers, and representing them by a genius adapted to their peculiar circumstances, is as ancient as the arts of painting and sculpture; and in conformity to this practice the artist has in this picture represented the Thames, of a venerable, majestic, and gracious aspect, sitting on the waters in a triumphant car, steering himself with one hand, and holding in the other the mariner's compass, by the use of which modern navigation connects places the most remote, and has arrived at a certainty, importance, and magnitude, unknown to the ancient world. The car is borne along by our great navigators, Sir Francis Drake, Sir Walter Raleigh, Sebastian Cabot, and Captain Cook; in the front of the car, and apparently in the action of meeting it, are four figures representing Europe, Asia, Africa, and America, ready to lay their several productions in the lap of the Thames.

The supplicating action of the poor negro slave, or, more properly, of enslaved Africa, the cord round his neck, the tear on his cheek, the iron manacles, and attached heavy chains on his wrists, with his hands clasped and stretched out for mercy, denote the agony of his soul, and the feelings of the artist thus expressed before the abolition of slavery became an object of public investigation.

Overhead is Mercury, the emblem of Commerce, summoning the nations together; and following the car are Nereids carrying several articles of the principal manufactures of Great Britain.

In this scene of triumph and joy the artist has introduced music, and for this reason has placed among the sea-nymphs Dr. Burney, whose abilities as a musician were universally acknowledged.

5.—The Society.

This picture represents the distribution of the rewards of the Society of Arts, a society founded for the purpose of introducing and perfecting the useful arts in this country. Not far advanced from the left side of the picture stands the late Lord Romney, then President of the Society, habited, as all the other noblemen are, in the robes of his dignity; near the President stands his Royal Highness the Prince of Wales; and sitting in the corner of the picture, holding in his hand the plan of the institution, is Mr. William Shipley, "whose public spirit gave rise to this Society." In the back-ground appear part of the water-front of Somerset-house, St. Paul's, and other objects in the vicinity and view of this Society as instituted at London. As a very large number of the rewards bestowed by the Society had in Barry's day been distributed to promote the arts of painting and sculpture, the artist has also most judiciously introduced a picture and statue; the subject of the picture is the Fall of Lucifer, designed by Mr. Barry when the Royal Academy had selected six of the members to paint pictures for St. Paul's Cathedral; the statue is that of the Grecian Mother Dying, and in those moments attentive only to the safety of her child. In the corners of the picture are represented many articles which have been invented or improved by the encouragement of this Society.

6.—Elysium, or the State of Final Retribution.

In this picture, which occupies the whole length of the room, the artist has, with wonderful sagacity, and without anachronisms, brought together those great and good men, of all ages and nations, who have acted as cultivators and benefactors to mankind.

In the top of the picture, the painter has happily glanced at what is called by astronomers the system of systems, where the fixed stars, considered as so many suns, each with his several planets, are revolving round the Great Cause of all things; and, representing everything as effected by intelligence, has shown each system carried along in its revolution by an angel. Though only a small portion of this circle can be seen, yet enough is shown to manifest the sublimity of the idea.

In the centre of the picture are animated portraits of the good and great of all ages; and in the other corner of the picture the artist has represented Tartarus, where, among cataracts of fire and clouds of smoke, two large hands are seen; one of them holding a fire-fork, the other pulling down a number of figures bound together by serpents, representing War, Gluttony, Extravagance, Detraction, Parsimony, and Ambition; and floating down the fiery gulph, are Tyranny, Hypocrisy, and Cruelty, with their proper attributes; the whole of this excellent picture proving in the most forcible manner the truth of that great maxim, which has already been quoted, but cannot be too often inculcated:—"That the attainment of man's true rank in the creation, and his present and future happiness, individual as well as publice, depend on the cultivation and proper direction of the human faculties."

7.—Portrait of the late James Barry, R.A.

In Barry's original design the space at the end of the room, between the pictures of "Orpheus" and the "Grecian Harvest-home," was to have been filled with a portrait of George the Third, and that between "The Thames" and "The Society," with a group representing Queen Charlotte superintending the education of her family at Windsor Castle. Barry did not live to complete these pictures, but his intentions were accurately recorded in his own etchings as follows:—

No. 8.—Designs intended to have been painted as the two grand centres over the chimnies in the great room of the Society for the Encouragement of Arts, &c., at the Adelphi, one intended to represent the King in the year 1761, recommending to both Houses of Parliament a Bill for the Independence of the Judges, the other representing the Queen at Windsor, in the superintendence of a scene of domestic education. It was the opinion of the author that these or such scenes were a just tribute to the virtue of his own time, and would happily coincide with the views of the other six pictures on Human Culture, and form an interesting part in the integral or totality. As he was not enabled to add these to the others, he was glad to have it in his power at least to show the whole of what he intended by adding these two sketches to the engravings of the rest of the work.

Nos. 9, 10, 11, 12, 13, 14, aad 15 are groups taken from the pictures Nos. 3 and 6.

16.—Temptation of Adam.

> I feel the link of nature draw me; flesh of flesh,
> Bone of my bone thou art, and from thy state
> Mine never shall be parted, bliss or woe;
> So having said, as one from sad dismay
> Be comforted, and after thoughts disturb'd
> Submitting to what seemed remediless.
>
> *Milton's "Paradise Lost," book* 9.

17.—The Phœnix, or the Resurrection of Freedom.

A tablet in this picture is thus inscribed:—"O Liberty, thou parent of whatever is truly amiable and illustrious, associated with virtue, thou hatest the luxurious and temperate, and hast successfully abandoned thy loved residence of Greece, Italy, and thy more favoured England, when they grew corrupt and worthless; thou hast given them over to chains and despondency, and taken thy flight to a new people, of manners simple and untainted. Hallowed and venerable are thy footsteps. Time, that best arbiter, shall distinguish, and strew thy track with honours."

18.—Testimonial to the Memory of Charles James Fox.

A testimony of veneration for the integrity and transcendent abilities which for more than 20 years have been, though unsuccessfully, yet vigorously, uniformly, and gracefully exerted in the public service, this little piece of copper, which, as the key-stone of an arch, binds together these groups and the virtues they commemorate, is inscribed with the honourable and glorious name of Charles James Fox, by his humble servant, James Barry, July 25th, 1800.

19.—Job Reproved by his Friends.

Dedicated to Edmund Burke, Esq.

20.—Sacra Christa Familia.

21.—The Conversion of Polemon.

Peregrinatus est hujus animas in nequitia, non habilavit valor.—*Maximus*, lib. 6, cap. 9.

Polemon, an Athenian youth, abandoned to debauchery and glorying in the infamy that attended it, as he was returning home in the morning from his night's entertainment, overcome with wine, perfumed with unguents, and his head crowned with a festal garland, saw the door of the philosopher Zenocrates open. He indecently entered the school, which was filled with learned men, and endeavoured to disturb the company and the wisdom and eloquence of the speaker by his licentious, drunken jests. The countenance of Zenocrates still continued the same, and, departing from the subject on which he was speaking, he began to discourse on modesty and temperance, by the gravity of which Polemon was so affected that he took the garland from his head, laid aside his licentiousness and effeminate appearance, and, thus restored to health by the wholesome medicine of one discourse, from an infamous debauchee he became an illustrious philosopher, remarkable for his sobriety, virtue, and abilities, and succeeded Zenocrates in the school of Plato.

22.—Philoctetes in the Island of Lemnos.

This engraving of a picture in the institute at Bologna is with the greatest respect inscribed to Sir George Saville, Bart., by his very humble servant, James Barry, R.A.

23.—The Fall of Satan.

The Royal Academy having in the year 1773 selected six of the members to paint each a picture for St. Paul's Cathedral, this sketch of the Fall of Satan, being one of the designs executed for that purpose, is with the greatest respect dedicated to the Right Reverend Father in God, Thomas, Lord Bishop of Bristol, Dean of St. Paul's, and to the reverend gentlemen of the Chapter, by James Barry, R.A.

24.—Satan's Address to the Fallen Angels.

Whether for war or peace.

25.—Satan and Death.

26.—The Birth of Venus.

27.—King Lear.

Published 1776.

28.—Portrait of Pitt, Earl of Chatham.

Secretary of State from 1757 to 1763.

29.—Pandora.

Heathen mythology asserts that Pandora was the first mortal female that ever lived. She was made with clay by Vulcan at the request of Jupiter, who wished to punish the impiety and artifice of Prometheus by giving him a wife. When the woman of clay had been made by the artist, and received life, all the gods vied in making her presents. Venus gave her beauty and the art of pleasing, the Graces gave her the power of captivating, Apollo taught her music, Mercury instructed her in eloquence, and Minerva gave her the most rich and splendid ornaments. From all these presents which she had received from the gods the woman was called Pandora.

MARINE AQUARIA.

The successful establishment by the Crystal Palace Company, at Sydenham, of a marine aquarium, of a large size, opens up many important subjects in connection with the propagation and preservation of sea-fish. The instruction and amusement to be obtained from such a collection as Mr. W. A. Lloyd has got together is unquestionable, but, looked at from a broader point of view, there is no doubt that such an insight may be obtained into the habits of the various classes of edible fish, as to add considerably to our present knowledge, and enable us to use that knowledge for the benefit of the national industries connected with the obtaining of fish from the sea, and likewise for the increase of one of the food resources on which we are greatly dependent, but from which, at the present time, we do not get the full value that we ought.

The great difficulty of the fish supply of this country is its intermittence; occasionally the market is so bare that fish is almost worth its weight in gold, at others, the supply is so large that thousands of baskets are wasted. This intermittence is due to many causes—the weather, the time of the year, the habits of the fish, &c.; but it is quite possible that marine aquaria may lead to the establishment of marine reservoirs on our sea coasts, in which live fish may be preserved when the supply is over abundant, to be given out when, through stress of weather or other causes, fishing is impossible, or the catches are small. If such reservoirs were established, a telegram from a leading fish salesman, who saw his stock was below the requirements of the market, would land on his sale boards by rail in a few hours fish, alive and fresh, and all the waste that now goes on would be avoided. This plan has been suggested before, and Baron Godin made an effort to establish such reservoirs at several places on the French coast; the wonder is that so obvious and rational a method of equalising the supply of fish has not been adopted. That some such means are required, if such a wholesome food is to be generally and extensively eaten, is certain. The fish supply to the metropolis is falling off. Mr. George Hassard, of Great George-street, Westminster, has just published an analysis of the returns printed by the Markets Committee of the Privy Council, which shows that the total weight of fish has declined from 132,004 tons in 1866, to 116,463 tons in 1871. There has been a slight increase in the quantity coming by rail, but a very large decrease in the quantity coming by water. If, therefore, Mr. Lloyd can help, by his knowledge of the habits of the various edible sea-fish, and of their behaviour in semi-captivity, towards a consummation so devoutly to be wished as a cheap and regular supply of fresh fish, the time and trouble spent in perfecting the aquarium of the Crystal Palace will have been of some service to the community other than the providing for them of mere amusement. It is satisfactory to know that the fish at Sydenham have been, on the whole, healthy, and that no very great difficulty has been found in reconciling them to the altered conditions of their existence. It may be mentioned that the quantity of sea-water stored is 100,000 gallons, of which not more than 20,000 gallons are in use at the same time, a continuous flow being kept up from and to the great reservoir. The water is kept sweet by means of continuous motion, by aeration, which resembles as near as possible the amount of air forced into the sea by the rushing and tossing of the waves, and especially by the falling of their huge crests, and by the growth of a certain vegetation; the loss by evaporation is made good by the careful addition of fresh water.

The essentials of a healthy aquarium are laid down by Mr. Lloyd as follows:—

"An aquarium is an arrangement for the maintenance of living aquatic animals under the following three conditions:—1st. The water must not be changed, though it may have added to it from time to time whatever it may lose in fresh water by evaporation, or lose in any other manner, as, for instance, in such solid matters as are taken from it in the course of the formation of the shells and other hard parts of creatures existing in it. 2nd. The water must be not only kept in a pure and respirable condition by its absorption of atmospheric air at its surface, and which absorption may or may not be increased by putting the water in motion in any convenient manner, but this purity must be assisted by the presence of vegetation growing in it and tending to decompose the poisonous carbonic acid gas evolved from the animals, such vegetation taking up the carbon of the gas into its own substance, and liberating the resulting oxygen for the use of the creatures. 3rd. The animals must not be lung-breathers, that is to say, they must either be such as the sea anemones and corals, and some others which have the function of respiration diffused over their entire bodies, or be such as the creatures above them (up to and ending with fishes) provided with gills during their whole period of existence. Consequently, as lunged animals do not require the purifying processes just alluded to, the services of an aquarium are not for their use, and they are therefore excluded from aquaria; and this exclusion applies even to such aquatic animals as water lizards, frogs, and salamanders in their adult states.

"These conditions apply alike to marine and to fresh-water aquaria. It is not known how long the same water may be kept unchanged, with the necessary occasional additions referred to; but periods of ten years with no apparent detriment are frequently met with. The duration of life of animals in aquaria depends on their kind. Thus there are now in England many healthy sea anemones which have been in aquaria for the last eighteen years; and some fishes, as pike and carp, for ten years; while other fishes, as cod and turbot, grow so quickly in captivity as soon to become too large for any existing tanks; and there are some, chiefly belonging to the herring family, which, though capable of being speedily transferred during journeys of a dozen hours in duration, usually die from some unknown causes (possibly one cause being change of temperature) in a few minutes, or in a hour or two after being placed in an aquarium. But in the case of a large number of animals living naturally in rivers or in the shores of the sea rather than in the open ocean, but always being more or less concealed by the water in which they exist, an aquarium presents absolutely the only mode by which they can be conveniently observed alive at all times.

"Bearing in mind the three conditions here laid down, the 'vivara' of the ancient Romans, and all modern sea and fresh-water ponds consisting of receptacles in which fishes and other creatures, for table or other purposes, were or are kept in water in communication with the sea or with flowing fresh water, cannot be termed 'aquaria' in the conventional sense to which it is now necessary to restrict the word, the water being changed constantly."

The Sydenham Aquarium certainly seems to fulfil all the conditions required, and the collection that has been got together is of great value. By an arrangement of the light the fish are easily seen by visitors, and the tanks being square the distortion which too often mars the pleasure of looking into an aquarium does not take place. Taken altogether, the experiment of keeping sea fish inland in a healthy state, without change of water, has been successful, and Mr. Lloyd, to whom the result is due, deserves every credit for having carried it out. With the appliances he has now at his command, and the opportunities he has for studying the habits of the fish, he will be able, with the vast experience he has had, to obtain very valuable information, which may have a very important influence in the future upon the rearing, breeding, and preservation of marine fish.

The success of the Crystal Palace aquarium leads us to hope that the one now being completed at Brighton will be another useful institution. It will, of course, labour under less difficulties than the one at Sydenham, or the one that is proposed for Manchester. It is also to be hoped, however, that out of this advance in the direction of the keeping up of marine aquaria not only will science be extended in a manner that she has been largely excluded from, but that some efforts will be made, and some knowledge obtained, in the direction of the increase of the food of the people. The aquarium at Manchester is to be built from funds raised by a company started under the superintendence of a number of gentlemen resident in the city who are interested in marine zoology, and desire to promote scientific education in all its branches. The building will contain all the recent improvements shown to be necessary at the Crystal Palace and Brighton aquaria, and will be rectangular in shape, 120 feet long, and 70 feet wide. This space will be divided into two side galleries, each 120 feet long and 15 feet wide, separated from the central saloon by a light screen. Running along one side of each of these galleries will be a series of tanks, about 80 in number, 40 in each gallery, varying in capacity from 300 to 3 000 gallons, and the roofs will be so arranged that the light will pass through the water at an angle of about 45°, thus rendering distinctly visible the living inhabitants and plants contained in the grotto-like tanks. The grand saloon will be also 120 feet long by 40 feet wide, supporting on light iron columns an open panelled roof. All the windows will be so arranged as to admit only the exact quantity of light required, as it is found that an excess of light acts upon the higher marine plants and animals in a manner directly contrary to its action upon terrestrial life, blanching them as ordinary plants are blanched by being earthed up, while the most brilliant-coloured marine plants are those which live in comparative darkness.

In the guide-book published by Mr. Lloyd for the use of visitors at Sydenham is the history of aquariums, in which some interesting details are given. It appears that the very first recorded person who, endeavouring to keep marine animals far from the sea (in London), and feeling the difficulty of doing so, and who set about the devising of means of overcoming it, was Mrs. Thynne, who (as recorded by Mr. Ward), in the spring of 1847, sent to the sea for weeds to place in water for her animals in town, and so to keep them in good condition. It will be seen that this lady did not do this by accident, while doing something else of more consequence to her, but she introduced plants for a definite and avowed purpose, stated beforehand, and that was more than any one else before her ever did with sea animals and sea water.

In the summer of 1849, the late Mr. Robert Warington, of London (with precisely the same intention and success as Mrs. Thynne with sea-water), began experiments with fresh water aquaria, and in January, 1852, he commenced applying the balancing principle to marine creatures and plants, and sea-water, and, at the same time, Mr. P. H. Gosse, also in London, began his experiments with sea-water animals and plants. After several private attempts, the late Mr. D. W. Mitchell, the secretary to the Zoological Society of London, erected a fish-house or aquarium in the society's gardens, Regent's-park, which was commenced in the summer 1852, and opened to the public in May, 1853, and this was the first public aquarium in England or anywhere, and it still exists in nearly its original state, save in its diminution of light; and whatever may be its deficiencies consequent on being erected at a period when there was no experience available for guidance in its formation, it originated by far the greater part of the popular movement in the cultivation of aquaria in Britain and elsewhere, and which prevailed as a kind of mania from 1854 to 1860, reaching its highest pitch in the last-named year, and then declining till it almost ceased to exist in its domestic aspect in 1862. In 1854, a public aquarium was opened for a few weeks in the now defunct Surrey Zoological Gardens, London; and, after that, another one was formed in the Zoological Gardens of Dublin; and then others were set up in public institutions in Belfast, Galway, Edinburgh, Scarborough, Weymouth, the Crystal Palace, and in one or two other places; but the one in Dublin is noteworthy, as Dr. Ball, its manager, devised a method of keeping the sea-water in occasional motion by passing bubbles of air through it from a pair of bellows worked by visitors. In America there was an aquarium at Boston; and another one formed a part of Barnum's Museum in New York; and in all of these the animals were sometimes in a series of tanks, sometimes in only one; but in every instance there was the same defect that characterises private aquaria, namely, the creatures at first too many in number, too large in size, wrong in kind, ending at last with none at all, combined with want of constant motion in the water (in the form of streams of water, and not merely in the form of bubbles of air), and with too much light and heat, developing too much vegetation.

In 1855, Mr. George Hurwood, of Ipswich, contrived an arrangement whereby the pressure of a steam of fresh water, such as that existing in the pipes of waterworks of towns, or which can be got from a high cistern already existing in a dwelling-house, may be employed to compress air, and the compressed air in turn forces a current of sea-water into an aquarium; and this plan is perhaps the best that can be adopted for small aquaria where hand-labour is undesirable, though the motion is of necessity intermittent, unless the apparatus be in part doubled, and also though there is a small waste of power each time the air-vessel is charged. This arrangement was adopted in several private aquaria in England, but afterwards on a much larger scale in the first public aquarium erected in Paris, in the Jardin d'Acclimatisation there, in 1859-1860. This aquarium was very successful, and the sea-water was not once changed during the ten years of its existence, until the whole was destroyed in the war of 1870, and in 1862 it stimulated the Zoological Society of Hamburg, then in the first year of its existence, to have an aquarium in its gardens. This aquarium was opened in the spring of 1864, and is much larger and better than the late Parisian one, and it became speedily very popular and successful in every way, and is still the best, though not the largest, aquarium on the Continent, thanks to the early influence of Dr. H. A. Meyer, Professor Mobius, and the late Baron Ernest von Merck. The sea-water is circulated partly by an engine set in motion by water from the town waterworks, which drives a pair of water-pumps (instead of compressing air, as was done in Paris), and partly by a steam-engine which drives two other pumps. The great pecuniary success of the Hamburg aquarium caused other public aquaria to be erected in various parts of the Continent, namely, in Hanover in 1866; in the Boulevard Montmartre, in Paris, in 1867; in the Reserved Park of the Paris International Exhibition in the same year (twice); at Boulogne-sur-Mer in 1866; twice at Havre, in 1867 and 1869; in the Zoological Gardens at Brussels, in 1868; in the Flora Gardens of Cologne, in 1869; and in Berlin, in 1869. The money capital embarked in these twelve aquaria has amounted to about £180,000.

COAL IN SWEDEN.

An interesting article on the discovery of coal in Sweden has been contributed to the *Times* by an occasional correspondent. Writing from Copenhagen, on April 9th, he says:—"The considerable and continuous rise in the price of coal, an inevitable consequence of the ever-recurring miners' strikes and of the constant rise of labour in England, has been severely felt in all branches of industry, and given new impulse to the schemes for supplanting English coal by some other fuel. For 150 years it has been known that the Swedish province of Schoonen—or Skâne, as it is called in the native idiom—contains coal, and several mines have been worked at different times. One of them, the coal mine at Höganäs, close under the bleak promontory of Kullen, which keeps guard at the entrance of the Sound, and just opposite Elsinore and Kronborg Castle, has been in continuous working since 1796, yielding a reasonable profit to the proprietors, and encouraging the growth around the mine of a whole manufacturing town, especially of large potteries, the products of which enjoy great popularity in the north, and may be found spread over all the Scandinavian kingdoms. The property of the Höganäs pits has passed to a company, and under its direction some of the derelict old mines have been taken up afresh, new ones have been opened, and at the same time borings have been carried on over a large area of the province to get a more detailed knowledge of the position of the strata. The result of these borings have surpassed all expectation. Layer after layer was detected, varying from 1½ to 8, 12, 16, and even 20ft. in thickness, and it began to be believed that a large part of the province rested upon superposed beds of coal and easily penetrated sandstone. A perfect coal fever caught our Swedish neighbours, and the contagion was carried even across the Sound to our shores. It was the repetition, on a small scale, of the oil fever in the petroleum district of Pennsylvania. The shares of the coal company jumped up to a ridiculous height, to fall down some short time after to half their quoted value and then take some new start. Every little proprietor fancied a gold mine under his turf, and prices of ground were run up to what must be now considered fabulous prices, passing from hand to hand, and leaving handsome profits to everyone except the last holder, who may find one day to his cost that the axiom '*Beati sunt possidentes*' does not hold good in all human relations.

"The present time is very favourable to all sorts of schemes and projects. From Berlin and Hamburg a veritable deluge of new banks, new credit societies, new manufactories, new commercial and industrial combinations is pouring over us, and everything is eagerly taken up. The starters of a new company begin by pocketing a clear profit of 5, 7½, or 10 per cent., as a tribute due to their influential names; the shares offered to the public are the object of keen competition, and are noted the next day on the Bourse with a fair premium. In short, we are making all the preparations for a commercial and financial breakdown, in comparison with which the fearful crisis of 1857 will seem mere child's work. As I think it probable that this spirit of speculation will very soon spread itself over the future Swedish coal mines, and that the British public will be invited to take a share in the undertaking, it may be as well to give your readers some explanation of the real state of the Swedish mining prospects, and so enable them to discern truth from fiction. To do this I think it best to give an extract from a very able article which the Professor of Geology and Mineralogy at the University of Copenhagen, Mr. Johnstrup, has just published in one of the daily papers.

"First of all, Mr. Johnstrup remarks, it has been proved beyond dispute that there is no hope of finding in Sweden coal of the same quality as that produced from the English mines. The English coal belongs to the proper 'coal formation' of geology, the Swedish coal to the so-called 'Jura formation,' a difference of the greatest importance as bearing on the heating value of the two sorts. Swedish coal, even the better specimens, cannot be put higher than at two-thirds, or, at the utmost, three-fourths of the heating power of ordinary English coal. It gives a great deal of ashes, is not suitable for coke, and, like all other sorts of Jura coal, it does not stand humidity or exposure to the air, being consequently unfit for long transport. In the more distant seaports of Sweden, it pays, even with the present high prices of English coal, to import them instead of procuring Swedish sorts, the difference of price corresponding with the difference of intrinsic value. On the other hand, the mines may become of great importance for local industry, and as the railway passes through the district a new application may be found for them in feeding the locomotives.

"Another point to be considered is the depth of the layers. The pits of Höganäs that have been worked for almost a century are carried down to a depth of about 100 yards, the coal seam being one yard and a-half thick; of this layer only half a-yard yields a combustible material, the rest being unclean matter and coal slate. The new strata detected by the borings at Raus, Billesholm, and Biuf, are at a depth of almost 100 yards, and the working of the mines will be rendered dearer and more difficult accordingly. The borings alone do not give certain knowledge of the quality of the mineral, but at all events the working of the mines increases in something like geometrical progression with the greater depth. In the Danish island of Bornholm, south of the peninsula of Schoonen, coal belonging to the same geological period has been detected long ago, but it was found that not even a seam of more than three yards could pay the working expenses. The pumping up of water alone would represent a very costly item.

"On the other hand, the explorations going on have undeniably brought to light a new source of income for Sweden, already so rich in mineral products. The upper layers of coal are almost all horizontally disposed, separated by mighty strata of sandstone, and accompanied by a very superior sort of fireproof clay, for which there will be manifold use in industry. The coal territory begins in the north at Höganäs, and extends southwards, or in a south-easterly direction, along the Sound, a distance of about 25 miles, reaching at its greatest breadth between the two towns of Helsingborg and Landscrona, where it is about 10 miles wide; the whole area forming a triangle with acute angles, or an oxygon, measures about 120 square miles. Some isolated spots have been found south of it, but without practical importance. If the rise in the prices of coal should continue, there may be good chances of working the mines at Schoonen with fair profit. At present, it would be hazardous to state more or excite greater expectations.

"The learned Professor concludes by answering the question, if there be any chance of finding coal on the Danish side of the Sound, the geological formation of the two coasts being homogeneous. That coal may be found in the environs of Elsinore he thinks not impossible, and for the sake of science he would be glad to see some borings tried. But as there is, close to Höganäs, a sudden leap or crack in the coal seams, which descend here all at once some hundred feet, the probability is that the coal layers on the Danish side, even if such should be discovered, would not be workable."

SCIENTIFIC INSTRUCTION.

A supplementary report to the first report of the Royal Commission on Scientific Instruction and the Advancement of Science has been issued. It recommends that the Science School be represented before the Board of the Science and Art Department by its dean, as the Royal School of Mines has been hitherto represented by its director; and that the council of professors shall have power, subject to the approval of the Board, to provide for the due maintenance of discipline in the general school and technical schools, the discipline of the students of the Royal School of Naval Architecture and Marine Engineering remaining under the principal of that school. The Commissioners consider that such modifications as to the conditions of admission to the courses, as well as such re-arrangement of the courses as may be rendered expedient by the consolidation of the schools recommended in the first report, should be considered and reported on to the Committee of Council on Education by the Council of Professors, due regard being had to the maintenance of its character as a school for special scientific instruction. Such re-arrangement should admit of provision being made for the continuance and extension of the instruction given to elementary science teachers during the summer months. With reference to the assistance required by the professors, they recommend that this subject should also be considered by the Council of Professors, and reported on by them to the Committee of Council on Education, due regard being had to the necessity of practical instruction, and to the suggestion in the previous paragraph concerning the instruction to be given to science teachers. The Commissioners find that the new buildings at South Kensington will afford sufficient space, as regards lecture theatres, class-rooms, and laboratories, for the theoretical and practical instruction of a large accession of students. A committee of Commissioners have inspected the new buildings, and the secretary has applied to the several professors for information as to the space they require. The Commissioners suggest the following general appropriation, considering that the detailed allotment of rooms had better be left to the professors themselves:—Basement—physics, metallurgy, chemistry. Ground-floor—School of naval architecture, general lecture-room, mathematics, applied mechanics, &c. First floor—Physics and chemistry. Second-floor—Chemistry. Third-floor — Biology, mineralogy, mining, geology, physics, chemistry (open air work).

The second report of the Commissioners has also been issued. Dealing first with scientific instruction in training colleges and elementary day-schools, the Commissioners recommend, as regards the elder children in the elementary schools, that the teaching of such rudiments of physical science as they have previously indicated should receive more substantial encouragement than is given in the regulations of the new code. As regards the younger children, they recommend that her Majesty's inspectors should be directed to satisfy themselves that such elementary lessons are given as would prepare these children for the more advanced instruction which will follow. The mode of instruction of pupil-teachers, the conditions of admission to training colleges, the duration of the course of study in them, and the syllabus of subjects taught, it is suggested should be so modified as to provide for the instruction of students in the elements of physical science. On the question of scientific instruction in science classes under the Science and Art Department, the Commissioners recommend that the instruction be so arranged as to work in complete harmony with the general system of public elementary education, but they consider it important that the Education Department and the department charged with instruction in science shall continue to be co-ordinate. They desire that a more efficient inspection of elementary science classes be organised, and that the inspectors should advise the local committees and report on the apparatus of instruction, the state of the discipline and methods, and the general efficiency of the arrangements. The Commissioners recommend that teachers who have already qualified by passing the May examinations in either of the advanced classes shall continue to be recognised as qualified to conduct elementary science classes, with the title of Elementary Science Teacher, and to earn the grants awarded by the Department of Science and Art on the results of the examination of their scholars; but that this qualification and title shall in future only be attainable by passing in the first of the advanced class. They further recommend that the grants made by the Science and Art Department for buildings be extended, under sufficient guarantees, so as to embrace institutions for scientific instruction, although they may not be built under the Public Libraries Act, or be in connection with a School of Art; also, that grants similar to those now made for apparatus be given for laboratory and museum fittings under proper guarantees. Whenever the arrangement for scientific teaching in any institution shall have attained a considerable degree of completeness and efficiency, it is suggested that such institution be recognised as a science school, and be so organised as to be become the centre of a group of elementary science classes, and to provide the assistance of first grade science masters, the loan of apparatus and specimens, and the means of instruction in the laboratories and museums to the more advanced students of the group. The Commissioners also recommend that assistance be given for the formation and maintenance of such science schools by special grants, the conditions of which shall be determined by regulations to be framed by the Science and Art Department; and that when laboratories are attached to second-grade grammar-schools in the schemes issued by the Endowed Schools Commissioners, the trustees of such schools be encouraged and enabled to invite the formation of elementary science classes, to be taught therein.

MEETINGS.

Aeronautical Society.—On Thursday, April 25th, a general meeting of the members of this society was held in the Hall of the Society of Arts, by permission of the Council, Mr. Glashier in the chair. The object was to hear remarks upon some experiments lately conducted at Messrs. Penn's engineering works by the Experimental Committee appointed by the Council of the Aeronautical Society of Great Britain to determine the relation between the velocity of the atmosphere and its pressure upon plane surfaces of varying dimensions and degrees of inclination. The instrument and experiments were made by Mr. Wenham and Mr. Browning. Mr. Wenham, in the absence of the latter, explained the nature of the instrument used. The experiments seemed to indicate the law that the lifting force of inclined planes, carried horizontally through air, was increased in the direct ratio that the sine bears to the length of the plane, or the height of the incline to the base. Thus, if, instead of stating the angles in degrees, they said "one in ten," or "one in three or four," as the case might be, this would at once express the proportion in which the lifting force exceeded the resistance. The average of all the results was very near to this, making a little allowance for the surface friction of the plane through the air. At 45 deg. the two forces were equal; above that the proportions were in inverse ratio, as the lifting force was less than the direct. It had been stated that the resistance of wedges or cones through the air was diminished directly in the ratio that the height or diameter of the base bore to the length of the cone. The experiments did not confirm this, but showed the resistance to be less in proportion as the angle became more acute. The Chairman, Mr. Brook, and a few others made some remarks. A vote of thanks was given to the Messrs. Penn for the assistance they had rendered in making the experiments. Mr. Head read a paper "On Flight," the object of which was to show that it was possible for man to fly through the air if a proper machine were made for that purpose. Mr. Head seems to have come to the conclusion he has from the flight of birds, of which he has been a minute observer. Some discussion ensued, in which Mr. Wenham, Mr. Harrison, Mr. Moy, Major Robertson, Mr. Hardingham, Mr. Hall, and Mr. Brook took part, after which a vote of thanks was given to the reader of the paper.

NOTES ON SCIENCE.

It is not generally known that in the vicinity of the Yellowstone Lake, Wyoming Territory, United States, there are numerous hot springs and geysers. These have recently formed the subject of a survey, by which much interesting information concerning them has been obtained. From the fact that the country near the Yellowstone and Firehole rivers has often been visited by earthquakes, of which some of the shocks have been very severe, but little has been known concerning this region, even the Indians abstaining from visiting it. On the shore of the south-west arm of a lake which is about twenty-two miles long, and from ten to fifteen miles in width, there is an interesting group of hot springs covering a belt about three miles long and nearly a mile in width, and Mr. F. V. Hayden has, in the *American Journal of Science*, given an account of their leading features. From this we learn that these springs have built up a series of beds or strata twenty-five feet thick in the aggregate, composed of laminæ of silica which have been worn into a bluff wall by the waves. The shores are covered with the decomposed siliceous crust, so that it looks as if it were covered with the fragments of washed sea-shells. Many of the springs are in a constant state of quite violent ebullition, but rise and fall every second or two. Quite a symmetrical funnel-shaped crater is formed with a circular rim, varying from a few inches to several feet in diameter. Some of these funnel-shaped chimneys extend out into the lake several feet, and the hot spring deposits may be seen through the clear depths for fifty yards. The belt described is only one of numerous similar groups, and the number of geysers are considerably over a thousand. One of the most attractive of these operated every hour during the stay of the surveying party, throwing up a column of water six feet in diameter and from one hundred to a hundred and fifty feet in height. Its eruption, which lasts usually for fifteen minutes, is preceded by a sudden emission of steam from the crater. A bill has been introduced into congress, the object of which is to have this wonderful region set apart as a great national park for all time.

The beauty of the purple of Cassius is well known. It is formed of a combination of gold and tin. In the course of a paper read before the Chemical Society by Mr. Alfred H. Allen, "On the Detection and Estimation of Tin," he said that the action of nitric acid on alloys of tin and gold produces a beautiful purple residue, which owes its colour to purple of Cassius. This residue, when heated with concentrated sulphuric acid, gives a purple solution, which, on further heating, becomes colourless, the whole of the tin being dissolved, and the gold remaining as a heavy brown metallic residue. The purple residue is always washed free from nitric acid. If hydrochloric acid be added before the purple solution turns colourless, a small quantity of gold will remain in permanent solution, probably as a chloride. As a precaution against this source of error, if the solution has any yellow tint after adding hydrochloric acid and an equal bulk of water, it will be well to boil it with a crystal of ferrous sulphate, which reduces the gold without affecting the stannic solution.

Mr. W. F. Barrett has communicated to *Nature* the results of a very thorough course of investigation into the phenomena associated with a hydrogen flame. These phenomena, he rightly conjectures, may prove of much future usefulness. Although the effects narrated may be obtained without any special precaution, Mr. Barrett considers that in order to study the phenomena free from disturbing causes, three things ought to be attended to—the gas should be stored and purified by passing it into a gas-holder through a solution of potash, followed by a passage through a solution of either perchloride of mercury or nitrate of silver; the gas should be burnt at a platinum or a steatite jet, to which it must be brought from the gas-holder by means of an indiarubber tube; and lastly, it must be burnt in a perfectly dark room, free from dust and atmospheric agitation. When the hydrogen flame is produced under these conditions the following results are demonstrated:—1. That the combustion of hydrogen exhibits some physical peculiarities and produces phosphorescence on many substances with which it comes in contact. 2. That the blueness so often seen in a hydrogen flame is due to the presence of sulphur derived from either the vulcanised rubber tubing, from atmospheric dust, or from the decomposition of the sulphuric acid spray from the generator. 3. That a flame of hydrogen forms an exceedingly delicate re-agent for the detection of sulphur or phosphorus. 4. That many sulphates, and also carbonic acid, are apparently decomposed by a hydrogen flame. 5. That this flame is a test for the presence of some gases, notably carbonic acid. 6. That these results are capable of practical application.

How to illuminate opaque objects when viewed by a high power under the microscope is a subject which has long engaged the attention of microscopists. A new method of illuminating such objects is proposed by Dr. H. A. Johnson. It consists in sending a beam of light down the oblique body of the binocular upon the prism by means of a plane mirror or rectangular prism. By this arrangement objectives as high as the twenty-fifth, by an inch in focus, have been used successfully by both daylight and lamplight.

A means for measuring the chemical intensity of light has been proposed by Dr. Vogel. He uses a nitro-prusside solution, which, suffering decomposition by the action of light, deposits a precipitate which is Prussian blue. The solution used must be one of known specific gravity, and after a small quantity has been exposed to light for a given period, it is removed into a partially darkened room and its specific gravity again ascertained, when it will be found that in proportion to the intensity of the light, so will be the quantity of the Prussian blue precipitated, and of course the diminution of the specific gravity. Data are thus obtained for measuring the actinic power of the light. To prepare this sensitive liquid, chemically pure oxide of iron, best obtained from the oxalate, is dissolved in hydrochloric acid, and the solution is then evaporated nearly to dryness in order to expel the excess of acid. To this is now added an aqueous solution of nitro-prusside of sodium in the proportion of three parts of the iron to two of the latter. This operation must be made in a room lighted by yellow rays only, for the solution is exceedingly sensitive to the chemical rays of light. As an instance of its sensitiveness to the latter rays, some of the liquid was exposed to the light of a kerosene lamp for forty-eight hours without being affected; but no sooner was it exposed to the light emitted from a piece of burning magnesium wire, than the Prussian-blue began to precipitate. In addition to using the specfic-gravity test as a means of estimating the power of the light, the quantity of the precipitate formed might, in a graduated tube, also afford a ready means for at least an approximate idea of the actinic intensity.

An apparatus for obtaining water from the depths of the ocean has been invented in Germany. An open vessel of suitable form and size is lowered by means of a rope, and when the desired depth has been reached, an electrical current is transmitted through a wire that accompanies the lowering rope, and this current, inducing activity in an electro magnet attached to the apparatus, releases powerful springs, which act upon stop-cocks, thus enclosing the water at any degree of depth. Some useful experiments in the determination of the carbonic acid in sea-water have been made through the agency of this apparatus.

NOTES ON COMMERCE AND TRADE.

The recent exports of coal and coke from the United Kingdom have presented a further increase upon those of 1870. The exports of February were 915,282 tons, against 718,417 tons in February, 1871, and 653,309 tons in February, 1870. The shipments to France appear to have regained all their old importance, the movement in that direction having been 253,652 tons in February, against 154,913 tons in February, 1871, and 189,425 tons in February, 1870. The aggregate exports in the two months ending the 28th of February this year were 1,757,610 tons, against 1,278,107 tons in the corresponding period of 1871, and 1,411,923 tons in the corresponding period of 1870. In these totals, France figured for 507,282 tons, 260,590 tons, and 380,704 tons respectively. The exports have increased this year to Russia, Sweden, Denmark, Germany, Holland, France, Spain, Italy, and British India, but they have decreased to Brazil. The value of the coal exported in February was 518,456, against £361,635 in February, 1871, and £321,881 in February, 1870; and for the two months ending the 28th of February this year £988,084, against £642,306 in the corresponding period of 1871, and £631,388 in the corresponding period of 1870.

At this juncture, when Irish affairs are so much discussed, and the question is so often asked whether Ireland is making progress in her material interests, there must be some utility, says a correspondent of the *Standard*, in calling public attention to facts with which her progress is connected. At a moment when the agricultural labourers of England are in moral revolt against their condition, the Irish labourers are as to wages uncomplaining. Their savage warfare is with evictions and the oppressive exercise of landlord influence upon those who follow their political prejudices or principles, no matter which for our purposes of remark. The enactments of the present government in reference to the land are now practically working; strenuously opposed by one section of landlords, and as strenuously supported by another, the latter in the minority. The tenant farmers are satisfied. There are various enterprises connected with fisheries which might be made, but never have been made, one of the most fruitful of Irish productions. Generally, the fish that is just out of season in London can be caught abundantly on the Irish coasts, so as to ensure the great markets of England a long and continuous supply. The mines of Ireland are beginning to be worked. Her iron is of the very best quality, generally free from sulphur and other impurities, and largely attended by antimony. Anthracite coal exists over a wide area, and, presumably, rock oil is likely to be found in those districts. In the present dearth of iron ore in England for our furnaces and mills, these facts are important. Copper exists abundantly, which, in the present high price of that metal, is important. Lead—silver lead of an ordinary character, and silver lead of extraordinary richness, are to be found in that country. Its commercial importance is so far growing, that one-third of the coasting trade of the British Isles is Irish, a fact scarcely to be credited; a reference, however, to the Board of Trade returns for 1851, and for the first quarter of 1852, will abundantly confirm these statements. On the whole there are symptoms of improvement and progress in Ireland.

The report that the steamer *Harefield*, Captain Farrar, passed through the Paumbem Channel with comparative ease and without having suffered the least damage, is a matter of considerable interest to those who are engaged in the cotton goods trade of Calcutta and ports in the Bay of Bengal and Coromandel coast. The opening in question is a narrow pass between a remarkable ridge of sandbanks which almost completely obstructs the channel between Ceylon and the Indian coast, stretching from the Island of Manarr on the Ceylon side to the Island of Rameswaram, at the south-east point of the Carnatic. To a sailing vessel safe navigation in these confined and sinuous passages is impracticable; but now that steamers are transacting so much of the trade of India with Europe, the utility of the channel is obvious. A vessel coming from the Suez Canal or from Bombay could, by striking through the northern passage instead of rounding the island, save two days at least—probably more—a most important consideration, now that the voyage between England and India is a matter not of months, but days. It is of equal importance in the trade with China. Captain Farrar estimates his gain at two days and a-half, as he believes that by going round the Point de Galle at the south-western extremity of Ceylon, he should have met with "a two-knot current." He considers that, with a quick vessel, there is no danger whatever, the least water being 14 ft., the width of the passage 150 ft., and the length 150 yards. The *Harefield* was a light steamer, but the Captain thinks the channel could with a moderate outlay be made practicable even for loaded steamers, and that it could be used for at least nine months in the year. The Madras government has done what was required to bring the channel into its present state; and, as the amount received for dues would be very considerable were the passage regularly used, it might be quite worth while to lay out further expenditure in the same direction.

There has been laid before the House of Commons an Act passed by the Governor-General of India in Council in October last, with a view to provide for the ultimate adoption of a uniform system of weights and measures of capacity throughout British India. The Act directs that the unit of weight shall be a "ser," equal to the French kilogramme, and the unit for measures of capacity a measure containing one such ser of water at its maximum density, weighed in a vacuum. Other weights and measures of capacity, to be authorised under this Act, are to be integral multiples or sub-multiples of these units, the sub-divisions to be expressed in decimal parts unless otherwise ordered. When proper standards have been provided for verification of these weights and measures to be used by any government office, municipal body, or railway company, the Governor-General in Council may direct that the weights and measures so authorised shall be used in dealings by such office, body, or company.

The last Bombay papers give a few particulars of the Indian budget produced by Sir R. Temple in Council in Calcutta on the 6th ult. Actuals, 1870-71: Receipts, £51,413,685; ordinary expenditure, £49,930,695; surplus, £1,482,990; extraordinary expenditure on public works provided by loan, £1,167,810. Regular estimate 1871-72: Receipts, £49,976,500; ordinary expenditure, £47,276,500; surplus, £2,700.000; extraordinary expenditure on public works, £1,736,800. Budget estimate, 1872-73: Receipts, £48,771,000; ordinary expenditure, £48,534,000; surplus, £237,000; extraordinary expenditure on public works, £2,615,000. Income-tax proposed, 1872-73, one per cent., with exemption of incomes below 1,000 rupees per year. No other fiscal changes. No loan for public works either in England or India, loan funds in hand being sufficient for works in progress. Estimated cash balance, Indian Treasury, 31st March, 1872, £21,500,000. Anticipated cash balance, 31st March, 1873, £17,500,000. At conclusion Sir Richard Temple introduced the Income-tax Bill to the select committee to report on the 16th.

In the year 1854, there were 53,823 acres of hops, and in the year 1871, 60,029 acres cultivated. In 1863, the amount charged for brewers' licenses in the United Kingdom was £934,829 7s., and in 1871 it was £399,576 11s. 6d.

GENERAL NOTES.

Proposed Submarine Tunnel.—It is proposed to tunnel under the Strait of Canseau, between Nova Scotia and Cape Breton, in order to connect the railway at Cape Breton with the mainland. The distance is about 2½ miles. It is estimated to cost the moderate sum of 2½ millions of dollars.

Flexible Marble.—There has been exhibited in America a flexible marble slab, which is procured from the Portland quarries, Vermont. Professor Hay, of the Western University, of Pennsylvania, describes its constitution as—carbonate of lime, 97·50; magnesia, a trace; silica, 2·05; water, 45=100. The above composition and its crystalline character together proclaim it to be a true marble, and, at the same time, a pretty pure specimen of that mineral. The indubitable flexibility of the slab is its most remarkable feature. Dana states that "some of the West Stockbridge marble is flexible in thin pieces when first taken out." The slab in the possession of Mr. Holliday is about two inches thick, and is nearly as flexible as an equal thickness of vulcanised india-rubber.

Prizes for Art Workmen.—To encourage technical education in the design and execution of works of art in the precious metals, the Goldsmiths' Company have resolved to give the following prizes, viz.:—An annual prize of £50 for the best design for some article in gold or silver which, when manufactured, shall exceed 30 oz. in weight; an annual prize of £25 for the best model of some such article as aforesaid; and an annual prize of £25 for the best execution and workmanship of some such article as aforesaid. Also, three annual prizes of £25 each for (1) the best design, (2) the best model, (3) the best execution and workmanship of some article in gold or silver which, when manufactured, shall be less than 30 oz. in weight; and annual prizes of £25 each for the best specimens of (1) chasing or *repoussé* work, (2) engraving, and (3) enamelling in the precious metals. Originality is necessary to obtain either of the prizes for design, and no copy shall be the subject of a prize. The prizes will be awarded in November. It has also been decided to found a travelling scholarship of £100 per annum, to be awarded by the wardens to a student who has shown exceptional talent, and who shall have obtained a prize for design for three successive years, in order to enable him to study art in the precious metals on the Continent.

A New mode of Propelling Ships has been invented and patented by Mr. J. J. Allingham, of Hamilton-road, Everton. Mr. Allingham's idea is to make the waves, acting upon the hull, propel the ship; and this he proposes to do by the following contrivance. Beneath the keel of the vessel he would fix two oblong steel frames, each fitted with two sets of blades to open and shut crosswise. One frame he would secure to the forepart, and the other to the stern. Both the frames would be fixed at an angle. When the vessel rises in the sea the pressure of the water upon the frames would of necessity force her forward; and when she sank the blades opening would form the opposite angle, and the onward motion would thus be continued. The apparatus would also have the effect of steadying her. When she rolled over to the right, the blades on the left side of the frames being shut, the frames would tend to bring her back to the perpendicular and when she rolled to the left the closing of the blades on the right side would have a similar effect. The angle of the frames would have to be increased or lessened according to the state of the weather. To stop the vessel it would be simply necessary to close the blades in the frames. It will be seen that the action of the appliance depends entirely upon the motion of the waves; but at sea it is rarely the case that there is not a sufficient motion in the water to raise a vessel several feet. The inventor believes that the apparatus would be a sufficient propelling power for ships not required to travel at a great speed; but would supply ships with a limited quantity of rigging as auxiliary power, and to provide against accident. The working of the invention was shown recently at Canada Basin, Liverpool, upon a model ship seven feet in length. The little vessel held its way against the tide, and even in comparatively calm water travelled at a considerable speed.

Spontaneous Combustion.—The *Scientific Press*, an American paper, reports that, in March last, a Detroit druggist, assisted by two gentlemen, resolved to make a number of experiments with regard to spontaneous combustion. They first took a piece of cotton cloth, which had once formed part of a sheet, and which had been used until quite threadbare, and smeared it with boiled linseed oil. An old chest was placed in the loft of a store-room back of the drug store, a piece of zinc over it, another piece under it, and then the chest filled with paper and rags, and this particular piece of cloth placed in the centre. Although the room was not a light one, and the weather cold, in eight days there was such a smell of fire about the trunk, and the chances were so good for a conflagration within it, that the contents were emptied. An examination showed that the fibre of the oilcloth had untwisted and shrivelled up, and that the rag looked as if it had been held too near a hot blaze. In April, when the rays of the sun were stronger, a pair of painter's overalls, literally covered with paint and oil, were rolled up, a handful of pine-shavings placed inside, and these were placed next to the roof-boards of the loft. The experiment was not a week old when, during one warm afternoon, a smell of smoke alarmed a workman in the next room, and he found the overalls burning. During the hot weather of August, a handful of old cotton rags, in which two matches were placed, but which were not smeared with oil or other matter, were shut up in a tin box, and hung up in the loft, a window allowing the afternoon sun to shine directly on the box for several hours. On the fourth day the box was taken down to see how the experiment was progressing, and the contents were found to consist of nothing but a puff of black cinders. The old chest was again filled this time with the contents of a rag-bag, some portion of them being smeared with benzine. The trunk was placed in an outhouse. One day the family came home to find a few ashes marking the place were the trunk stood, while the bricks above and around were badly stained with smoke.

Mechanical Shorthand.—The taking down a discourse by mechanical means is one of the standing problems amongst mechanicians. The bulletin of the Société d'Encouragement of Paris declares that the object has at length been effected, and that an apparatus is now regularly employed in stenographing the discourses before the society, which answers its purpose completely. M. Gensoul, the inventor of the apparatus, has adopted the novel mode of striking simultaneously all the letters of each syllable. The apparatus is thus described in the bulletin above-named:—It is composed of three small key-boards, each containing four double keys, and the combination of these represent all the consonants and vowels. The key-board to the left, which occupies the four fingers of the left hand, is devoted to the initial consonants of syllables, while that on the right hand expresses the final consonants. The central key-board, which is played by the two thumbs, is devoted to the median vowels. In addition to the above there are two supplementary keys, which are played by the wrists; one of these keys marks *e* mute. The operator touches at once all the letters of a syllable, just as a musician strikes all the notes in a chord on a piano, and this action takes no more time than the emission of the voice which produced the syllable. The mechanism of the apparatus is so arranged that each key brings down a type, which, after being inked by a pencil, impresses its mark on a band of paper, moved forward by clockwork, but which is held in position for an instant at the moment each type is ready to make its impression. The marks are, therefore, as rapid as necessary, and they are made equally perfect, however fast the apparatus is operated upon; they represent the stenographic discourse in all its integrity. With the knowledge of the characters employed, the bands may be read off at any time with facility. The mechanical stenography causes no sensible fatigue of mind or body, but an operator requires some months' practice before he can keep up with a speaker. In conclusion, the report adds that such an apparatus might be placed in communication with a telegraphic apparatus, and a speech thus telegraphed and printed at any distance with the same rapidity that it is traced on the band of the apparatus.

Burnt Iron and Steel.—Mr. M. Williams has given the result of some inquiries into the causes which produce burnt iron and steel to the Chemical Society. After some remarks upon the physical characteristics of the damaged materials, he asserts that he has found in all the samples of iron which he has subjected to examination particles of black oxide, more or less abundantly distributed throughout the mass. These are, however, absent in burnt steel. The method which he suggests of quickly deciding this question is to take a small quantity of fresh borings or filings, and to cover them with some diluted nitric acid. As the iron dissolves, the free oxide separates and remains suspended in the liquid, rendering it dark in colour. These particles shortly disappear, and are thus to be distinguished from separated carbon. No such discoloration takes place with good irons. The cause of the burning of iron he explains as follows:—As soon as the small quantity of carbon is removed from the heated mass by oxidation, this process extends to the iron itself, not only upon the surface, but into the interior. The higher the temperature, and the longer the exposure, the greater is the quantity of carbon necessary to protect the iron; and this, in the author's opinion, is the reason of the failure to produce merchantable iron by the Bessemer process. The high temperature and great exposure of the metal in the converter to the air causes oxidation of the iron to take place even in the presence of considerable carbon. The best iron, therefore, should be that in which carbon is brought to the lowest possible proportion, without oxidation of the iron. Burnt steel the author considers to be steel which has, by re-heating, lost some of its carbon by oxidation, and by sudden solidification has had the resulting carbonic oxide imprisoned in the interior of its mass. The well-known permeability of iron for certain gases renders such a process not difficult to understand. The structure and properties of "burnt iron and steel" are therefore "caused by the presence of intermingled particles of combustion products breaking the continuity of the metal" The carbon is burnt in the case of the burnt steel, the iron itself in the burnt iron.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

May 8th.—"On the Use of a Revolving Rabble in the common Puddling Furnace." By F. A. Paget, Esq., C.E.

May 15th.—"On a New Mode of Utilising Sewage Precipitates." By Major-General H. Y. D. Scott, C.B.

May 22nd.—"On Painted Metallic Hangings for Mural Decoration." By G. Clark, Esq.

CANTOR LECTURES.

The Fourth Lecture, on "Silicates, Silicides, Glass, and Glass Painting," by Professor Barff, was delivered on Monday evening, April 29th. The remaining lectures will be given as follows:—

Lecture V.—Monday, 6th May.

Styles of Glass Painting—Illustrations with the Electric Light, illustrative of the Nature of Colour.

Lecture VI.—Monday, 13th May.

Method of Polishing and Silvering Plate-glass—Manufacture of Glass Tube and Moulded Glass—Embossed Glass—Devitrification—The Process of Applying Photographs to Enamels and Porcelain—Mosaics—Decorative Painting on Opaque Glass.

Lecture VII.—Monday, 20th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose have been issued.

Members are particularly requested to note that an ADDITIONAL LECTURE has been arranged. It will take the place of that hitherto announced as Lecture VI., which will thus become Lecture VII. The tickets for Lecture VI. will not be given up, but will be retained for admission to Lecture VII.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS, 8.** Cantor Lectures. Prof. Barff, "On Silicates, Silicides, Glass, and Glass Painting."
Royal Institution, 2. General Monthly Meeting.
Social Science Association, 8. Mr. P. H. Holland, "The Civil Responsibility of Employers to those Injured in their Employ."
Entomological, 7.
British Architects, 8. Annual Meeting.
Medical, 8
Royal United Service Institution, 8½. Mr. William Stirling Lacon, "The Rule of the Road at Sea."
London Institution, 4. Professor Bentley, "Elementary Botany."

Tues. ...Civil Engineers, 8. 1. Renewed discussion, "On the Construction of Heavy Artillery." 2. Mr. F. A. Abel "Explosive Agents as applied to Industrial Purposes."
Royal Institution, 3. Mr. Edward B. Tylor, "On the Development of Belief and Custom amongst the Lower Races of Mankind."
East India Association, 8. (At the House of the Society of Arts.) Mr. R. H. Elliot, on "What the True Interests of Manchester really are in India."
Pathological, 8.
Biblical Archæology, 8½. 1. Mr. William Simpson, "On Underground Jerusalem, more particularly the Plateau of the Haram es Shereef." 2. Mr R. G. Jenkins, "Some Observations upon the so-called New Moabite Stone, described in the *Times* of 26th January, 1872." 3. Mr. Solomon M. Drach, "Some Mathematical Observations on the Dimensions of the Base of the Great Pyramid, and the Royal Coffer."
Zoological, 9.

Wed.....**SOCIETY OF ARTS, 8.** Mr. F. A. Paget, "On the Use of a Revolving Rabble in the common Puddling Furnace."
Geological, 8. 1. Mr. S. J. Whitnell, "Notes on Atolls or Lagoon-islands." Communicated by Prof. N. S. Maskelyne. 2. Mr. J. R. Dakyns, "On the Glacial Phenomena of the Yorkshire Uplands." Communicated by Prof. Ramsay. 3. Rev. William Bleasdell, "On Modern Glacial Action in Canada" (second article). Communicated by Prof. J. W. Dawson. 4. Mr. D. Macintosh, "On a Sea-coast Section of Boulder Clay in Cheshire."
Royal Literary Fund, 3.
Royal Society of Literature, 4¼.

Thurs...Royal Institution, 3. Prof. Tyndall, "On Heat and Light."
Antiquaries, 8½.
Mathematical, 8.
London Institution, 7½.

Fri.......Astronomical, 8.
Royal Institution, 9. Mr. Nevil Story-Maskelyne, "On Meteoric Stones."
Quekett Club, 8.
Royal United Service Institute, 3. Captain C. W. Wilson, R.E., "Our own Maps and those of other Countries, and their Use in War."

Sat.......Royal Botanic, 3¾.
Royal Institution, 3. Mr. R. A. Proctor, "On the Star Depths"
Geological Museum, 8. Swiney Lecture. Dr. Cobbold, "On Geology."

Journal of the Society of Arts.

No. 1,016. Vol. XX.

FRIDAY, MAY 10, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 8th, 1872; John Jones, Esq., of Middlesborough, in the chair.

The following candidates were proposed for election as members of the Society:—

Cheston, Chester, jun., Manor-offices, West Hackney, N.
Christie, Hector, Langcliffe-place, Settle, Yorks.
Fletcher, Rev. T., D.D., Park-house, Hampton-wick, S.W.
Howell, Charles A., Northend-grove, Northend, Fulham, S.W.
Jones, George Hugh, Buxton-college, Grove-house, Forest-land, West Ham, E.
Lofts, Henry, 99, Mount-street, Grosvenor-square, W.
Pellegrin, Louis Antoine Victor, 36, London-street, Fitzroy-square, W.
Render, Frederick, Beech-house, Etchels, near Handforth, Cheshire.
Wybrow, William, Ravensbourne-lodge, Bromley-common, Kent.

The following candidates were balloted for and duly elected members of the Society:—

Anderson, Sir James, F.S.S., 16, Warrington-crescent, W.
Barrington, Richard, 48, West Abbey-road, Kilburn, W.
Bennett, Thomas, 70 and 71, Turnmill-street, Farringdon-road, E.C.
Bentley, Charles S., Hazleville-villa, Sunnyside-road, Hornsey-rise, N.
Butler, Rev. Henry Montagu, D.D., Head Master of Harrow School.
Chinery, D., F.R.G.S., Bosworth-lodge, Willesden, N.W.
Kenwick, George, 6, Percy-villas, Campden-hill, Kensington, W.
Pickering, John, 28, Springfield-mount, Leeds.
Pritchett, George James, New Adelphi-chambers, John-street, Adelphi, W.C.
Sandars, Samuel, 28, Gloucester-place, Hyde-park, W.
Townend, Edward, the Nooke, Cullingworth, near Bingley, Yorks.

The paper read was:—

ON THE USE OF A REVOLVING RABBLE IN THE COMMON PUDDLING FURNACE.

By Frederick A. Paget, Esq., C.E.

Statistics of British Puddling.

There are more than seven thousand seven hundred puddling furnaces erected in Great Britain. As each furnace costs about one hundred and thirty pounds, the whole number represents an invested capital of more than one million of pounds sterling. Supposing that only six thousand five hundred of these are actually at work, and each turning out only seven hundred tons per annum, this would mean an annual production of more than four millions and a half tons of puddled bar. At the present average price of £7 10s., this represents a money value of nearly thirty-four millions sterling. At each of these furnaces two puddlers and two underhands or assistants are employed; thus making up an army of twenty-six thousand men at work, for twelve hours daily, at the most laborious and arduous occupation in the whole range of manufacturing industry. For each ton of puddled bar at the very least an equal weight of coal is consumed. This amount is notoriously exceeded in almost every puddling furnace, except Mr. Siemens', by more than twenty-five per cent. We may, therefore, safely assume that the total weight of fuel consumed is at least equal to that of the iron produced; or four millions and a half tons of coal.

Now if, without in any way altering the mode of firing of these furnaces, we could, say by any mechanical aid, accelerate the puddling process by only 25 per cent.; that is to say, if the four and a half millions of tons of puddled bar could be produced in nine months instead of twelve, one quarter of the four millions and a half tons of coal would be saved. At the present price of coal of £1 per ton, this would amount to a saving of £1,137,500; the puddlers themselves being also allowed to earn in the nine months the same amount they would otherwise make unaided in twelve; and no regard being had to other advantages to the masters and men.

Puddling by Unaided Human Labour.

The process of hand-puddling in the ordinary reverberatory furnace used for the purpose can be divided into four stages:—

1st. Melting. The pig-iron, together with a proportion of hammerslag, is charged on the bed, previously lined with either puddling mine, bull-dog, or both, and plastered over with wet hematite ore. As the cast-iron gets softened by the heat, it is broken into smaller pieces, and stirred up with the cinder. This is done by the hand rabble, which has to be continuously moved over the whole surface of the bed. This stage lasts about 35 to 40 minutes.

2. In the second or boiling stage, the iron has to be violently rabbled in order to bring it into a state of ebullition or boiling. In this operation the puddler has to exert himself very considerably, working the rabble to and fro and from side to side over the bed.

3. "Coming to nature." The iron now begins to thicken and to get tougher and tougher; the "boil" stops, and it "comes to nature," or begins to assume the consistency of heated wrought iron. The puddler works it in this pasty consistency from side to side of the furnace, separating it into different pieces.

4th. Balling. The wrought-iron is now collected into balls, varying in weight and size, ready to be taken out of the furnace to be hammered or squeezed into blooms. This stage takes about ten minutes.

In the ordinary mode of puddling, should the pig-iron get entirely melted on the bed, it is a disastrous circumstance for the puddler. The bath of metal, with its even surface hidden under the lighter cinder, offers very slight surfaces of contact to oxidation. To meet this, he is forced to very violently exert himself in stirring up the metal; and he is obliged to shovel in quantities of hammer-slag, cinder, or other sources of oxygen, which cool down the metal and lower the quality of the product.

There can be no doubt that an unaided man's strength is insufficient for this labour. Dr. Percy, whose opinion as a metallurgist, chemist, and medical man is universally known to be of the very highest importance, states that the majority of puddlers "die between the ages of 45 and 50 years; and, according to the returns of medical men to the Registrar, pneumonia, or inflammation of the lungs, is the most frequent cause of their death. This is what might have been anticipated from the fact of their exposure to great alternations of temperature under the condition of physical exhaustion." They are also liable to cataract, induced by the intensely bright light of the furnace; and the forearms and faces of some puddlers are also often scorched to a bright red tinge in a curious way. As Dr. Percy observes, "it is not surprising that puddlers should manifest a growing disinclination to bring up their children to this occupation, to which, as a general rule, their strength ceases to be equal beyond the age of 45 or 50." On the puddler more than Adam's curse seems to have fallen—copious drops transpire, not merely from his brow, but from all his almost naked body, while engaged in what Mr. W. Bridges Adams has termed "the absurdity of setting a number of human beings to stir up a metallic pudding in order to throw off the scum."

Pig-Iron is Refined by Blast solely to relieve the Puddler.

As the energy of human labour thus has its natural limits, the present process of manufacturing wrought iron has to be kept as closely as possible within those limits. One of these means is that known under the name of "refining," or "fining," at least a portion of the pig-iron, before charging it into the furnace. A novice would naturally inquire why the metal to be puddled cannot be run directly from the blast-furnace on to the bed of the puddling-furnace, with the great attendant saving of fuel that would evidently result. This has in fact, been patented and timed more than once; but the work of puddling out the carbon is thereby so much increased as to be quite beyond unaided muscular power. On the contrary, the grey pig-iron from the blast furnace has to be melted up again and submitted to a blast on its surface from inclined tuyeres in a separate furnace. The metal is thus "fined" simply to quicken the ordinary operation of hand-puddling, at the same time somewhat relieving the puddler in his arduous labour. By it alone very grey pig, containing much uncombined carbon, can be puddled by hand into a good quality of wrought iron. The Bessemer process proves that a blast of air, injected through molten pig-iron, only gets rid of the silicon and carbon; so that we cannot suppose that the incomplete process of blowing air upon the top of the bath of molten iron can do more in the way of purifying, or that the metal thus treated really deserves the term of "refined."

Mr. Truran states that the consumption of coke in the finery furnace is from 4 cwts. to 8 cwts. per ton; that the "loss" is about ten per cent., and that an engine of 16-horse power is required to keep up blast sufficient for a production of one hundred tons weekly. When to this are added interest on first cost of these furnaces; their wear and tear; the labour, &c., it will be seen that this process amounts to a considerable item in the ironmaster's books. The total cost can, in fact, be estimated at from ten to fifteen shillings per ton.

The Charge is Fused in the Puddling Furnace solely to Relieve the Puddler.

We have seen that the pig-iron to be puddled is charged cold on the bed of the furnace, where it is slowly melted down. The reason for this is to relieve the puddler in two ways. Taking from thirty to forty minutes in melting, and requiring from him comparatively less work, it gives him time to rest from his previous terrible exertions; while the surface of the pig-iron, as it is melted down and broken up, gets partially decarburised. On the other hand, if the fusion of the pig-iron be too slowly effected, great scaling occurs, with an unnecessary increase of "loss."

Now let us suppose a charge that would give us 400 lbs. of puddled bar. This, in Staffordshire, for instance, would take from one hour and twenty-five minutes to one hour and a half of the time of a furnace. Of this time, from thirty-five minutes to forty minutes will be taken up in melting the cold metal on the bed. Let us further suppose that this heat of 400 lbs. of puddled bar took in all ninety minutes; forty minutes of which were employed in melting. According to an assumption greatly in favour of the furnace, it takes an equal weight of coal to puddle an equal weight of iron. In that case more than 177 lbs. of coal will have been burnt in merely melting up. Now only a very extravagant cupola would take more than 50 lbs. of coke to do this work; and the price of the best Durham coke is only about 24s. at the ovens. Mr. Jonathan Ireland, of Manchester, states that in his cupolas, only 1¼ cwt. of coke per ton of iron is burnt when melting all day long, and that the average loss of metal is 5 per cent.—being with Cleveland iron a little more. It has been found in the Bessemer process that the melting cupola rather adds to than diminishes the carbon. An advantage in this case, this would, in the puddling furnace, much increase the labour; and without the application of power to the rabble, iron melted in the cupola would be as impracticable as that run from the blast furnace. It is, in fact, well known that the reverberatory furnace used in puddling is a very bad melting apparatus. Another advantage of the cupola is that it keeps back the sand and pebbles that too often injure by their silicious contents the nature of the slag in the puddling furnace.

Puddling Machines with Oscillating Rabbles.

The difficulties attending hand-rabbling are therefore such that thinking minds have long attempted to find a remedy applicable to existing furnaces. The first of these attempts was made by Herr Schafhäutl, now Professor at Munich, whose name is well known to metallurgists by his puddling "physic." Professor Schafhäutl, as long ago as 1836, actually puddled iron with his machine at the Tividale Works, near Dudley. His leading idea was to take the common puddler's rabble, connecting it with machinery for giving it longitudinal and transverse motions imitating those when in the hands of the puddler. Professor Schafhäutl states that his machine failed to gain general acceptance not so much from mechanical causes as from lack of money. A similar plan was developed in France by Messrs. Dumeny and Lemut. Their machine has been working since 1862 in works at St. Dizier of which they are the proprietors. A good many modes of oscillating the rabble in this way could be designed; and, accordingly, numerous inventors have appeared in this field. The more prominent of these are Messrs. Bennett (1863), Eastwood (1864), Griffith (1866), Whitham (1867), Morgan (1867), and also some others. Probably nearly a dozen double furnaces in England are being worked by machines of this class. There can be no doubt that they relieve the puddler; the application of steam-power necessarily allows the furnace and its charge to be increased, and the quality of the puddled bar is raised. Mr. G. Beard has stated at the Institution of Mechanical Engineers that he "had found the iron puddled by machine as good as that worked by hand when the pigs used with the machine were three shillings or four shillings per ton less in price than those used in hand puddling." At the same time, these machines are open to objections, amongst which the considerable first cost and wear and tear must figure. The bearings have a tendency to heat, and the gearing to break. Any hole in the bed, or anything too much obstructing the oscillating tool, often results in a break-down. As the iron thickens, it is also driven by the rabble to the sides of the bed. The oscillating rabble necessarily does not cover the whole surface of the bed, at any rate of an old furnace, and much is thus left to be done by the hand rabble. There is then the difficulty of using a rabble like this during the third stage of the process. When the iron "comes to nature," as the puddler feelingly terms it—from his encountering at the end of his rabble the tough, pasty, infusible mass resulting from the elimination of the carbon—the resistance to the machinery is so great and irregular that it must be stopped. Two different kinds of the most successful machines with oscillating rabbles were lately tried by the Committee on Puddling of the Iron and Steel Institute. According to the figures officially given, it appears that, in the one case, there was an interval of fifteen minutes between removing the mechanical rabble and getting the iron ready to ball; and, in the other, thirty-two minutes. During these intervals the puddler had to work with the hand-rabble on the iron while "coming to nature," or getting tougher and tougher, affording the greatest resistance and the hardest work. This mechanical difficulty also results in a greater "loss" in the furnace, especially with heavier charges than can easily be balled by hand. The oxidation of the heated mass before and during the balling stage goes on very rapidly. In favour of these and other machines it must, however, be borne in mind that more complete puddling, by getting rid of impurities, necessarily involves greater "loss" or drop in the furnace; but there is also less loss in rolling. Then, as regards balling, even in Mr. Danks's and Mr. Spencer's revolving furnaces, the smaller balls, required for small merchant bars and other uses, will have to be divided by hand.

THE REVOLVING PUDDLING RABBLE.

One of the earliest attempts (Hazlehurst, 1854) to puddle by machinery embodied the idea of a revolving rake, and this is stated to have been comparatively lately (Bayliss, 1866) revived in an experimental furnace, and with good results. As a rule, however, rotating rakes have been found to soon get clogged up with iron and cinder; while, even if successful in the fluid metal, the mere mechanical resistance would be most destructive as the iron "came to nature." A more refined mechanical idea would consist in simply giving the ordinary hand rabble a rotary motion, while still allowing it to be guided by the hand of the puddler. To Mr. Edward Hutchinson, of Messrs. Pease, Hutchinson, and Co., Skerne Iron Works, Darlington, belongs the merit of having first invented and experimented with the revolving rabble. His trials were very successfully carried out as long ago as 1865; being, however, relinquished during the same year, and without having been published in any way. Monsieur Dormoy, quite independently, took up the same idea, and has been perseveringly working it out since 1866.

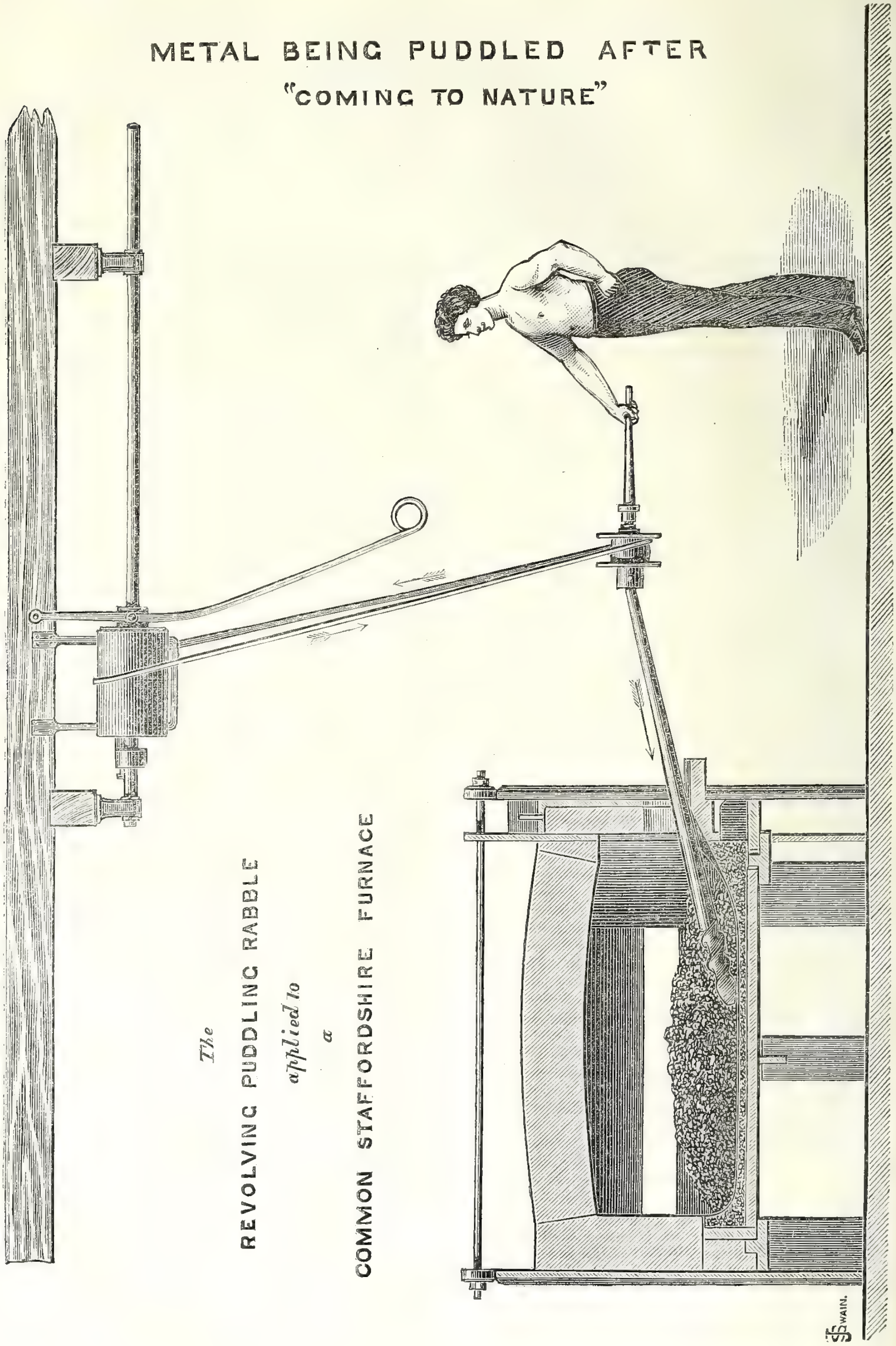
Any puddling machinery must be essentially simple and non-liable to get out of order by the roughest and most careless usage. This simplicity, required by the men, is also required by the furnace; the high temperature of which, with the attendant rapid current of air passing through, must not be interfered with. A glance at the accompanying illustration will render the whole apparatus intelligible. A common belt, driven from shafting about six feet above the furnace, rotates the sheave, loosely jointed at one end to the puddling rabble, and at the other turning on a pin held in the hand of the puddler. To prevent any jarring action to his hand. the pin he holds may be wound round with spun yarn or gasket, embraced by a leathern or india-rubber tube. The strap thus rotates the rabble; supports part of its weight like a suspension link; and acts as a universal joint; much as in the familiar instance of the rotating hair-brush. The belt must evidently adapt itself with ease to the great variety of positions which have to be taken by the tool in every part of the furnace; to the necessity for removal when too hot; and to the progressive changes in the metal. Mechanism could easily be applied to the rotating rabble in order to work it regularly to and fro; but this additional complication has not been found necessary. Its great speed—from 300 to 800 revolutions per minute for white pig, and from 800 to 1,000 for grey metal—is found to give it all the mechanical energy required. The end of one form of rabble, about four and a half inches in diameter, when revolving with 500 revolutions, necessarily has a speed at its circumference of nearly 600 feet per minute. On the other hand, the iron, even when boiling, is not thrown up. The centrifugal impulses are not sufficient to overcome the cohesion of the hot metal. The power required has been indicated by Herr Biedermann, now of Floridsdorf, near Vienna, at from one-quarter to one-half of a horse power per furnace per hour; but the draught would necessarily increase towards the end of the heat. There is no bearing near the furnace necessarily liable to get hot; no gearing to break on any sudden resistance; and the strap itself acts in its usual way as an admirable friction brake. It is difficult to imagine how the apparatus can come to grief in any other way besides breaking the strap. For such a case, a spare belt is kept hanging on the shaft; or the puddler could even merely go on in the ordinary way. If kept well greased, however, the belt lasts from three to four months without renewal. Any diminution in speed can be obtained by slightly relieving its weight off the belt—thus allowing more or less slip. On the other hand, any unusual resistance can be overcome by the puddler pressing the tool down on the belt. Simply by crossing the strap the rabble can be rotated from left to right, or *vice versâ* alternately, as required. The tools, in spite of their extra weight, are easily removed from the furnace by taking them off the strap by means of a hook on a light chain suspended near the furnace from the roof; and laying them on small trestles about 18 inches in height and width. The rabble can thus be changed in thirty seconds. There is no chance of the tool disturbing the fettling, as it merely rests loosely with its weight on the bed, just as in hand-working. Experience has shown that the revolving rabble involves no change either in the plant of the works or in the habits of the workmen; it could be adapted in a couple of hours to any common furnace; and the author has designed an apparatus that could be at once applied. The thing is also singularly cheap, as can be seen at the first glance: and cheap tackle—it can scarcely be called a machine—means also cheap repairs. The great question of wear and tear, only safely determinable by long usage under the most varied circumstances, is, indeed, often forgotten when examining a new machine.

Even at the very beginning of the heat, the greater command of puddling power has an important result. The "yield" is found to be greater as there is less liability of the pig-iron, while being melted in the furnace, getting burnt therein for want of regular stirring. But in one very important point it is more useful than any other known apparatus applicable to a common furnace. Even when the iron is "come to nature," the tool can be worked like a drill through the tough, pasty mass. The operation can be thus entirely completed if the mass has not to be balled. If balls have to be made only about ten minutes' work with the ordinary hand rabble has to be done at the end of each heat. Further, it is well known that the more the iron has been worked, and the better it has been puddled, the less is the necessity for forming it into well-shaped balls, as it is so easily kneaded under the hammer. It has everywhere been noticed, in France, Hungary, and Styria, where the revolving rabble has been used, that the balls produced were very close, withstanding remarkably well the shock of the hammer.

The ordinary rabble is only about $1\frac{1}{4}$ in. square. It consequently easily gets too hot, then requiring to be taken out. The rotary rabble, with a diameter of $2\frac{1}{2}$ in., and weighing about 80 lbs., lasts from a fortnight to one month; some have even lasted as long as six months, though this is exceptional. Should this tool get too much heated and take a slight bend, it can be straightened even while it is turning by slightly forcing the bent part against the side of the hole in the door.

As already pointed out, any saving in fuel would necessarily be in the direct ratio of the speed of the operation over that of hand puddling. With charges of even 800 or 1.000 lbs. of grey pig, the working of the revolving rabble only lasts from twenty to thirty minutes; with white pig, from ten to fifteen minutes. The metal is then in separate pieces, almost ready to be taken out. No pig-

METAL BEING PUDDLED AFTER
"COMING TO NATURE"



The
REVOLVING PUDDLING RABBLE
applied to
a
COMMON STAFFORDSHIRE FURNACE

iron, however much carburetted, or otherwise alloyed, has been able to withstand its action. Either soft fibrous iron, fine-grained iron, or steel, can be produced according to the wish of the puddler.

Mr. Hutchinson, in a letter to the *Iron and Coal Trades Review* of April 17th, states that, with his rotary rabble he "could puddle a heat of grey iron in an hour, and with very little labour on the part of the puddler." He considers "that, by the adoption of some such simple contrivance as this, in conjunction with the plan of working three shifts instead of two in the twenty-four hours," "a clear saving of ten shillings per ton on puddling could be effected, without the complete and immediate substitution by costly machinery of the puddling furnace at present in use." At present, the Cleveland puddlers finish only six heats per shift of twelve hours, or one heat of about four and a-half cwt. per two hours, instead of the one heat per hour cited by Mr. Hutchinson. Supposing that during the proposed shift of eight hours they turned out only six heats, or eighteen heats instead of twelve in the twenty-four hours, this would be equivalent to increasing the rate of production of the common puddling furnace by more than thirty-three per cent., or one-third. In other words, the same furnace, with the same amount of coal, would produce in eight months the same amount of iron it now turns out in twelve. This would be equivalent to a saving in coal alone of more than one and one-third million of pounds sterling per annum, without reckoning the gain in time.

A tool like this would do for the puddler what the slide-rest has done for the metal turner. While actually increasing the demand for his labour, the slide-rest has raised the metal turner from an over-worked drudge to a skilled operative, able to work at his trade from youth to old age. Even if the iron-masters were to use the revolving rabble merely to relieve their men, and without requiring a greater number of heats from them, they would gain:—

1. A great improvement in the quality of the iron produced.
2. A great diminution in the number of ruinous "cobbles" or "wasters."
3. The capability of working up very grey or also inferior kinds of pig, without using any "fined metal."
4. A diminution of loss in mill scale between the rolls.

Messieurs Paris, Guyot, and Huin, of St. Dizier, state that "the mere saving in waste iron would be sufficient to induce them to employ the apparatus." This is more especially the case when manufacturing special and merchant bars that have to be rolled from piles.

As already observed, the reverberatory furnace is notoriously a bad apparatus for melting. In melting for the Bessemer converters, for instance, it has been superseded by the cupola. For reasons adduced, the use of the rotary rabble should evidently be combined with that of a melting cupola. The men have sufficient command over the work to be able to overcome any extra carbon in the metal. In fact, if the metal be charged in a molten state, the heat can be completed in at the most half an hour or forty minutes. With thorough hand puddling, the "yield" has been found to be increased beyond the charge of metal when rich fettling has been employed, just as in Mr. Danks' furnace. Mr. C. W. Siemens, in his regenerative puddling furnaces, has also found the "yield" increased by the reduction of the fettling. Similar results are to be expected with an efficient aid to the puddler.

The true way to use this tool would, of course, be, not merely to melt the metal in a cupola, but to increase the charge, and with it the capacity of the bed, and to use a furnace with two doors. Double furnaces have often been tried; but they have been found impracticable with manual labour, from the self-evident cause that the work is so much increased. This portion of the subject, as it relates to furnaces that would have to be specially built, need not now be considered.

WHY MECHANICAL PUDDLING RAISES THE QUALITY OF PUDDLED BAR.

Perhaps the most important truth which has been lately elicited touching mechanical puddling is its effect in improving the quality of the puddled bar. Mr. Danks has worked up almost every kind of American and British pig metal with excellent results as to quality. Mr. Adam Spencer has in his revolving furnace produced excellent iron from Middlesborough metal containing two per cent. of phosphorus. As already noticed, experience with oscillating rabbles points to more or less improvement in the quality. Mr. Hutchinson, as we have seen, improved the quality of Cleveland iron with his revolving rabble. Monsieur Dormoy has puddled with success some old cannon balls the Turks left behind them at Temesvar, in Hungary, so white, and containing such a large quantity of arsenic as to be utterly intractable by the ordinary process; he has also operated at Zeltweg, in Styria, upon pig metal alloyed with copper and sulphur; upon the sulphurous pig metal of the Loire and that of the Moselle—the latter containing very large per-centages of phosphorus. In every case perfectly tough iron and steel, often rolled into the most difficult special shapes, have been produced. It is clear to the eye of the mechanic that all these otherwise very differing apparatus are alike in one particular,—that of more or less thoroughly stirring up the first broken, then molten, and lastly pasty, metal, together with the fettling on the bed. The infinite variety of chemical conditions formed by the different kinds of pig and fettling, under which these results have been obtained in England, the United States, in France, Styria, Hungary, and Austria, clearly debar us from searching for any recondite chemical cause; and it is evident that, whether this thorough stirring be obtained by exhausting manual labour, or by an imperfect oscillating rabble, or by a revolving bed, or by a revolving rabble, the mechanical effect must be the same. That is to say, the molten cast-iron has to be continuously stirred up in order, in the common furnace, to expose it to the oxygen entering at the door, and contained in the fettling; in Mr. Danks and Mr. Spencer's furnaces to the oxygen in the latter only.

There thus seems to be three principal reasons why mechanical puddling, or, in other words, good puddling, produces such good iron. The operation is (1) completely carried out; (2) the puddled bar is really homogeneous; (3) the multiplication of the surfaces of contact intensifies the purifying chemical reactions.

1. Very good iron is, of course, often produced by hand puddling; but it is a labour clearly beyond human strength required to be continuously exerted—day by day, and night after night—for years. In hand puddling there is hence notoriously a liability in the "underhands" shirking their arduous work, and producing bad iron. Mr. Menelaus, of Dowlais, has, in fact, publicly stated that in hand puddling "it was often found that portions of badly-puddled iron have been wrapped up in the ball by the puddler." This statement may be said to have been long ago distinctly proved by a process that underwent a thorough trial. Mr. Davis, of the Low Furness Iron and Steel Works, proceeded in the belief that an ordinary puddled ball really consists of a mixture of good and completely converted iron with "raw," or only partially converted, iron. On crushing such balls, when cold, under stamps, and grinding the pieces between rolls, they separated themselves into two distinct sorts, namely, lumps of wrought iron originally embedded in, so to say, husks of white pig iron. By re-heating and working up the portions thus demonstrated to be wrought iron, excellent blooms were produced; but the plan did not answer financially.

2. An assumption that the lumps of pig metal as usually charged into the puddling furnace could produce homogeneous iron without some stirring up could only be based on the supposition that they were all similar in

chemical composition and specific gravity. When, for instance, copper and tin are melted together to form brass, unless they are stirred up while being fused and run out, the metals separate, and arrange themselves according to their densities; and this action in the case of pig metal would only take place in a somewhat less degree on account of the slighter divergences between the different portions. As a matter of fact, "fined" iron does tend to rise to the top.

3. Few facts connected with metallurgy are more certain than that, while the carbon and silicon are easily oxidised out of pig metal, this is not the case with phosphorus and sulphur, the first rendering the iron cold short, and the second red short. Mr. Parry considers "that the effect of puddling is to reduce the quantity of sulphur to about one-third, and of phosphorus from one-fourth to one-fifth of that originally contained in the pig-iron." Mr. I. Lowthian Bell is of opinion that nine-tenths of the phosphorus are expelled in puddling. It is only reasonable to conclude that this beneficial effect increases with good hand puddling, and rises in proportion with the thoroughness only obtainable by a steam propelled rabble. The reactions between the metal and the fettling must be intensified by the increase of contact surfaces afforded. To take an instance. Black oxide of manganese was in 1835 advocated by Schafhäutl, and his recommendation has been confirmed by Caron's analyses, as an agent for taking up at least the sulphur. The difficulty attending it, however, consists in its not being fusible, and hence able to come into intimate contact with the iron. The powerful agitation afforded by the revolving rabble would, it is evident, just afford these large surfaces of contact. But without the use of more or less expensive "physic," it may be relied upon that inferior pig metal, thoroughly beaten up by this simple tool, will produce better iron, by at very least five shillings per ton, than when the unaided and easily-fatigued human arm is employed.

DISCUSSION.

Mr. Botly asked if the principle described by Mr. Paget was the same as the patent process about which so much had been heard lately, and which a deputation went to America to see. From all he had heard he thought that was a great improvement in the manufacture of iron, inasmuch as it tended to produce that toughness in the material which, as all who were in any way acquainted with the iron trade knew, was a great desideratum in wrought iron; indeed, without it, it was impossible to make good steel. From the philanthropic point of view also this process appeared to be a great recommendation, and everything which would tend to increase the duration of human life by lessening the immense labour now required in the intense heat of a puddling furnace, must be hailed with great satisfaction.

The Chairman said he should like to say a few words on this subject, though not in his capacity as chairman. He had listened to the paper with very considerable interest, because the iron trade at the present time was giving a great deal of attention to the subject of mechanical puddling. With regard to the number of puddling furnaces, he thought Mr. Paget had rather under-estimated them than otherwise, and his estimate of 400 million tons of puddled bar was not over the mark. The ordinary puddling furnace had, with one or two minor exceptions, undergone no improvement, but was just the same as it was turned out from the hands of Cort many years ago, which he thought was a disgrace both to the iron and engineering trades. That might have arisen from the fact that engineers and others thought iron masters did not want mechanical puddling; and, again, the men as a rule had not shown themselves very much in favour of any improvement. In fact, when any improvement was proposed which tended to lessen the labour in puddling, the men always claimed to have the whole advantage, requiring an extra price for puddling, and they generally managed to defeat all the efforts of inventors by their obstinacy and indisposition to give any new plan a fair trial. Up to the present time they had had to undergo the most arduous labour that could be performed, and yet the men were indisposed to co-operate with inventors in diminishing that labour, and, he must say, discouraged them very much in every respect. Dr. Percy and others had said that puddlers did not live very long, but he thought there were other other causes which tended to weaken their physical powers than those which belonged to puddling proper. It was generally understood that puddlers were rather free livers, and, as he had himself seen a great many old puddlers, he thought here must be some reason besides the nature of their occupation why a good many of them dropped off early. Anyone minutely acquainted with iron works knew that puddlers, as a rule, were a very intemperate class of people. The puddling process had gone on for many years without the slightest successful attempt to improve it, but recently ironmasters had had to face this difficulty, that the production of pig-iron could be increased to an almost unlimited extent, new fields having been opened in many parts of the country, but the power of producing finished iron was limited to the number of puddlers available; and though the demand for iron had gone on increasing of late years, the iron manufacturers had not been able to manufacture puddlers; they had plenty of material to work, but could not find men to work the furnaces, and hence it became quite evident, that unless some means were provided for increasing the output at the forges, very great difficulty would have to be encountered. The iron trade was, at the present time, looking upon all these improvements of the puddling process with very great favour, instead of giving inventors the cold shoulder, as formerly, and saying that the rule of thumb would do for them. Mention had been made of the revolving puddling furnace of Mr. Danks and Mr. Spencer, but these differed altogether from the ordinary puddling furnace, being more like an American churn; and in order to put up these new mechanical furnaces of Mr. Danks and Mr. Spencer it would be necessary to reconstruct the works entirely. Moreover, these furnaces were calculated to work 10 cwt. or a ton at a time, so that probably a large number of firms engaged in the manufacture of iron would find it inconvenient to take up this new form of mechanical puddling. Large masses of iron were more suitable for the production of rails and ships' plates, but for merchant iron, bars, and the numerous sections of iron used for smithing, he did not think it would be found that the large furnaces were so convenient. He believed it would be found that this mechanical rabble would be very useful to iron manufactures in lightening the labour of the puddlers; and one great advantage was, that it could be adapted to the existing furnaces with very little expense. Mr. Yates, who was present, had paid a great deal of attention to this subject, especially to the lining of puddling furnaces, rotating vessels, and so forth, and he was sorry he had not given the meeting the benefit of his experience.

Mr. Yates said he had not spoken earlier, not from any mock modesty, but simply because he was a practical man and not accustomed to speech-making. For the last ten years he had been occupied with this matter, and had taken great interest in it, and should be very glad indeed to see all the good effects realised which were hoped for. He had had much pleasure in hearing Mr. Paget, because he had described a process which he thought might prove a stepping-stone to what he desired to see—general mechanical puddling. His own attention had been principally given to revolving furnaces and the differences attending their use. The principal of these, as everybody who tried them discovered ten years ago, was connected with the lining of the furnace. He thought of a great many things, and at last the idea occurred to him, that as anything heterogeneous damaged the quality of the iron, it would be desirable to have something homogeneous; and he believed the result would be that no lining at all would be required, but that the furnace itself would be made of metal, and would be able to sustain the heat and the stress put upon it. Such was the hope he entertained, and he was happy to say that he was rather fortified in it by the opinion of some of his friends.

Mr. Jeavons (of Jeavons and Co., Millwall) said he would simply give his own experience of the revolving rabble. The first trial he had took place at the Millwall Iron-works, about seven o'clock the previous evening. He was proud to say that the heat was worked in a much shorter time than usually taken; that everything went straight forward; not a single hitch, although started in the dark, and everything gave perfect satisfaction. The yield of iron was good, the quality was very good, and the time much shorter than was taken to work the iron with the hand. He had no doubt that when the machine was put to a proper test, with suitable iron and under suitable circumstances, it would be a very great acquisition to the iron trade. He had no doubt that he should soon be able to speak much more sanguinely about it than he did then; he did not see anything approaching to a failure, and on a future occasion he should be glad to give an account of the experiments at his works. He concluded by inviting gentlemen to visit his works and see the machine at work.

Mr. Paget, in replying, said Mr. Botly was quite correct in insisting on the necessity for toughness in iron, and it could only be attained by good puddling, which eliminated the sulphur and phosphorus from the metal. There could be no doubt of the philanthropic value of such a process as he had described, because it would exert very little strain indeed on the physical powers of the workman. Only the previous evening, in company with Mr. Jeavons, he had seen a gentleman aged about 60, without removing either his hat or overcoat, bring a charge "to nature" in about fifteen minutes, which showed the work was not very laborious. The figures he had given were the results, he believed, of the Chairman's own industry, though he had taken care to keep them as low as possible, in order to avoid any danger of exaggeration. There was no doubt that the puddlers were generally opposed to the introduction of machinery, but he did not think this was much to be wondered at, considering the nature of the attempts that had hitherto been made in this direction. Danks' did away with the puddlers and the old furnaces together, and, therefore, it was no wonder the men did not like it: and the other mechanical rabbles which he had described were unable to deal with the iron when it "came to nature," and consequently left the hardest part of the work to be performed by the puddler's unaided energies as before. To Mr. Hutchinson belonged the credit of having first experimented with a revolving rabble, but by his own account it must have been a very uncomfortable affair, and have knocked the men's knuckles about considerably, as it had not an elastic handle or loose joint. Puddlers, no doubt, had the reputation of being addicted to drinking, but when it was considered that they worked twelve hours at a stretch in such an intense heat that they often had to wring the perspiration out of their linen, a great deal of allowance ought to be made for them. They were really obliged to drink something or other, though many of them, no doubt, did not choose the most desirable beverage. The Chairman, who was a distinguished member of that Iron and Steel Institute, which had spent a great deal of time and money in investigating the merits of Mr. Danks' furnace. Naturally he was rather prepossessed in its favour, but from the figures published by the Iron and Steel Institute, it appeared that this furnace required about 27 cwt. of coal for every ton of iron produced, which was more than some ordinary furnaces consumed. Therefore, if you could obtain a means by which the operation was accelerated, so as to save 30 or even 25 per cent. of fuel, you had a more economical apparatus than Mr. Danks'. The size of the furnace was a totally distinct question; but common furnaces could be built to puddle 10 cwt. or a ton at a charge with the revolving rabble, and they were actually in existence in Austria. The fact was, this apparatus was so very simple, and gave such command over the rabble, with so little fatigue, that the puddler was able to search out every corner of the furnace. A speed at the circumference of the tool of 1,500 feet per minute was readily attained, which formed a most efficient and powerful stirring apparatus, and he thought he had given pretty good reasons for holding that puddling was simply stirring, and that thorough stirring was good puddling

The Chairman said he wished to correct one mistake which Mr. Paget had fallen into with reference to the consumption of coal per ton of iron produced in Danks' furnace. The Commissioners, when in America, were only able to get the furnace to work one shift, that was 12 hours out of the 24; whilst in England they were worked continuously, one shift following the other. The Commissioners who went out had to keep the furnaces alight during 12 hours without getting anything out of them, so that it increased the consumption of fuel very considerably. He had very much pleasure in proposing a vote of thanks to Mr. Paget for his valuable and interesting paper.

The resolution having been carried the meeting separated.

Mr. Jeavons stated that he would be glad to show, at the Millwall Iron-works, the working of the rabble to any gentleman who would like to see it in actual operation.

At the close of the meeting the secretary called attention to some photographs that were hung round the room, lent by Mr. J. Gerson, of Rathbone-place, Oxford-street. These photographs, which will remain up for the inspection of the members for a week, are the production of the Berlin Photographic Company, and are reproductions of celebrated German paintings, both ancient and modern. They are remarkable for their great size and for the clever manipulation displayed.

INDIA COMMITTEE.

A Conference was held on Friday, April 12th, Sir Donald McLeod, C.B., K.C.S.I., late Lieut. Governor of the Punjaub in the chair, when the discussion was resumed on Mr. Frederick Campbell's paper "On India as a Field for Private Enterprise," read March 8th (see *Journal*, pp. 329 and 417).

Mr. Hyde Clarke said the subject of the paper read by Mr. Frederick Campbell was of such great importance, that he was sure all would be convinced that it was well deserving of the more extended consideration which could be given that evening. It was a matter of great congratulation that the interest in that important question had so much progressed of late, and they were very much indebted to Mr. Campbell for bringing it before them in such a hopeful way. It was true that Mr. Campbell, in considering the topic, had confined himself more particularly to one district, and had viewed that district with a tendency to *couleur de rose*. Nevertheless, it was satisfactory to look back and observe the progress which had been made since the question was introduced in the House of Commons, at his (Mr. Clarke's) suggestion, in the year 1858. At that time they were told by the representative of the government—the Secretary of the Board of Control—in resisting Mr. Ewart's motion, that there was not a space of 100 feet square, available for the purposes of cultivation, to be found in the whole of the hill or upper districts of India suitable for

European occupation. On the present occasion, however, they had accounts from eye-witnesses, persons who had taken an actual part in the development of the trade and agriculture, testifying to the suitableness of this field for the enterprise and skill of Englishmen, and assuring them that it was capable of wide extension and development. Satisfactory as had been the advance of information on this subject, it was a matter of regret to reflect that, notwithstanding all the promises which had been made by the government of India in respect to the occupation of the hill regions, those promises remained to a large extent unfulfilled. To take only one district to which reference had been made in the first portion of the discussion, the district of Darjeeling, here it was twelve years since they were promised that the cantonments should be extended, so as to provide accommodation for a larger body of English troops; but so little had been done that even now the official report on the works was that they were "still in progress." Then, in regard to the railway, after long discussions and considerable investigation, the claim of the East India Railway to construct a branch of 180 miles, which was to have given through communication from Darjeeling to Calcutta, was rejected, and the preference given to another scheme, which could afford no such advantages as the route in question. So, if they examined the subject generally, they would find that there had been a lamentable falling off on the part of the government. And yet it was only by the government leading in such a matter as this that progress would be obtained for private and independent enterprise. The effect that a certain number of English troops placed in the hill districts would involve, for instance, would be most important in encouraging private European enterprise. Looking at Darjeeling, they must attribute its beginning to the circumstance that there was a small English population planted there, which had been the cause of the extension of enterprise upon which they now congratulated themselves. Much more might be done in this way, if the government would give that moral assistance which was not in the nature of an artificial or objectionable bounty, but which would greatly accelerate the advancement of the trade of the district. With such small materials much had been done at Darjeeling, and that, too, chiefly by retired officers. A permanent tea district had been formed; the cultivation of the Terai had been largely extended; a numerous European population had been gathered there, the nucleus of a reserve force. In considering the question of the English settlement in India, it was necessary to disabuse the mind of some prejudice. They had been told that India was not a place which could compete for English immigrants in comparison with Canada; and nobody in his senses would think of proposing India in rivalry with Canada. Canada is a country easily accessible, where the rough labour of persons without capital can be turned to account. But there are other places besides Canada to which emigrants betake themselves, and reaching which, they encounter heavier charges and greater inconvenience—colonies like these of Australia, New Zealand, and South Africa. These persons are generally in possession of some portion of capital, which they turn to account in the enterprise, not differing in any material degree from those required in India. For that class of emigrants—the class of small capitalists—there is every encouragement in India, as, for example, in the tea plantations of the north, and the coffee plantations of the south. If success had followed the efforts of English enterprise in the development of these branches of trade, why not in many others? Of course there were difficulties which would naturally suggest themselves to practical persons who were not so sanguine as Mr. Campbell; but if the English settlers were liable to the incursions of Looshais, or the uprisals of Kookas, there were similar difficulties to be met with in entering upon any new field of occupation, and there had been something much worse in some of the best of the colonies, as for instance, the insurrections of the Maories in New Zealand, and the Kaffir wars in South Africa. Therefore, he thought, that when they came to examine carefully the objections which had been raised to the English settling in India, and compared them with the actual facts, they would see that there was no insuperable difficulties in the way of making India a field for the enterprise and energy of Englishmen; but that, on the contrary, there were many circumstances that were calculated to favour it. Even the fact of a numerous native population was no obstacle, for it provided an ample source of manual labour at a cheap price. Yet cheap labour had been advanced as an objection against English settlement, as if the English settler were to be dependent upon the expensive aid of his fellow countrymen, and must ignore the presence of natives ready and willing to act, and in many cases with natural capacities which enabled them to readily adapt themselves to the directions of others. This was, in fact, the advantage of Natal with Kaffir labour, of New Zealand with Maori labour; and Fijians were being taken to Queensland. In Natal Indian coolies were introduced, but the coolies were just as available in India itself. Without, therefore, indulging in too hopeful a view, or without cherishing any anticipation of vast profit, surely enough had been shown to prove that India would present a remunerative field for private enterprise? All that was wanted to secure success was the exercise of discrimination and common sense. Mistakes in the selection of districts would doubtless be made. They were made in Australia, where there had been, in several instances, a moving of the population to fresh centres of more promise. Even where the place of settlement had presented moderate advantages, it had, nevertheless, by the operation of a perfectly natural law, been abandoned on the discovery of a better site. India would not differ from other lands in this respect. With *primâ facie* reason for believing that the immigration of English settlers in India would prove successful, they would be justified in urging the government to offer encouragement—not perhaps by offering bounties or by giving grants of land, but by diffusing information, by abandoning the systematic discouragement to immigration, and by the facilitation of the intercommunications. It was quite true that, in view of the relations of the British government to the populations of India, an indiscriminate influx of Europeans would not be an unmitigated advantage. It must be admitted that much evil has sometimes arisen in the great centres of population—particularly since the opening of the Suez Canal—by the presence of the scum and refuse of Mediterranean seaports. The influx of such as these had, without a doubt, been a source of great difficulty to the whole country, as causing conflicts with the natives and embarassment to the government. But the immigration of settlers would be of a very different kind, and there were the best reasons of State policy and natural interest why it should be encouraged. In the temperate hill regions to which they would go, they would not be under the same temptations as the Europeans of the hot and malaria seaports; they would be under a severer control, both by the laws of government and the moral code of society. These would be an orderly population of industrious habits, whose example would be followed by the surrounding natives. In such a society the European loafer would find no congenial scene, nor would he experience any encouragement to subsist upon the charity of his countrymen, unless he followed the example of the rest, and worked. The question ought not to be considered as merely a tea question; there are many other industries besides tea which could be immensely developed—coffee cultivation might be greatly extended, the culture of fruit and vegetables much improved, and the breed of cattle rendered much more valuable, to say nothing of what might be done in the improvement of the wool. Do but place an ordinary Englishman in India, and he becomes the centre of active industry and prosperity among the natives, and with improved means of communication this national advancement may become general. What Dr. Campbell had said at the previous meeting regarding Tusser silk was well worthy of consideration; and with regard to cotton, a production in which every Englishman naturally took a special interest, there was absolutely no reason why there should not be a much more extensive cultivation of it; and, speaking generally, it was simply true to say that the internal trade of India was only in its infancy, and would be developed to a surprising degree in the event of a facilitation of the means of intercommunication. At Darjeeling fine samples of Sea Island cotton had been grown. The whole question was also of great importance in connection with another question which had been raised, viz., the stability of the British empire in India; for with a body of industrious and well-conducted Europeans living in regions suitable to their occupations, it was palpable that the security of the government would be greatly increased, and the government would no longer be so dependent as now upon the seaports as points of communication; and as their position became more and more assured, the attempts to cause disturbance would become fewer and fewer, and would finally cease to be made.

Major-General Clarke thought he might say a few words upon the subject which had been introduced by Mr. Campbell, and which had been so ably re-opened by Mr. Hyde Clarke: and he was encouraged to do so because, as a late servant of the Indian government, he had had considerable experience in various parts of India. He might first say that he did not share in the too common strictures which were passed upon the government of India, for if it was not perfection, it could not justly be accredited with all the destructive propensities which were often ascribed to it. He might also remark that a great change in regard to Europeans had taken place of late years. Formerly, if once a European went to India he could not return without having a good deal of money; but since 1834 the country had been thrown open, and was now as free to strangers as any land. As to the reception of new-comers by the Anglo-Indians, he could give his testimony—and he believed others who had experience of India would say the same—that open hospitality was practised among the English, without regard to social position, and any in distress met with ready assistance. Whether India afforded a field for private enterprise was a large and important question. He thought it might be taken as certain that in handicrafts, a place of labour in which natives exhibit singular skill, there was no chance for an Englishman unless he was a capitalist, and introduced machinery and other means for competing with native labour. Mr. Campbell had overlooked one question in his paper, and that was, he had omitted to inform the English settler how he was to live during the necessary two years in which he was gaining experience. Mr. Campbell himself, a man of varied experience, said that the opportunity which a government appointment afforded him, gave him facilities for gaining knowledge which was of incalculable service to him when afterwards he adopted a new vocation. He was then a skilled man, ready to meet any contingencies that might arise. But an ordinary European, to go out and gain experience, must be a man of some capital: and therefore the statement that India afforded the same facilities to colonists as other British territories could not be accepted in its entirety. Moreover, as he had remarked before, the skill of the natives in handicrafts was such that it was only by the aid of machinery that they could be successfully competed with; and, until very recently, the cost of the introduction of machinery in the interior was so enormous as to practically prelude the attempt; but latterly the development of the railway system had made it possible to introduce machinery, a speculation which would, no doubt, prove remunerative. Prior to that time, it would have been impossible to encourage the immigration of Europeans into India, but now that the facilities had so much increased the case was vastly different. But India was such an enormous country that the remarks applying to one province of it could by no means be applied to another, for its 127 districts each presented special and distinct features; and, although in many of these there was doubtless good opportunity for the profitable employment of British energy and capital, yet he would confine his remarks more particularly to Oude—the province in which he last served—sometimes called the Garden of India. So far as his knowledge extended, Oude had enjoyed a happy immunity from the local famines which so much afflict some districts, and this circumstance is partly to be traced to the character of its streams, which are similar to those of the middle counties of England, and not presenting the usual features of an Indian stream, namely, alternately a dry bed and a deep torrent. Moreover, without being a damp climate, the atmospheric moisture was much larger than in other provinces; and the cereal crops are in a manner independent of a water supply. A defective rainfall would tell on the crops, but only in a degree similar to the effect of a small rainfall in England. In this district of Oude he thought many occupations might be carried on by Englishmen, as, for instance, in the manufacture of oil-cake and the preparation of oil-seed, mustard, linseed, &c. There was room for immense improvements, for although the industry was largely carried on by the natives, yet it was well known that they treated the oil-cake so imperfectly that it was frequently submitted to a second process on its arrival in Europe. Paper manufacture was a branch to which Europeans might direct their attention with the certainty of remuneration. The grasses and fibres suitable to the manufacture of paper grow luxuriantly in India, and anything in the character of the esparto grass would rapidly develop in a few years over the vast sandy tracts of the Punjaub which, while not suitable for anything else, were eminently suitable to the culture of esparto, being just the same as land upon which it is cultivated in Northern Africa and the south of Spain. As regards cotton, there was an extraordinary variation in the opinions as to what an acre may produce in India; and, although as much as 500 lbs. per acre had been said to be produced, yet 200 lbs. to 250 lbs. might be accepted as a very fair average, in good soil, well-cultivated. But so far as Oude is concerned, the cultivation of cotton could never be very extensive. One cause of the want of enterprise of Europeans in India was, no doubt, the collapse of the tea mania, to which allusion had been made, but that a healthier tone was succeeding was shown by the fact that the shares of a tea company which a short time since were sold for 3s. 6d., had risen in value to £1 17s. 6d. Then he believed that the manufacture of silk could be very much developed, for, from some small experiments which he had made, he was assured it could be successfully carried on in Oude; and in regard to the Tussor worm, he might add that the trees upon which it delights to feed are found in great abundance in Oude. He thought, also, that in the manufacture of catechu much might be done, in the whole of the submontane districts. Oude, too, was well suited to the preparation of salt meat, an industry which would have no competition amongst the natives. And even in so small a thing as bristles, which could be procured in India in large quantities, and which command a high price in Europe, much money could be made. It would be useful to know, as giving a practical basis to the suggestions which had been made, what was the number of non-official Europeans in India subsisting by industrial occupations; and no doubt this could be obtained without much difficulty from official sources. At present they knew that there were a considerable number of Europeans in particular districts, but no definite information was possessed as to what were their pursuits. His own opinion was that the number of Europeans in what might be called the outer districts of India was not so large as was commonly supposed. A few chiefs kept Englishmen as gardeners or masters of their horse; but, speaking generally, Europeans were exceedingly scarce. The fact that famines have occurred in some districts of India need not deter Europeans from attempting to settle in India, for these had not arisen from a general want of grain, but from a local want, which, owing to the ineffectual means of communication, could not be supplied with facility; and with good roads and railways, such calamities would cease to occur. Speaking on this part of the subject, he might add that much ingenuity was displayed in England in the manufacture of food for cattle, whereas in India there were many pulses which by attention might be brought into use for the purpose. He might say that he had seen as fine a field of peas growing in Oude as he had ever seen in England, and they were produced at about one-fifth of the price. The fruit cultivation of India was also capable of immense development; and one of the things in which the natives were defective being in the selection of seeds (owing to the money-lender who advanced them having no interest in it), skilful English seedsmen would find a remunerative field in India. Moreover, although there were some beautiful cattle in India, the breed of animals generally was capable of improvement. As regards forest products, much also might be done at the hands of Europeans; as, for instance, in the manufacture of candles from the tallow tree, which has been introduced from China, and which grows rapidly in India. Skilled European labour might also be applied to the cultivation of tobacco, and, from experiments he had tried, he was convinced that good qualities could be produced; indeed, some Havannah which he sold in the market fetched 25 per cent. more than the other tobaccos. On the whole, therefore, he was of opinion that while the field for private enterprise in India could never be looked upon as offering the same advantages as the colonies to ordinary immigrants, yet there was ample room for people of some capital to try their luck, and with much augury of success.

Mr. G. Williamson said he had not enjoyed the opportunity of hearing Mr. Campbell's address, but he had since read it, and he had come to the conclusion that it was much exaggerated in some points, no doubt unintentionally. For himself, having spent a great deal of his life in India, and in Assam, and having had much to do with tea cultivation there—indeed, he might say, without fear of contradiction, that he had been instrumental in bringing more land under cultivation than any single man—he could not help being struck with the remarkably sanguine aspect from which Mr. Campbell had viewed the profits from tea. He (Mr. Williamson) had been engaged since 1849 in the cultivation of tea in various localities, and he knew of no authentic instance of anything like 50 per cent. being realised. Some of the largest companies had been very successful; as, for instance, the Assam Tea Company, which has, at the present moment, something like 6,000 acres under cultivation, at the cost of £200,000, or about £40 per acre—a price at which no single individual would be able to get it. Deducting expenses, that company had been able to declare a dividend of 15 per cent. last year, and this year it might be 20 per cent.; 25 per cent. would be a high average of profit on tea cultivation, and it would mislead people to allow them to suppose that they had nothing to do but invest their money and realise their profit. As a field for colonists, there could be no question that Assam was totally unsuited to any but those possessed of capital, and provided with a good deal of common sense and determined perseverance, together with a resolution to rough it. Without these qualifications, there is no chance of success in Assam. As regards the climate, his experience had been decidedly bad; and there were few parts of the world worse, and the natural consequence was a great deal of ill-health among Europeans. He had himself suffered from fevers, whose *sequelæ* still remained with him; and though many of his contemporaries did not suffer, it was simply because they were in a place where, it was to be hoped, there was no suffering. Then, as regards the means of communication, the fact was that Assam is unfitted for roads, and its natural means of traffic is the Brahmapootra and its tributaries. To construct a trunk road through Assam would not be enough; it would require constant attention, for, in a very short space of time the jungle would obliterate it. Besides, the intersection of numerous streams would render necessary the construction of numerous bridges—a fact which rendered a railway a work of extreme difficulty. Indeed, he was of opinion that the trade of Assam could not be made to pay half the working expenses of the railway, and therefore although the railway might be some advantage to Assam, yet, on the broad view of the matter, it would be a loss to India at large. The river route was the natural route, and, seeing that the voyage from Assam to Calcutta was performed in from 15 to 20 days, while from Calcutta to England took four months, the delay was comparatively trifling, and inflicted no hardship upon the planters of Assam. Mr. Campbell was apparently sanguine as to the cultivation of cotton in Assam, but some years ago, in deference to the pertinacity of the Manchester people, the government appointed an American planter to make experiments, and supplied him with money and instruments. The experiments were tried for a series of years, first in one locality and then in another, but with one uniform result—dead failure. He (Mr. Williamson) might add that his own experiments in the matter had afforded the same result. And if a plant requiring the most delicate nurture and careful management could not be produced by such experiments as these, it would certainly not succeed if cultivated by ordinary means. Mr. Campbell was right in describing the soil of Assam as rich, but it is unsuited to the growth of cotton, and the little that is produced by the natives is of a very inferior quality. In conclusion, Mr. Williamson remarked that he had thought it right to make these observations, in order to correct any erroneous impression which might be made by Mr. Campbell's address, but he thought that if Mr. Campbell had spent more time in Assam he would have arrived at different conclusions.

Mr. Cassels confessed that he took the same view of the subject as the previous speaker, and agreed in thinking that Mr. Campbell had taken too rose-coloured a view, which would not bear close scrutiny; and if men were tempted to go to India by Mr. Campbell's address, they would infallibly be the victims of great disappointment. He was satisfied that India would never be the place for European emigration on a great scale, though it would do for men of capital, who would be able to live two or three years upon their own means. But a poor man should not go to India. As regards the question of cotton cultivation, he had heard Mr. Williamson's remarks with great interest, for he, till then, was unaware that experiments in cotton-growing had been made in Assam, and that it might be made a cotton-growing country. As regards the statements that the natives had little to learn from Europeans in the way of agriculture, he would point to the fact that they had learned very much. Cotton in India is now at least 40 per cent better than it was, and it is owing to the improved means of cultivation. The produce 25 years ago was only 30 or 40 lbs. of clean cotton per acre; now it is 60 lbs. in bad seasons, and 80 lbs. in a good season; and there is no reason why the average produce should not be immensely increased, and the time would no doubt come when the acre in India would produce from 200 to 250 lbs. of clean cotton. Moreover, a great deal had been done, and much more remains to be done, in the way of teaching the natives to select seed—a thing they had never done before. It is true that in some things the native had proved himself right and the European wrong, as for instance in the matter of ploughing. The native urged that deep ploughing was a mistake, and that the burning heat of the sun destroys the vitalising powers of the soil; and events seem to proved that they were right. He might observe that the establishment of the new Department of Agriculture in India would no doubt effect a great deal of good. It was impossible to compare India with such countries as Canada and New Zealand, where men went to found homes for their families, whereas in India that was not practicable. In conclusion, he reiterated his conviction that India was fitted only for men with some capital and with a large share of good sense and determination.

Major-General Clarke observed that he had not said the natives had little to learn from Europeans in the matter of agriculture; but he knew that they were good practical agriculturists without the aid of machinery.

Mr. Williamson said he might add that the cotton with which experiment was made at Assam was not native but American cotton.

Major-General Clarke remarked that it was the opinion of many eminent men that it was best to conduct experiments with native cotton.

Mr. Hyde Clarke stated that the American varieties had proved a failure in Western India and in Turkey, whereas the Indian varieties had succeeded in those places.

The Chairman said he had been much interested in the remarks which had been made, as they had been exceedingly practical. The speech of Mr. Williamson was especially valuable, as it was from one who had a large acquaintance with the districts to which Mr. Campbell had directed special attention. Mr. Campbell had given his paper a general title, as applying to India at large, but in point of fact he had confined his remarks almost entirely to Assam; and though he had treated that part of the subject in a very interesting and useful manner, yet the subject would admit of further discussion. Mr. Campbell must have been fortunate enough to reside in Assam in exceptionally favourable circumstances, for the experience of others did not lead them to speak so highly of Assam in general as he had done. It would appear that in the country of Assam we have the great valley of the Brahmapootra, which would be different from all other Indian valleys if it did not contain many of the elements of malaria which were productive of fever and other maladies. But Assam also contains the high lands of the Khasia hills, and of this portion he could fully believe all that Mr. Campbell had said regarding climate and health. He had been favoured with a pamphlet by Dr. Archibald Graham, late Deputy Medical Inspector of the Poonah division, which fully supported Mr. Campbell's statements regarding that part of Assam. Speaking of a locality near to the military fortress of Shillory, he says, "the climate is unsurpassed, and scarcely any can equal it, at an elevation of from 3,000 to 4,000 feet. The soil is fertile, and richly stored with ores. Immense forests of fine timber exist, and there is an abundant water supply, so that the Select Committee, in August, 1859, described it as 'a delightful climate, where Europeans and their descendants could continuously live.'" Further, he quotes the testimony of an officer who lived for many years in Assam:—"I have no hesitation," he states, "in saying that there are some parts of the hills which have a climate unsurpassed by any other; and no doubt in these parts Europeans and their descendants could live in health and happiness, as far as climate is concerned." A lady who lived with her mother and family amongst the Khasia hills states:—"I suppose no climate in the world can be found equal to it, at an elevation of from 3,000 to 6,000 feet. It is a great mistake to suppose that on the hills the English colonist could not thrive from generation to generation. There is no degeneration of the race up there. Elderly people are much stronger and better, not having the severe and trying English winters to undergo, and which destroy so many of our population by inducing chest complaints." This lady was brought up from childhood on the hills, and never had a day's sickness. Col. Lees, of Calcutta, states that both the Khasia and Garrow hills are rich in the extreme, and admirably fitted for colonisation; Mr. Campbell's eulogy of the hill district of Assam was therefore fully borne out; but Mr. Williamson's remarks no doubt applied to the plains.

Mr. Williamson intimated that this was the case, and that the climate of the hill district was delightful.

The Chairman said that Mr. Campbell had urged in his paper that means should be found for locating Europeans of small capital in India; and to those who were acquainted with India, the project would recommend itself as feasible. No doubt there were places in India where Europeans might settle with advantage; but he quite agreed with those who had remarked that a person going to India without capital, and without a knowledge of the country, would find it very difficult indeed to establish himself there. With regard to the occupations to which Europeans might successfully address themselves, many had been, and many more might be suggested. Many departments of industry had been successfully developed by Englishmen; they were all aware how largely the cultivation of indigo is practiced. He might mention, that even in the climate of Urhut, on the banks of the Ganges, the gentlemen under whose superintendence indigo was grown, notwithstanding their being out in the sun during the day, enjoyed good health; and there were many other parts of India in which Europeans would thrive if healthily employed in the open air during the less trying portion of the year. In respect to the production of silk, they knew that for a hundred years there had been English factories in Bengal, and large quantities of silk have been manufactured under the superintendence of European officers and men, and the trade is still increasing. Various experiments have also been made which show that the culture of silk might be successfully carried on in other parts of India, and incoming Europeans would find this a legitimate object of attention. Of late, considerable attention has been directed to the cultivation of the rhea grass, which grows abundantly in Assam and elsewhere, and the government have offered a reward of £5,000 to anyone who will invent a machine adapted for clearing the fibre of the plant. The fibre can be produced, but the desired machine is not yet forthcoming, and accordingly—from a financial point of view—the cultivation of the rhea has not been successful. With regard to the cultivation of cotton in India, they all knew that very much had been done. Mr. Cassels had summarised the experience of those interested its production, as regards the presidency of Bombay, as others had done for other parts; and it is certain that in vast districts of India—Berar, the Southern Mahrattas, Guzerat, and others—the cultivation of the plant could be indefinitely developed. The cotton of Berar is very different from the ordinary cotton, in that it has only three cells in the capsule, whereas the other Indian varieties have four; and one of the most experienced of the American cotton planters imported by government had expressed to him the opinion that this cotton might be rendered equal to the cotton of the Southern States of America. If European enterprise and skill were applied with wise economy, and in a judicious manner, great improvements could be produced in Indian cotton. The cotton of the Punjaub and the north-west provinces, however, he might add, is not, in his opinion, suited for the English market, being of a coarse and inferior nature. There are many other branches of trade which are capable of being turned to good account, and which are in course of being turned to good account by Europeans in India; and we have scattered throughout India many European firms who very largely deal in the products both of the plains and the hills. The Tusser silk of Central India, west of Bhagalpoor, is capable of great development and extension to other parts of India—notably of the submontane tracts of the Punjaub—where the jujube tree, one of the trees upon which the worms feed, grow luxuriantly. Mr. Campbell had expressed his opinion that sugar cultivation is a less profitable investment than cotton; whereas, in his own experience of India, sugar has been found one of the most profitable of all crops. Then, in regard to tobacco, much could be done—for some of the Indian kinds, especially those from on the hills, are of very superior quality, and have a high value in the market. Dr. Stewart, Curator of Forests in the Punjaub, states that the Latakia variety is largely superseding the indigenous varieties, and no doubt its extensive cultivation will prove very advantageous. Unfortunately, however, the Europeans are few who are in a position to invest capital in developing the resources of promising districts. The improvement of the breed of cattle and horses had been alluded to, and no doubt much could be done in that direction. Indeed, before he left the Punjaub, a Mr. Landels, who introduced the camel to Australia, and who is skilled as a breeder, came to the country, and expressed his conviction that it is admirably adapted for breeding purposes—on the whole, better than Australia; and he was prepared to establish a breeding farm, with the aid of some capitalists of Calcutta. 100,000 acres of land were allotted to his use by the government, but unluckily the men upon whom he relied for the means of carrying on the experiment failed to support him, and the scheme was abandoned. Without a doubt, there are many parts of India where a really enterprising European, possessing the necessary qualifications, may develop the resources of the country in a remarkable manner, and realise considerable profit; but he must be prepared for much trial and anxiety. In handicrafts there is much room for the exercise of skill in particular branches, although in others the field is fully occupied. Our railway workshops in India are proving a great school of improvement, excellent work is now turned out, and the natives are found to be apt in the management of machinery and superior tools. Some remarks had been made with regard to the agricultural system of the natives, and their reluctance to deviate from beaten paths of habit, but his own experience did not lead him to wholly adopt that opinion. For instance, the light plough commonly used by the natives—and perhaps wisely—is abandoned in such districts as possess a deep rich soil, especially those which produce the wild grass, called Kans, spreading its network of roots in all directions. Here the light plough could not move, and the deep plough, drawn by an increased number of cattle, is resorted to. This showed that the natives were aware that different kinds of soil required different treatment, that they did not overlook the advantages of deep ploughing, and that if they confined themselves to the small plough, in most instances it was on good grounds. In respect to the whole question of the immigration of Europeans to India, he was quite sure that the government would give the greatest encouragement to the residence of industrious and respectable settlers from Europe and America. They are anxious to develop the resources of the country, and give every scheme for doing so all reasonable encouragement and assistance. Of course they have a natural apprehension of any Europeans who do not bear a good character, and who, entering into the interior, where they would not be under immediate control, might perpetrate much violence and mischief before they could be effectually controlled. Happily, however, excepting in the vicinity of the seaports and some other parts, the Europeans in India are generally well-conducted, and the natives have gathered round them gladly. In regard to the location of European soldiery in some places, the natives have been at first apprehensive, but have after a time acquired feelings of a totally different kind. In respect to what had been said in disparagement of the government in the matter of sending troops to Darjeeling, it should be remembered that the government have to study the military necessities of the country, and the general opinion has been, that to station any considerable body of troops there would be to throw them away. He would repeat that the government are willing and anxious to lend their aid in every way to the promotion of trade, the extension of railways, or whatever might seem likely to advance the prosperity of the country; and he had been given to understand that the prospect of a railway to Darjeeling was now under consideration, and if so, he had no doubt that the progress of tea-cultivation in that district had exercised considerable influence upon the government in deciding the matter. In conclusion, he trusted that the meeting would agree in expressing their thanks to Mr. Campbell for having brought forward the subject, into which all must admit he had thrown much earnestness, and had raised a discussion of great value.

Major-General Clarke having seconded the vote of thanks proposed by the chairman,

Mr. Campbell, in acknowledging the compliment, observed that there is probably no more thankless office for a man to undertake than to attempt to bring facts relating to India before the English public. If he states the facts as to the disgraceful state in which, after one hundred years of our government, the country is, he is met with a howl of official horror, and swamped in a flood of laudation on our paternal government and the beneficence of the English rule. On the other hand, when he states such facts as had been done in his own address regarding the capabilities of India, the public are naturally incredulous, and wonder how such facts can have been concealed for 100 years. Again, the manner in which one is met when endeavouring to enlighten the public is most disheartening, as the very people—the residents of India—who would be expected to support one's efforts, not unfrequently throw the greatest obstacles in the way, either from ignorance or want of thought. He could not better illustrate this than by referring to the remarks made by three gentlemen long resident in India. One of these told the conference that he resided in the district adjoining Assam 22 years, and that it takes two months to reach Assam from Goalando. He (Mr. Campbell) had travelled the route scores of times, and to reach the first tea gardens in Assam from Goalando takes about six or seven days, and the extreme point in Assam could be reached in from 12 to 14 days, and he had performed the return journey to Calcutta in six days. Again, both Mr. William Tayler and Dr. Campbell threw discredit on his statements in general, because he described the Darjeeling road as passably good. Now, like the Assam route, he had travelled this road pretty often, and had frequently gone 108 miles of the journey in a four-wheeled conveyance in 12 hours, and the remaining 32 miles in 4 hours, facts which spoke for themselves. The last 32 miles were doubtless bad during the rains, but not so bad as to be impassable; and he submitted that, when a man could make cent. per cent. for his money, it was not a trumpery difficulty like that which would weigh with him. Mr. Elliott had called for caution because he suffered from certain diseases in the part of India in which he resided; but he forgot to tell them how many thousand miles he was away from the district under consideration. Again, Mr. Elliott said that the breeding of horses does not pay in Northern India, but he failed to say that the country referred to is 2,000 miles away, and as much resembles Assam as Holland resembles the Swiss Alps. General Clarke complains that the discussion referred only to a single province, instead of to all India; but when it was considered that the statements in the opening address refer to lands extending over 14 degrees of latitude, and that he had shown how England may be independent of China for tea, and of America for cotton, the subject of discussion could hardly be said to be too limited in extent or importance. There could be no doubt that some surprise might justly be expressed at the favourable statements which he made as to the profits to be made in India; but so far from the facts being overdrawn, they are greatly understated, and in offering evidence in proof, he could defy the closest criticism. To state one fact—one of the tea companies cultivates 5,000 acres of tea, and off 4,000 acres they obtained £120,000, of which £43,000 was clear profit. Analysing these figures, they would find that the 1,000 acres which gave no tea were cultivated from the proceeds of the 4,000 acres, and could not have cost less than £5,000. Then if twenty-five per cent. be deducted for the additional expense incurred by a company over that of a private individual, which is an absurdly low calculation—they would have £18,000. These sums added together make a net profit of £66,000, or £16 10s. an acre. Anything more satisfactory than that it would be difficult to find in any part of the world. But he would not detain them longer. He had shown them that the districts he had referred to are capable of producing all the tea, and cotton, and silk required in this country, and food-stuff sufficient to amply secure against the recurrence of famines in India, giving at the same time 50 to 100 per cent. profit to the producers. He thought it worthy of the Society of Arts to use their best endeavours to bring about these results, and to this end he would propose that a deputation be organised to wait upon the Duke of Argyle, calling upon him to carry out such operations as may best assist them. The Indian Secretary of State should be urged to open out an experimental farm in the centre of these districts, to be managed, not as a "job," to find a berth for some government servant, but by some practical man who understands his business. The accounts of this farm should be made public, and would prove that he had in no way over estimated the capabilities of these splendid lands. There need be no excuse on the score of expense, for there ought to be no difficulty in finding a manager who would be content to pay the Government 25 per cent. for their outlay, before he received a shilling remuneration for himself. Were this scheme carried out, he was certain that in a few years millions of acres would be brought under cultivation, and a vast independent English-speaking community of natives and Europeans would be found who would do more in ten years to make India what it ought to be, than has been done during the last century. With such an independent community, in communication with interested parties at home, the great want of India would be supplied; viz.:—public and independent inquiry. At present the creed of India is utter suppression. In India, petroleum was known to exist many years before it was dreamed of in America; at the present moment America obtains millions per annum from the production of petroleum; in Assam, millions of gallons are running to waste in the soil. Within three or four days' sail of Calcutta are seams of magnificent coal lying on the surface, and which can be excavated at a nominal cost. And yet coal is sent from England to India across 10,000 miles of water. India once enjoyed the entire monopoly of the world in saltpetre; but that trade has been almost extinguished. Iron ore exists in connection with coal in all parts of the country, and yet the supply of iron was imported from England. Compare India with other countries—America, for instance. America, from 1864 to 1868. increased her cotton exports more than a million of bales, under gigantic difficulties; India, with every advantage in her favour, increased in the same time only 20,000 bales. After 30 years, India is able to export 10,000,000 lbs. of tea; in 13 years China increased her export of tea by 90,000,000 lbs. In 20 years China increased her exports of silk eight-fold; India remained stationary. Good cavalry remounts can be reared in Australia for £20 each; a much inferior animal costs the Indian Government more than £100 each. But perhaps the most extraordinary fact is that the colonies actually export fruit to India. But perhaps the greatest disgrace to India is the determined opposition to European enterprise. While the whole world has been seeking the assistance of English energy and capital, the Indian government have used every effort to exclude it from the country, and to stamp it out of existence. If it gained accidental admittance, what was the result? Whilst that magnificent energy which is the admiration of the rest of the world and the detestation of the Indian government, has been creating states and converting deserts into beautiful gardens, India is unable to grow sufficient food to save millions of her inhabitants from starvation almost annually. Could such a state of things exist if there were free discussion and full information on Indian affairs in this country, such as would exist if the lands he had described were in the hands of English planters? He therefore hoped that when these things had been duly considered, in connection with the fact that from two to three hundred millions sterling per annum would be created and brought into circulation to enrich England and India, instead of going into the hands of foreigners who hate us, measures would be taken to urge the government to take the initiative in the matter for the proper development of the resources of the country.

On the motion of **Mr. Hyde Clarke**, seconded by **Major-General Clarke**, a cordial vote of thanks was then accorded to Sir Donald Macleod, for presiding at the two sittings.

CHANNEL PASSAGE COMMITTEE.

The Committee met on Tuesday, 23rd of April, at three o'clock—Present: Mr. Seymour Teulon (Vice-Chairman of the Council), in the chair, Mr. Edwin Chadwick, C.B., Mr. C. W. Eborall, Major-General Eardley Wilmot, R.A., F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., and Captain Scott, R.N.

Mr. Eborall gave evidence as follows:—I joined the South Eastern Railway Company about 16 years ago. At that time our boats were very inferior to those we are now using in the summer time. For instance, the length of one boat, which I recollect very well, the *Princess Maude*, was 140 feet between the perpendiculars, her moulded breadth 19 feet, and light draught of 6 feet. The largest boat that we are now running in the summer time is the *Albert Edward*, which is 205 feet between the perpendiculars, to the breadth of 24 feet, and a light draught of 6 feet. The harbour authorities objected to the great length as being unsuitable to the harbours both of Boulogne and Folkstone; but notwithstanding that I urged upon the directors that we should have boats of that length, and I am happy to say that we find no difficulty in using them. Still I think they are the maximum length that can be used under existing circumstances. The boats running between Calais and Dover are about the same size; though about 15 or 16 years ago they were as small as the *Princess Mary* and the *Princess Maude*. We have tried, therefore, to go with the times as far as practicable. It is urged now that larger boats should be used in the service, and I quite agree that larger boats are necessary; but until the harbours are improved we cannot run materially larger boats with safety.

The Chairman—What are the South-Eastern now doing?

Mr. Eborall—We had a report which has been sent to the Committee from Mr. Harland, an eminent shipbuilder of Belfast, who was requested not only to report upon the boats but upon the harbours as well, and he states, as I have said, they are boats as large as can safely be used, looking to the existing state of things; in fact everybody who has looked into the question and understands it, admits that that is the case. He then points out what might be done, but to carry out his suggestion it would require an enlargement of Dover and Boulogne harbours, which would involve a very large expenditure, and the question is, whether it is desirable to expend money thus on this side of the Channel, seeing there is no probability at present, as far as we can see, of any improvement on the other side. We should be quite willing to work concurrently with the French government in the matter. I may state, however, as regards Dover, the Harbour Board are contemplating improving that harbour, so that vessels may be run as large as the Holyhead and Kingstown boats at any time of the tide, thus anticipating the improvement of the French harbours, and I think it is a wise step to take.

Q.—I believe the Admiralty and Board of Trade are opposing Mr. Fowler's scheme?—They think it unwise to allow a scheme of that dimensions to be authorised, as it would stand in the way of any more moderate and reasonable plan being adopted. It is, in my opinion, chimerical and absurd. As you have mentioned Mr. Fowler's proposal, I would say it would cost to run one of his large boats (the dimensions of which are 450 feet length, 57 feet beam, and 85 feet across the paddle-boxes, with engines of 1,500 horse-power), as far as we can estimate it, about £150 to £182 per trip, whereas our boats cost only £38 to £40 per trip. It would therefore take an enormous increase of traffic to compensate for the increased expense of running the boats alone. In this estimate I have included wear and tear, but not interest on the capital outlay, which would amount to a large sum.

The Chairman—I have received a circular from Mr. Leigh, who has a large model exhibiting at the Westminster Palace Hotel, and he claims to be the originator of this scheme of Mr. Fowler's. He proposes that the boat should be 500 feet long by 90 feet across the paddle boxes.

Mr. Eborall—It is well known that other people have the same notion as Mr. Fowler.

Mr. Liggins—It surely would be very ridiculous to have boats of that gigantic size, when there is no chance of there being passengers enough to fill them.

Mr. Eborall—The idea is, that boats of that description would cause the traffic to enormously increase.

Mr. E. Chadwick—Especially if you reduced the fares.

Mr. Eborall—That is a problem that is difficult to solve. I should not like to reduce the fares, as far as I am concerned.

The Chairman—Another matter, to which the Committee have directed their attention, is the placing of luggage on board. Has your attention been called to it?

Mr. Eborall—For years I have had my attention called to this point; but when I have gone into it, I have found a great many difficulties in the way. The plan proposed of using large crates, or boxes, would only apply to small packages, not to such boxes as we constantly have. We have packages constantly going to the Continent as large as the boxes themselves which are used on the Holyhead steamers. The packages of continental luggage are something enormous. These crates, therefore, could only be used for small packages, and no doubt there would be some convenience in that, but the objection is, that if these packages were put into boxes they would take up more room than they if the baggage were stored on the vessel. There would be empty spaces left in the boxes, and, seeing we have no room to spare, the boats being so small, the question is whether our boats are suitable for that sort of thing. But if we had large boats it would be all right. In the Holyhead boats these large crates are put on to the bridge, but we could not do so, because we want the bridge for passengers; it is the most favourite place on a fine day. The proper thing to do when we get larger boats would be to have movable bodies to the goods-trucks, so that the body may be taken off, leaving the under-carriage, and to be put on board and taken off again on the other side, and placed on another. No doubt that will be done at some future time, but it would not be safe with our existing boats; the top-hamper would be so great as to interfere with the safety of the vessel. There is another objection to it as a matter of detail—we have to be very careful in our tallying of the luggage, shipping it, and getting it out again. If we had some packages inside boxes and some outside, it would cause confusion, and sometimes irregularity. Now we check every piece that goes down when it gets to Folkestone and when it is unshipped at Boulogne, and taken to the station; and I am afraid we should lose some check on that tallying if we had crates for the small pieces and the large pieces went loose. Sometimes we have 300 or 400 parcels going across. If we could get larger boats there would be no difficulty about the question of luggage.

Mr. Chadwick—There appears to be universal concurrence of all who have travelled, all but our railway managers, about the eligibility of the American system of checking baggage.

Mr. Eborall—I know all about that, for I have travelled in America on a railway inquiry; but there are far greater numbers travel here than in America, and there are there longer intervals between the trains. They do not take the same quantity of luggage that we do. Besides, our railway stations are not constructed for that sort of thing.

General Eardley Wilmot—In America the luggage goes in larger pieces, and for longer destinations. There a lady will take a box as big as half a room, but an Englishman takes a great many smaller parcels.

Mr. Eborall—It is not all plain sailing there. I had a special authority with reference to travelling, and every advantage in my favour, but still all was not right with my luggage

Mr. Liggins said he was surprised at this remark, because it seemed to him that the American plan was perfection, and though he travelled for several months in America, he never lost anything.

General Eardley Wilmot asked whether any re-arrangement of the interior of the small vessels would admit of the luggage being shipped in the way proposed?

Mr. Eborall said he did not think there was any room wasted, but the subject was now being investigated, to see whether it would be possible, by some arrangement of the hold, to use crates on board; but he feared it would not be possible until we had larger boats. Still, they had not given up the idea, and he had sent the carriage superintendent down to Holyhead to see how it was conducted there, and to see whether there was any saving of time, and the damage to the luggage, for that was really the most important point.

Mr. Liggins said he had suggested that boxes should be used half the size of a luggage van, which would take a larger number of small packages. It must save time to move 40 or 50 packages at once instead of singly. He thought these boxes might be stowed in the hold.

Mr. Eborall said he was afraid not, for the hold was very small, and the aperture to it was very small, and they could not afford to remove much of the deck in order to enlarge it. The greater part of the baggage in fine weather was taken on deck, and that was the best way to carry it. He thoroughly understood what was intended, because when he was connected with the Lancashire Railway some years ago, they were the first to adopt the plan of movable bodies for carrying calicoes and such like goods to the print works. The conclusion he came to was that the present boats were too small for these very large packages.

The Secretary—You came to the conclusion, in substance, that, with the present size of boats, any improvement is impossible?

Mr. Eborall—No; I do not say that; we are trying what we can do. With these large boxes it will be necessary to have new cranes, but that will not be of much importance.

Mr. Liggins—Are not the boats of the General Steam Navigation Company much larger than your largest boats, and do they not go in and out of Boulogne safely?

Mr. Eborall—That may be so; but we run tidal trains, whereas they suit their time to full high-water; but we have to run ours two hours or two and a quarter from the time of high tide. If we were to do as the Steam Navigation Company do, it would made a very bad service between London and Paris.

Mr. Liggins—But faster boats would require less time for crossing?

Mr. Eborall—We have the fastest boats that can be constructed of this size. Mr. Penn and Mr. Samuda had almost a *carte blanche* to construct the fastest boats they could make of that size.

The Secretary—Could you not always time your boats to leave Folkestone so as to arrive at Boulogne at high-water.

Mr. Eborall—That would not make so good a service as we have now. We have to arrange with the Northern Company of France with regard to the trains, and they only give us four different times at which the trains can run. We have tried to get them to alter it, but they will not do so, as it would interfere too much with their regular service to alter the tidal service every day. Therefore they run for about four or five days at one time, and then four or five at another, which causes the difficulty. We want a harbour on the other side that we can enter and leave at any time of the tide, with boats as large as the Holyhead boats. A tidal service is very objectionable in every respect, because passengers never know what time they will have to start.

The Chairman—Have you paid any attention to the question of swinging cots.

Mr. Eborall—I have been inquiring into that, and I find they would take up a great deal of room without very much advantage, They would require more room than sofas, and we cannot spare any room in our vessels; they are too small.

Mr. Liggins—Have the inquiries you have made on that subject shown there is any advantage in them.

Mr. Eborall—As far as the opinion of our nautical men go, they say there is not.

Mr. Chadwick—Here we have on this committee the evidence of Admiral Ryder, of long maritime experience, who tells us he always provides a suspended cot or bed for himself. Then we have the experience of our colleague, General Eardley Wilmot, who is very susceptible to sea-sickness, who finds the suspension of his bed on stanchions an effectual relief. Then we have had the evidence of a distinguished yachtsman, who having provided one suspended cot has a second constructed. I strongly hold to the notion that the fact of a thing being done is evidence of its possibility. Then we have Mr. Bessemer's convictions of the principle of suspenders on a large scale, for which he is making preparations. Added to these testimonies, I have had the evidence of the successful carriage of great numbers of wounded men in suspended cots in America—even railway carriages.

Mr. Eborall said it made all the difference being on dry land.

Mr. Chadwick.—But much of the dry land carriage on the American railways is very rough and undulating indeed, and the difference is by no means so great as assumed.

General Eardley Wilmot said it always struck him, on going down into a cabin, what an enormous size the tables and sofas were, which were not of any use to anyone. He thought the space occupied by sofas might be occupied by swinging cots.

Mr. Liggins said the sofas appeared large in some parts of the cabin because they had to be adapted to the outside shape of these shallow ships. He found they were too narrow rather than too wide to lie upon.

Mr. Eborall said he had tried Mr. Ashbury's cot in the *Cambria* on a rough day, going from Torquay to Dartmouth, and he thought it very uncomfortable. He was not a good sailor, but he was afraid of being turned out every now and then.

The Chairman said one of the questions before the Committee was if any plan could be suggested for better fitting up the interior of vessels than the mode now adopted.

Mr. Eborall—We have in our gentlemen's saloon simply sofas with horsehair backs, and canvas on the floor. In the ladies' saloon the backs were of velvet, and the cabin was carpeted. He did not think there was anything which could be dispensed with.

Mr. Chadwick said he thought in place of 12 sofas, they might find room for 10 or 11 suspended cots. The American cots he had referred to were made to swing within a very small space, on flexible suspenders.

Mr. Eborall said he did not think passengers would approve of such a change, and he believed the railway ambulances in use for the sick on the Continent were fixed.

The Chairman—Can you give us any information with regard to the boats being crowded.

Mr. Eborall—During the time I have been with the company I have only had two complaints with regard to over-crowding. I do not think our licensed number can be called excessive. It is 154 in the summer and 110 in the winter in the *Princess Maude;* for the *Victoria*, 358 in the summer and 288 in the winter. The maximum number that we carry is about 350, and the minimum varies very much, perhaps as low as 30 or 35.

The Chairman—One other matter that was referred to of some importance was the effect of carrying fish, and also bullion, upon the stowage of the vessel. Could that be altered in any way?

Mr. Eborall.—I don't think any objection can be made to bullion; but with regard to fish, unless we carry it at the time we do, it would never be sent at all. Fish arrives from the north early in the morning, and we have to dispatch it by a day train; unless we send it by the tidal train we cannot get it across to Boulogne, and it would lose twenty-four hours before getting to Paris; because if we kept it here until night, it would get to Boulogne in the morning, and it would not be sent farther until the following night. The same with bullion. You must dispatch it in the morning, so that it may reach Paris by the next morning. If it were not sent that way, in all probability it would not be sent so often as it is, because it is simply a matter of exchange. If we could dispatch a boat in the morning, it might be accomplished; but we cannot get our goods to dispatch until the day, and they have to be sent by night. By sending them by night, we get them forwarded the following night from Boulogne; but if we do not do it in that way, we should lose twelve hours; so there are difficulties attending it on all sides. We could dispense with the carriage of fish, but we should lose very largely, as it pays a very good freight; at the same time there is not enough to send an extra boat for. Sometimes it is five tons, and sometimes 20 or 25 tons. We are bringing a good deal of fruit now from France, but the greatest part of the fruit and vegetables comes from Normandy by way of Dieppe.

The Chairman.—Can you give us any information with regard to the average time occupied in crossing?

Mr. Eborall.—In winter, boats average 2 hours, and the summer boats 1 hour and 36 minutes.

The Chairman.—Mr. Hodgkinson stated that, in conjunction with the Chatham and Dover Railway Company, you carried the mails, and that there is a penalty attached to the boats not doing their journey within a fixed time. Has there been any penalty enforced?

Mr. Eborall.—I cannot find that there has been any penalty levied against us, except on one occasion. We are joint contractors for the mail service.

The Chairman—That is rather important, because it shows that the vessels must have done their passage within 15 minutes.

Capt. Scott—Would the penalty always be enforced?

Mr. Eborall—To show you that it would be enforced, twelve months ago there was a dispute about a penalty, when the vessel did not go at all in consequence of stress of weather, but we had to pay the penalty. I did not refer to that, because that cannot be called a question of slow service. The penalty is £5.

The Chairman—I can speak to that point, because I was a director at the time the contract was entered into with the Post-office. They then said they would have no question at all as to the weather being bad, or anything of that sort, but if the vessel did not arrive in a given time the company must pay the penalty, whereas if they were fifteen minutes under there should be a premium.

Captain Scott—Have you any drawings showing where the luggage is stored, because two or three questions arose on that point?

Mr. Eborall—I do not think we have any drawings, but the luggage is mostly put in the forepart of the vessel. We can tell exactly what it is when we carry horses; we have always a difficulty in taking them, that is, in finding room for the horse-boxes, on account of the space they occupy.

The Chairman—It was mentioned the other day that the Ostend boats are very superior to yours.

Mr. Eborall—The new Ostend boats are made on the model of the *Victoria*.

The Chairman—We have heard it stated that they draw much more water?

Mr. Eborall—It is not so. I wanted to be satisfied on that point, and I inquired of Captain Boxer, who writes to me to say it is not so. I myself sent the drawings of the *Victoria* to the Belgian Government, and they modelled their vessels from her.

The Chairman—There is one other subject—that of ventilation.

Mr. Eborall—That is a matter which is being attended to now by Captain Boxer, and I think I had better hand in his proposed plan for ventilating the *Victoria*, showing exactly how it is to be done; we have not been losing sight of that question. I think Mr. Cole called Captain Boxer's attention to it when he was staying at Folkstone last year, and from that time Captain Boxer has been looking into it, and he thinks he can very much improve the ventilation of the cabins.

Mr. Chadwick—You mentioned just now the difference in cost in running larger boats across the Channel. Was there anything abnormal in the condition which made the difference so great as from £38 to £180, or does the expenses increase in that ratio according to the size?

Mr. Eborall—It arises from the great cost of the engines which are required to propel such an enormous boat across the Channel in an hour.

The Secretary—Would there be any practical difficulties in lengthening the boat from twenty-five to thirty feet with the present harbour accommodation?

Mr. Eborall—I think you would have to alter both Folkstone and Boulogne harbours.

The Chairman—It has been said that there is a niche in the Boulogne harbour which would enable a larger boat than yours to turn opposite to it.

Mr. Eborall—There is a very narrow entrance to that harbour. We have been very fortunate with our boats; but to run larger ones would, I am afraid, be dangerous. Those who have been at Folkstone and seen our boats come in on a rough day will acknowledge this.

Mr. Chadwick — How many passengers does Mr. Fowler propose to carry?

Mr. Eborall—He proposes to carry as many as 500 or 600, and to put the railway carriages on deck. But this plan is to my mind ridiculous. To be sea-sick in a carriage would be most objectionable. When you come to work it out you see the absurdity of taking the carriage in that way. If the traffic is to be increased so enormously, twelve or twenty-four carriages on the deck would be nothing like the number that would be required to take all the passengers he talks of carrying. And then, where are they all to go to? Are they all to go to Paris, and, if so, why should Paris be accommodated and not Brussels, or Boulogne, or Vienna, or other places. But the idea is that everybody is to go from London to St. Petersburgh, or wherever he wants, without changing his carriages; but to have separate carriages for all these destinations would be out of the question.

General Eardley Wilmot—One great disadvantage to travellers is having to scramble for a seat in the train on the other side. If there could be any system of numbered tickets which should insure a place in the train at Boulogne it would be a great advantage.

The Chairman said he had asked Mr. Leigh if he proposed that the 500 passengers should all travel across in the carriages? He said no; they would get out and walk about the deck; and if so, what would be the use of carrying the carriages. It would only be so much dead weight. He understood that Mr. Scott Russell had quite given up the idea of carrying passengers across in railway carriages.

Mr. Chadwick—Could you not give a person a ticket with a number on it, which would insure him a place in a certain carriage on the other side.

Mr. Eborall—I think you would have all sorts of confusion and dispute.

Mr. Liggins—You might telegraph every day the exact accommodation you required.

Mr. Eborall—That is done; we could not make up our trains otherwise. We have an arrangement with the telegraph company, by which we pay so much a-year, and use it as much as we like.

The Chairman—I think the Committee may gather, as the result of your evidence, that if any means can be devised for improving the service, your company will be anxious to carry it out.

Mr. Eborall—Quite so; it is to our interest to do so.

Mr. Liggins said he wished to add to what he had stated at a former meeting, a few particulars with regard to the *Iona*, a Scotch steamer, which he thought was a type of vessel which might be adopted in the general design for the Channel service. Upon the main deck there was a very fine cabin fore and aft, and below, under that, there was also a very fine cabin, used as a dining saloon. She only drew about four feet of water, and therefore the necessary height was obtained by a free-board of four or five feet, so that there were 7 or 8 feet under the beams. Any ship constructed to cross the Channel would, of course, draw more water, and therefore would give greater facilities for swinging-cots or sofas, or larger fixed sofas, which he should much prefer. He believed swing-cots were such a novelty that the travelling public were rather afraid of them, and wondered what on earth it was that gave way when they got in. When they began to move about they would probably hold on by the sides, and get their fingers broken off. However, with large cabins such as the *Iona* possessed, and with a large deck area, there would be plenty of space for getting comfortable sofas, on which one could lie down, with sides to prevent people falling off in rough weather. The *Iona* herself would hardly be strong enough for the Channel service, not being built for rough work, nor were all her dimensions suitable to a rougher sea service; but with a draught of 8 or 10 feet it would be easy to get a very fine stable ship, in which the motion would be brought to a minimum, and the deck might be made as strong as necessary. The deck-cabin would not interfere with the strength of the main deck at all; there was no advantage in the lowering down principle, except that with a very small draught of water there was otherwise no room for such a cabin.

The Secretary said the object was not to raise the deck so high as to catch the wind.

Mr. Liggins said it was very desirable if possible to get a useful deck underneath, as was the case in the *Albert Victor*, the *Albert Edward*, and the *Lord Palmerston*, where there was a dining-room underneath the main deck. The deck-cabin was not sunk below the main-deck because it would take away from the strength of the vessel.

The Secretary asked how the lower cabin was ventilated.

Mr. Liggins said by skylights at the side. The Cunard steamers were built in the same way. The upper cabin had windows all round, like a railway first-class saloon carriage, only on a grander scale. A boat with the deck area of the *Iona*, but with a greater draught of water and more freeboard, would meet all the requirements. The rolling motion would be very much checked by having bilge-keels or centre boards. Mr. Reed said centre boards did not check rolling, but he could not agree with that, because he had been in yachts where, when the centre boards were lowered, there was much less motion than when they were up.

Mr. Eborall said with regard to the *Lord Warden* being converted into a goods boat, the fact was that all but one of the captains in the service was opposed to her as a passenger ship, and they thought it better not to put her on again. They said it was like a canal all round outside the deck-house when the weather was at all rough or wet.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts & Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

The *Engineer* of April 26, has the following:—

"The Society of Arts is one hundred and eighteen years old; it has had its seasons of enthusiasm, of comparative inaction, and of steady, useful labour; and it makes an appeal in its old age for contributions from the public. Few who ask for aid have such a strong case as the Society of Arts, or, to use its full title, the Society for the Encouragement of Arts, Manufactures, and Commerce.

"It does not plead age, sickness, or misfortune, but, on the contrary, health, a good income, and success; it has done an immense deal of service, and it wants to do more; it handles a considerable sum of money, but it wants to handle a great deal more. The Society of Arts is not exactly a learned Society, it is not a public body, it is neither governmental nor opposition—it is simply a kind of association of watchmen, which is peculiarly well placed, in a social point of view, for learning the wants of the arts, sciences, and commerce, and for fixing attention upon them; its ears are ever open to the complaints of the public; and its rooms for the meetings of the discontented, the pleading, or the benevolent; it takes under its wing equally the great merchant class and the cabmen, the youth and the women of England. It has been at times the friend and advocate of all classes, and has never taken a fee or given rise to a scandal.

"Before the Royal Academy was formed it aided art; before schools of design were thought of it encouraged drawing and painting by medals and other rewards; it commenced public exhibitions before one had been held in France; in its bosom was hatched the idea of exhibitions of all nations. In short, in every movement which has had for its object the improvement of education and the furtherance of art, science, and commerce, the Society of Arts has generally been prominent, and often the hard-working pioneer as well as the triumphant conqueror.

"Its income is derived from the subscriptions of from 3,000 to 4,000 members, but it is bespoken every year; the demands upon it are incessant, and it is eager to meet them. It comes, therefore, boldly before the public, and says: 'I have done a great deal, I am full of life and energy, I see infinitely more good work to be done, and I want to be about it; but I must have more money. My annual subscriptions, though large, are not nearly large enough, and besides they are not secured; I want a good big sum always at my banker's, that I may undertake permanent duties and not be bothered by paltry considerations. I appeal to the wealthy of every class to give me an endowment for use in the public service, and, in order to place the demand on a clear and practical footing, I want not less than £100,000!'

"Nothing succeeds like success, is an old saying, and we feel sure that the past successes of the Society of Arts will secure that of the present appeal.

"Those who desire to give their hundreds, thousands, or tens of thousands, will find a complete set of forms, adapted to all cases, in the *Journal of the Society of Arts*, of the 12th of April, together with the arguments upon which the appeal is founded."

CONVERSAZIONE.

The Society's Conversazione is fixed to take place at the South Kensington Museum, on Wednesday, the 19th June. Tickets will be issued to the Members in due course.

SHIPS' LIFEBOATS.

The Committee met on Wednesday, 1st of May, at 3 o'clock. Present: Seymour Teulon, Esq. (Vice-Chairman of the Council), in the chair, Mr. A. Cassels, Capt. Nisbet, Vice-Admiral Ommanney, C.B., F.R.S., and Vice-Admiral A. P. Ryder. They took into consideration the arrangements for the actual trials of the full-sized boats now being built after the selected models.

FOOD COMMITTEE.

This Committee met on Friday, 3rd of May, at 4 o'clock. Present: Mr. Benjamin Shaw, in the chair, Dr. Blakiston, Dr. Pitman, Mr. Seymour Teulon, Mr. J. T. Ware, and Mr. J. A. Youl. The Committee had before them a report by Mr. Jenkins, on the supply and distribution of fish in the Midland Counties.

TELEGRAPH COMMITTEE.

This Committee met on Monday, the 6th of May, at 3 o'clock. Present: Mr. E. Chadwick, C.B., in the chair, Mr. A. Cassels, Lord Alfred Churchill, Mr. E. Lawrence, Mr. G. T. Snead, and Mr. Seymour Teulon.

Lord Henry Lennox has given notice in the House of Commons, that on the 31st of this month he will move :—

> "That a Select Committee be appointed to examine and report on the practicability of reducing the rates of telegraphic messages to India, to the colonies, and to the United States, and of increasing the number of telegraph stations for the service of the Royal and Mercantile Marine, and of completing and improving the postal telegraph system of the empire, by the purchase of the existing lines of submarine cables."

THE LIBRARY.

The following books have been presented to the Library :—

La Percée des Alpes. Traduit de l'original Italien, par l'Auteur. Presented by Charles Clauson, Esq.

A Treatise on Algebra; also a Treatise on Bookkeeping. By James Bryce, M.A., LL.D., F.G.S. Presented by the Author.

Storia della Farmacia e dei Farmacisti. By the Chevalier Federigo Kernot. Presented by the Author.

A Pamphlet relating to the "Sewage of Towns." By J. Brough Paco, Esq. Presented by the Author.

The following work has been purchased and added to the Library :—

Our Schools and Colleges. By F. S. de Carteret-Bisson, F.R.G.S.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport Financial Officer.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The King of the Belgians visited the Exhibition on Saturday morning. His Majesty, accompanied by the Duke of Edinburgh, was received at the Albert Hall by the Belgian Commissioner, Baron T'Kint de Roodenbeke, Mr. Corr Vandermaeren, and other officials.

Her Imperial Majesty the Empress of Germany visited the International Exhibition yesterday morning. Her Majesty, who was received by his Royal Highness the Duke of Edinburgh, the Marquis of Ripon, and the officials, was accompanied by Lord Torrington (Lord in Waiting to her Majesty the Queen), Lady Churchill (Lady of the Bedchamber to her Majesty the Queen), Count Furstenstein, Countess Schimmelmann, and Dr. Brandis. M. du Sommerard had the honour of conducting her Imperial Majesty through the French gallery. The visit lasted more than two hours.

Royal Albert Hall.—The first of the series of grand choral concerts, with M. Gounod as conductor, was given on Wednesday afternoon, by command of the Queen, who honoured the performance with her presence. Her Majesty arrived at four o'clock, and was accompanied by the Empress of Germany, her Royal Highness Princess Christian, her Royal Highness Princess Beatrice, his Royal Highness the Duke of Edinburgh, his Royal Highness Prince Arthur, his Royal Highness Prince Leopold, and his Royal Highness Prince Christian. Her Majesty remained until the end of the first part. At her entry and on her departure the National Anthem was sung by the chorus, accompanied on the organ by Dr. Stainer. The *Times* says that—"The hall to all appearance was as full as it could easily be—area, amphitheatre, great gallery, picture gallery, and balconies on either side of the organ seemingly crowded, while very few boxes in any one of the three tiers, so far as we could observe, were unoccupied. It is computed that some 7,000 people were present; and the spectacle was in the highest degree imposing. The chorus filled the orchestra to the roof. The lady singers were all placed in front—with their variegated costumes, a pretty sight, of course—the gentlemen behind them crowding both sides of the organ. We are informed that the number of singers was 1,134—346 sopranos, 194 altos, 236 tenors, and 358 basses, in two equal choirs. It would have been difficult to find place in the orchestra for another singer, although we believe that the Albert Hall Choral Society numbers in its ranks a good many more members. M. Gounod, on taking his place as conductor, received a hearty welcome; and if to him is due the credit of having trained this large body of choristers, a hearty welcome was his due on this account alone, putting aside his other and more widely-recognised claims. The choir is carefully balanced in its various sections, sings for the most part well in tune, attacks with good accent, can sing *piano* as easily as *forte*, graduate, when necessary, from one to the other; and only wants a little more finish of detail, and what is known as *chiar'oscura*, to become a choir of first-rate excellence. Such qualities as are exhibited by this large body of singers are much to boast of. What was done yesterday sounded in the greater number of instances as effectively as could be desired, and warrants a belief that, in unaccompanied choral part-song especially, a vast deal may yet be achieved at Albert Hall."

EXHIBITIONS.

Vienna Exhibition.—The Queen has appointed a Royal Commission to advise upon the best mode by which the United Kingdom, its colonies and dependencies, may be represented at the International Exhibition at Vienna in 1873; and the Prince of Wales, the British Ambassador at Vienna, the Lord President of the Council, Earl Cowper, Lord Henry Lennox, Lord Acton, and Mr. Henry Arthur Brassey have been named Commissioners, with Mr. Philip Cunliffe Owen as secretary.

The Duke of Edinburgh and the Dublin Exhibition.—At a meeting of the municipal council of Dublin, on Monday, a letter from the Lord Lieutenant's private secretary was read, in which it was stated that the Duke of Edinburgh had appointed the 4th of June for his arrival in Dublin, and that he would open the Exhibition of Arts and Industries on the 5th.

CORRESPONDENCE.

OPEN BOATS AND LOSS OF LIFE.

SIR,—The subject of Mr. John Acheson's letter, which appeared in your number of the 26th ult., should have the consideration of all who feel an interest in the welfare of our sailors and that arm of the nation which they represent. As one of these, I concur fully in your correspondent's statement that we shudder as we read of the loss of life from various causes at sea, which are, to a large extent, avoidable.

Not only are ships' boats heavy and cumbersome, and subjected to serious damage in every gale of wind when stowed in their places, but they are unquestionably a drawback to the ship's propulsion in heavy weather, when her safety may be dependent on its action upon the rudder to bow the adverse elements, besides which, in times of emergency, in the act of lowering from a rolling ship, what complications occur; and when at last the boat succeeds in getting clear away from the sinking ship fully stowed and deep with its peril-stricken cargo, a topping sea would, in all probability put an end to their suffering and anguish. The subject has always proved one of difficulty, and the committee now sitting will, no doubt, fully consider the whole subject as a national necessity.

There are other causes of disaster which contribute to loss of life and property in a far greater ratio, and these may be stated as coast disasters during gales, when anchors and cables are alone depended upon to hold the ship in safety. What, however, is the true state of things? We find in the Downs and other exposed roadsteads cables breaking and anchors dragging. And why? Not from any want of vigilance on the part of those whose lives are immediately in peril, but through official misconception in adhering to and enforcing rules which are mechanically erroneous, and altogether behind the requirements of an intelligent age. I will here instance the *Megæra* disaster. Her captain made for the Isle of St. Paul's, not to abandon his ship, but to stop a leak, as the commander of any merchant ship might have done under similar circumstances. The locality of the leak was found, but whilst measures were being adopted to staunch effectually, by common-place contrivances, and at hand on board every ordinary ship, three of her cables parted, which rendered the situation more and more anxious lest those left might prove as ineffectual, and in the darkness of night all on board might perish. To avoid such a calamity the fourth cable was slipped, and the ship beached. Then, in due time came one of the Peninsular and Oriental Company's ships (chartered for the occasion), and one of her Majesty's ships to the rescue. Each of these in a few days or hours lost two anchors from officially-proven cables, though the state of the weather did not prevent boat operations between the ships and the shore; in all seven anchors were lost. Is there no mechanical appliance in this advanced age to apply to cables and ships, so as to modify the sudden and sharp shocks upon cables, which cause them to snap, as they so often do in heavy riding; such useful appliances have been proposed to the Admiralty, accompanied with very high testimonials of approval from commanders who have testified to their great value, but without avail. The crude and questionable system of testing cables to a given strain should not be a practical acceptance of their reliable strength when subjected to the irregular strains consequent on heavy riding.

With your kind permission, I hope to return to the same subject shortly.—I am, &c.,

R. S.

Croydon, 1st May, 1872.

TELEGRAPHY WITHOUT INSULATION.

SIR,—Mr. Highton's paper on "Telegraphy without Insulation; a Cheap Means of International Communication," induces me to remind those interested in the subject of the following:—

In the *Spectator*, No. 241, dated 6th December, 1711, occurs a passage in which two persons are described as conversing with other "by the help of a certain loadstone, which had such virtue in it that it touched two several needles, when one of the needles so touched began to move, the other, though at never so great a distance, moved at the same time, and in the same manner." The writer then described "two dial plates, each inscribed with the four-and-twenty letters, having needles upon them . . . . . By this means the friends talked together across a whole continent, and conveyed their thoughts to one another in an instant, over cities or mountains, seas or deserts."

Again, in the "Money" article in the *Times*, of 3rd November, 1862, is the following:— "Incredible as it may seem, it is said that experiments have established the fact that intelligible signals can be exchanged between distant stations without the intervention of any artificial conductor whatsoever, and with equal success, whether the intervening space be wholly or partially land or water."

Doubtless, between the years 1711 and 1872, allusions to what may seem the dreams of visionary enthusiasts are to be found in print. That these imaginings have not been realised is no reason why they should be either ridiculed or discredited.

It may be asked—suggest any principle which has in it even a semblance of success.

It is easy (experimentally) to make apparent the lines of electrical force which are always passing through the air. The direction of these lines is very marked. Indeed we may say of them what has been said of sunshine—

> "No blast can break or bend one single line;
> In seven-fold strength it faces wave and wind;
> Heedless of their opposing turbulence,
> It passes through them in its quiet power
> Unruffled, and unbroken, and unbent."

A galvanometer declares when these lines are instantaneously cut and the direction in which the intersection is made. Now it is reasonable to conclude that an interruption of the electricity in a section of one such line will declare itself in the entire line.

Ascertain then (and it is presuming too much to say it cannot be done) the lines of magnetic latitude, and a disturbance in one such line may become apparent in a distant part of the same line.

Mr. Highton alludes to the delicacy of a thermo-pile to transmit the warmth of a kiss—it is, however, even more remarkable that the energy of the chemical affinities developed by a kiss upon two very small thread-like wires—one of zinc and one of copper—should be so powerful.

In a small book "On the Harmony of the Bible with Experimental Physical Science," which I published in 1869, is the following sentence:—"One human kiss, one human tear-drop, and the responsive light quivers on the opposite Atlantic shore—revealing thoughts that are cradled here."—I am, &c.,

Arthur Rigg.

THE SUPPLY OF PURE AIR.

Sir,—Notwithstanding the universally admitted importance of pure air in dwelling houses, as indeed everywhere, there is, it appears to me, in one particular a great disregard to the laws which regulate its supply in all our large towns, and especially in London. I refer to the practice of building houses—even in our best neighbourhoods of the West-end—in continuous unbroken rows, without any break except the accidental one of intersecting streets; and when we consider the enormous height of some of our new buildings, Grosvenor-place to wit, what sort of air can they have at their backs, especially considering the stabling and accumulation of offices often comprised in the space behind. Of course, I am quite aware that the closeness here would be as nothing compared with some other inferior and older neighbourhoods, but I cite these as being such splendid instances of the disregard of high sanitary laws; and although we know the reason to be the high value of the ground, and that no space or opening, even for a portion of the elevation, could be given without a sacrifice in this respect, yet surely all who know the value of pure, free air would say the gain was doubly worth the sacrifice.

I know neighbourhoods where the houses front some of the best and most open spaces and thoroughfares of the West-end, where the abominable imprisoned air poisons all the back rooms, and in summer especially renders them dangerously unhealthy, and no doubt induces much disease.

This subject seems especially important at the present time, when London is gradually being rebuilt.—I am, &c.,

H. C. W.

24th April, 1872.

FOREIGN COMPETITION IN TEXTILE FABRICS.

The *Warehousemen and Drapers' Trade Journal*, a paper established to advocate trade interests, has, in its first number, an article in which it says:—

"Considerable difference of opinion prevails as to the relative degree in which manufactures are affected by foreign competition in textile fabrics, some persons affirming that we still hold our own, while others deplore the fact that in many instances our trade is being displaced by the importations of the foreigner. We are, we think, in a position to exhibit the matter in its true light.

"Those who contend we still hold our own are generally persons engaged in branches such as the calico and low woollen trades, where every appliance that can be derived from large capital, invested in the newest and best machinery that can be procured, exists for cheapening the products of human industry, and is put into requisition in spinning and doubling the cotton, and in preparing the wool, a large trade being done abroad with foreign purchasers, who actually buy "warps" in Lancashire and return them in manufactured goods, in the shape of dimities, made at Ghent, which are sold to Manchester houses at a profit of 15 per cent.; and the representatives of the working classes, who, really not possessing any information upon the subject, say there is not the slightest ground for any apprehension from foreign competition, it being merely used as a pretence to lower the English workman's wages to a Continental level.

"But what is the fact? In one large house of business in the City, we are credibly informed, 90 per cent. of the silks sold in the establishment are of foreign manufacture.

The sarsnets that used to be made in Macclesfield, and consumed in great quantities for linings, are now displaced by German and French *lustrines*. The bulk of the figured silks that are used for making gentlemen's neckties now almost all come from Germany, and we are unable to compete with Basle in the production of cheap ribbons. In a wholesale warehouse in the City, in the haberdashery and small ware trades, 80 per cent. of the stock was found to be of foreign manufacture. Elastic webs, for braces, &c., which used to be made at Leicester, are now displaced by German goods. These various examples could be multiplied to an indefinite extent. Beautiful fabrics for ladies' cloaks, imitation seal-skins, and fancy cloths of all descriptions, now come over regularly from Berlin to this country; and it is getting the custom for English and American buyers to purchase their low goods at Leeds, and their fine and more tasteful goods abroad. If these facts are pointed out to a Leeds manufacturer, he will perhaps say, 'this is true, but our strength lies in producing a cheap article. We will take your old coat, and your old worsted stockings, and pull them to pieces, and turn you out a brand-new fabric at an astonishingly low rate, that we know nothing abroad can equal.' And this is really the true version of the case. In many of those departments where superior facilities exist for turning out great quantities of low goods, England has not a rival that she need fear, but in those matters relating to taste, we are surpassed by the foreigner in many branches of trade. When trade is healthy, and a lively demand for goods exists, as is the case now, these questions are put aside, to be brought out again when commercial panic sets in, and trade is depressed. This is certainly a matter of reproach to us, for while other countries have been fighting for existence or agitating for liberty, England has only had to perfect her various industries, and institute those improvements which should heighten the moral and intellectual position of the masses, in which direction, it must be admitted, a great deal at present remains to be done.

"The silk trade, as most people are aware, is not an indigenous one with us, and has often been pursued in its different branches under great difficulties. Mr. John Lombe, a man of great perseverance and business ability, becoming aware that the Italians possessed a decided advantage over us in their method of throwing silk, went to Italy and acquired the art under the most difficult circumstances, and first introduced it into Derby. The secresy with which their method was guarded may be guessed from an extract from the paper that was printed by Sir Thomas Lombe, and distributed amongst members of Parliament, when he applied for the renewal of his patent. He says:—'The Italians having, by the most judicious and proper rules and regulations, advanced and supported the credit of their manufacture, have also by the most severe laws preserved the mystery amongst themselves for a great number of years, to their inestimable advantage, as, for instance, the punishment prescribed by one of their laws for those who discover or attempt to discover anything relating to this art is death, with the forfeiture of all their goods, and to be afterwards painted on the prison walls hanging to the gallows by one foot, with an inscription denoting the name and crime of the person, there to be continued for a perpetual mark of infamy.'

"Now it is certainly not in throwing of silks that we are behind-hand, as a great deal of silk is thrown every year for the foreign market in this country. But where our manufacturers are at fault is, that they are not so well acquainted with the various points that constitute a peculiar fitness of the article for the purpose for which it is intended.

"The foreigner has been in the habit of buying the finest silk and paying the highest price for it. In the process of manufacture, he weights it by artificial means, and produces to all appearance a showier and better article for the money than the English manufacturer does. We say, to all appearance advisedly, for the foreign article is not generally so intrinsically good as the home-made article, and will not wear nearly so long.

"This is one phase only of a large and complex subject; the gist of our remarks lying in our intention to express our full conviction that it is in the power of the Englishman to equal the foreigner in the higher departments of taste and excellence in manufacture, did he bestow the same amount of attention that is given elsewhere to the more artistic departments of manufacture; and, further, that the sale of English goods is interfered with to a very great extent by foreign importations, not in all instances to the advantage of the consumer."

NOTES ON MANUFACTURES.

Among the specialities of the Exhibition may be mentioned the application of paper to purposes of upholstery. Messrs. Pavy, Pretto, and Co., of Hamsell-street, Falcon-square, exhibit curtains of what they call felted fabrics, the invention of Mr. Eugene Pretto. This felted fabric is nothing more nor less than a peculiarly made paper, something like Japanese paper, and in the manufacture of which various animal and vegetable substances are used, such, for instance, as buffalo skins, the intestines of animals, the fibres produced from the various nettles and grasses, barks of trees, and from flax, hemp, and cotton. These substances, mixed together in varying proportions, are treated much the same as the materials for paper are treated, that is to say, disintegrated, purified, bleached, rolled, pressed, and finally printed upon. The fabric produced differs, however, from ordinary paper in this, that it is not readily torn, is somewhat elastic, and soft enough to fall readily into graceful folds. The inventor claims for it, further, that it will resist the action of the weather and sun, and that damp does nothing more than make it more soft and yielding to the touch. The fabric at present has been principally applied to window curtains, roller-blinds, bed-curtains, and for the covering of walls, not so much in the way of ordinary paper-hangings, but more as chintzes or tapestries are used. The patterns are an imitation of the brocaded silks of Lyons, chintzes, and cretonnes. The inventor, however, has in view the production of a material that shall go much farther in superseding woven fabrics, in the shape of coverings for chairs, and even as carpets for floors. It certainly may be said of the curtains that are put up in various parts of the Exhibition, that they are bright and cheerful looking, and that it requires a close inspection to discover that they are not tissues. There is no doubt that the colours are less liable to fade than in chintzes, as they are printed principally in body colours, and will keep clean the longer as dust is not absorbed, but can be brushed off. The prices of the curtains vary from 5s. to 30s. per pair, complete; the material may also be bought in the piece. This application of paper is practically new so far as this country is concerned, though the Japanese have long ago found out that it could be applied to such purposes as what we call drapery is used for. Possibly prejudice may not do full justice to the invention and application at first, but if the new material really does answer the purpose of the old, and is besides more economical, woven fabrics for hangings will possibly have to yield to paper fabrics, even as tapestry yielded to the blandishments of wall paper.

A material which has come quite extensively into use in Germany, as a substitute for hair in the stuffing of saddles, &c., consists of a mixture of flax-seed and tallow. The advantage of this substitute consists primarily in the fact that the mobility of the seeds, one upon the other, prevents the packing or settling in any particular place, as often happens in saddles stuffed with hair, thus causing any given pressure to be readily and uniformly distributed over any given surface. The tallow serves the purpose, too, of keeping the leather flexible, and of preventing the absorption of perspiration; protects the article itself, and prevents the back of the animal from becoming galled. Animals with sores or galled spots on the back can be ridden with saddles stuffed with this material without any great inconvenience. The tallow also has the effect of preventing the rotting of the flax-seed, and is to be added in sufficient quantity to give the requisite softness to the entire mass. An aromatic odour can be imparted by introducing oil of turpentine or camphor powder, and the durability considerably increased thereby. One part of tallow to from six to ten parts of flax-seed may be used, according to the temperature.

A Sugar Congress, at which the English, French, Dutch, and Belgian refiners, and the French, Dutch, and Belgian raw sugar makers were represented, met at Brussels on the 17th ult. The following important resolutions were carried:—"1. The Convention of 1864, which maintained the principle of equality between the four nations, has not fulfilled its object. 2. There is therefore reason for its immediate modification. 3. The Congress expresses the desire that the different governments which entered into the Convention of 1864 shall be requested, with the least possible delay, to open international conferences, in order to arrive at a common understanding upon a system of taxation which shall suppress all drawbacks, and which (whilst leaving to the industry the fullest internal freedom of working) shall secure to the treasury in each country the full amount of the duty, and perfect equality in competition to the several national industries concerned. With this end in view the Congress thinks it right to recommend the study of the system of working in bond. 4. Meanwhile, the Congress expresses the wish that the four contracting governments should take steps, at the earliest possible moment, for the periodical revision of the types, and the maintenance of their identity, and it desires generally the cessation of those abuses which have been pointed out in this assembly. 5. The Congress desires that the requisite steps be taken to induce Germany and Austria to enter into the Convention. 6. It was resolved that another congress of the sugar interests should be held next year." We understand that the British delegates voted against the proposition for a periodical revision of the types, which they consider would not be required under a system of refining in bond, even if a scale of duties were proposed instead of one uniform rate.

Some facts relative to the durability of textile fabrics are given in the *Draper*:—"Wool and silk are the most enduring of textile fabrics. The first-named fabric gives evidence of its superiority as an article of clothing, from the fact that it is almost indestructible, and when from long service it is apparently worn out, its durability is once more seen in a new form, as it comes from the mills under the name of shoddy. Nor is this name of reproach entirely just; for are not carpets, druggets, mats, cloths, blankets, and many other articles of domestic use made from it, and does not its continued use attest the fact that for many purposes it can be employed to answer well the place of more expensive goods? The best wools for service are very strong, elastic, and soft to the touch. A variety of low grade wools similar to the Scotch cheviot, when of the right quality, will wear constantly and look well for many months, and in some cases have been known to look almost as well as new at the end of the second year. One peculiarity of this wool is that it takes the dye freely, and retains something of its original lustre until it is worn out. Cotton and flax are liable to a more speedy destruction than other textile products, and may ultimately be reduced to a mere wood fibre. Both of these materials, when made into fabrics, are frequently greatly injured by the process of bleaching, and will stand a very little use, even if their destruction is not greatly accelerated by the further abuse of the washerwomen. Unbleached cotton goods of all descriptions will outwear the bleached, and after a few times washing will look quite as well. Silk fabrics are very enduring, particularly velvet and plush, which often are in use for years, and retain their excellence and beauty until almost worn thread-bare. A textile product is obtained from several ruminating animals in the mountain ranges known as the Lama, the Paco, the Guanaco, and the Vicugua. The fleeces are very fine, lustrous, and long, and are remarkably free from the attack of moths. The fibre is peculiar, closely resembling the down of the Cashmere goat, and appears to hold an immediate position between wool and hair. In texture it is nearly as fine as silk, besides being very durable."

An ingenious patent is now being worked, by which leather for the soles of boats and shoes is rendered impervious to wet and damp by exhausting the air from the pores of the leather, and filling them up with a substance which unites with and adheres to the fibre, thereby strengthening without impairing the elasticity of the material. It is stated that the patent, known as "Fanshawe's Waterproof Leather," is not only likely to be largely employed for the purpose to which we have referred, but when asphalte pavement becomes more general, it will be possible to shoe horses with a material as hard as the asphalte itself, and which will prevent them slipping.

Ship Canal to Rotterdam.—It will be remembered that some years since the Dutch Government and the authorities of Rotterdam determined to cut a canal direct from that port to the sea, in order to avoid the tortuous route which vessels of commerce of large size were forced to take. This work has been pushed on with steady perseverance, and the first stage of the work is completed; a depth of about eleven feet at high water, has been obtained by ordinary dredging, and a steamer has inaugurated it by passing from Rotterdam to the sea. This canal will be of great service to Holland, and, in a less degree, to other countries trading with Germany, and must have a serious influence on the balance of carrying trade between Belgium and Holland, which has of late years been eagerly disputed.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evenings at eight o'clock.

May 15th.—"On a New Mode of Utilising Sewage Precipitates." By Major-General H. Y. D. Scott, C.B. On this evening Thomas Hawksley, Esq., Pres. Inst. C.E., will preside.

May 22nd.—"On Painted Metallic Hangings for Mural Decoration." By G. Clark, Esq.

CANTOR LECTURES.

The Fifth Lecture, on "Silicates, Silicides, Glass, and Glass Painting," by Professor Barff, was delivered on Monday evening, May 6th. The remaining lectures will be given as follows:—

Lecture VI.—Monday, 13th May.

Method of Polishing and Silvering Plate-glass—Manufacture of Glass Tube and Moulded Glass—Embossed Glass—Devitrification—The Process of Applying Photographs to Enamels and Porcelain—Mosaics—Decorative Painting on Opaque Glass.

Lecture VII.—Monday, 27th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture. Tickets for this purpose have been issued.

Members are particularly requested to note that an ADDITIONAL LECTURE has been arranged. It will take the place of that hitherto announced as Lecture VI., which will thus become Lecture VII. The tickets for Lecture VI. will not be given up, but will be retained for admission to Lecture VII, and this, the last lecture, will be delivered on Monday Evening, the 27th May, as the 20th, for which it has hitherto been announced, is Whit Monday.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon. ....**SOCIETY OF ARTS. 8.** Cantor Lectures. Prof. Barff, "On Silicates, Silicides, Glass, and Glass Painting."
Social Science Association, 8. Dr. Robert Druitt, "On Fæcal Contamination of Air and Water."
London Institution, 4. Professor Bentley, "Elementary Botany."
Royal Geographical, 8½. 1. Mr. R. B. Shaw, "On the Position of Pein, Charehand, and Lob-Nor." 2. Major T. G. Montgomerie, R.E., "A Havildar's Journey up the Chitral Valley to Faizabad." 3. Major B. Lovett, R.E., "Routes from Shiraz to Bam."
Asiatic, 3.

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8.
Photographic, 8.
Royal Institution, 3. Mr. Edward B. Tylor, "On the Development of Belief and Custom amongst the Lower Races of Mankind."

Wed.....**SOCIETY OF ARTS, 8.** Major-General Scott, C.B., "On a New Mode of Utilising Sewage Precipitates."
Royal United Service Institution, 8½. Mr. Vernon Harcourt, M.P., "Our Naval and Military Establishments."
Pharmaceutical, 11. Annual Meeting.

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Institution, 3. Prof. Tyndall, "On Heat and Light."
Chemical, 8. 1. Notes from the Andersonian University. 2. Messrs. David Page and A. D. Keightley, "On the Determination of the Solubilities and Specific Gravities of certain Salts of Sodium and Potassium." 3. Mr. Brown, "On the Influence of Pressure on Fermentation" (Part I.) 4. Mr. C. Greville Williams, "On Chinoline and Leucoline." 5. Mr. Alfred Wanklyn, "New Tests for some Organic Fluids." 6. Mr. C. O. Sullivan, "On the Products of the Transformation of Starch." 7. Mr. R. W. Atkinson, "An Examination of the Recent Attack upon the Atomic Theory."
Numismatic, 8.
Royal Society Club, 6.

Fri.......Philological, 8¼. Annual Meeting.
Royal Institution, 9. Prof. Abel, F.R.S., "On the more important Substitutes for Gunpowder."
Royal United Service Institute, 3. Surgeon-Major Wyatt, "Experiences and Reminiscences of the Siege of Paris."

Sat.......Royal School of Mines. Swiney Lecture. Prof. Cobbold, "On Geology."
Royal Institution, 3. Prof. Roscoe, "On the Chemical Action of Light."

Journal of the Society of Arts.

No. 1,017. Vol. XX.

FRIDAY, MAY 17, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 15th, 1872; THOMAS HAWKSLEY, Esq., President of the Institute of Civil Engineers, in the chair.

The following candidates were proposed for election as members of the Society:—

Brydon, John McKean, 39, Great Marlborough-street, W.
Carlton, James, Norbury-booths, Knutsford, Cheshire.
Churchill, Charles, 28, Wilson-street, Finsbury, E.C.
Cordes, Thomas, Bryn-glas, Newport, Monmouthshire.
Levick, Frederick, 46, Belsize-park, N.W.
Rehden, George, 2, Great Tower-street, E.C.
Streeter, Edwin William, 37, Conduit-street, Bond-street, W.

The following candidates were balloted for and duly elected members of the Society:—

Christian, Charles Ladd, Norfolk-lodge, Barnet.
Fewster, C. E., Hutt-street, Spring-bank, Hull.
Fitz Gibbon, A., the Rookery, Great Stanmore.
Galindo, R. E., 1, Augustus-road, New-road, Hammersmith, W.
Gill, Richard Marmaduke, Orme-field, Finchley, N.
Grimwood, G. A., Shern Hall, Walthamstow, E.
Holland, E. R., 37, Stoke Newington-green, South Hornsey.
Johnson, Samuel W., Kenward-house, Downspark-road, Clapton, E.
Lawson, Lionel, 2, Brook-street, Hanover-square, W.
Spowers, Allan, 33, Queensborough-terrace, W.
Thompson, H. H., 12, Copthall-court, E.C.,

The paper read was:—

ON A NEW MODE OF DEALING WITH SEWAGE PRECIPITATES.

By Major-General H. Y. D. Scott, C.B.

No class of doctors have differed more than sewage doctors, and the class has been recruited from widely different professions. Civil engineers, farmers, chemists, medical men, and clergymen, have all had their nostrums, and each sewage doctor has thought his neighbour a quack. At length, however, there appear signs of meekness in the opposing ranks, and the sober-minded of each party, whether filtrationists, precipitationists, irrigationists, or disinfectionists, are listening with more attention to the views of their opponents, and beginning to conceive it possible that their own systems might receive aid from the adoption of portions, at least, of some of their enemies' schemes. The following propositions will not, I believe, be contradicted now by any but enthusiasts:—

1. Though there are many cases in which the dry earth and analogous systems may be usefully employed, such systems are better adapted to country than to town life.

2. Large communities congregated in cities, and accustomed to the convenience and cleanliness of water-closets, will not abandon the luxury, if they can by any means retain it.

3. If the excreta could be disposed of by a dry-earth system of disinfection, the animal and vegetable matter, *e.g.*, cabbage water, the scourings of plates and dishes, and all the other impurities arising from the domestic operations of daily life, must be removed by water, and the water so used must be purified before it is allowed to run into our streams and rivers.

4. For the final purification of contaminated water, no artificial process, whether chemical or mechanical, can compare with filtration through a considerable depth of soil and of wide extent as compared with the water to be dealt with.

5. However valuable sewage may be to the farmer at such times as he may want it, if he be obliged to take it at all seasons, he will prefer being without it.

6. Whether sewage is to be utilised for purposes of irrigation or to be simply cleansed by filtration, it is advantageous to remove the fecal matters, either by subsidence, by filtration, or by precipitation, or by a combination of these methods.

7. Sewage is a comparatively harmless and inoffensive compound when fresh, but becomes highly offensive and deleterious when it has undergone putrefaction.

8. Putrefaction is greatly encouraged by the presence in the sewage-water of fecal matters, and their removal is, therefore, an important object, independently of the irrigation question.

9. The fecal matters of sewage have very little value as fertilisers, and in rare cases only can repay the cost of collection and distribution for agricultural purposes.

10. Such fecal matters cannot be collected and removed without creating a nuisance, unless they are previously treated with a considerable portion of deodorising substances.

The use of water, then, would appear to be a necessary evil; and if it be granted that the civilised being will prefer taking the chance of poisoning his neighbour who lives lower down the stream to having his own senses of sight, or smell, or his sentiment outraged, which would appear, by the frequency of injunctions, to be sufficiently proved; and if it is hopeless to innoculate the Englishman with the careful practice of the Chinese in respect of his excreta, it behoves us at once to endeavour to reduce the nuisance of water carriage to a minimum.

The proposal which I have to lay before you this evening is an effort in this direction. My scheme makes no claim to the complete purification of sewage-water, or to supersede irrigation or filtration, when these processes can be carried out, nor does it pretend to extract from the water those highly fertilising but soluble substances which are known to exist in sewage. It aims simply at removing from it the fecal matters (which are injurious, whatever the destination of the sewage) by the cheapest possible precipitants, and subsequently converting what has proved worthless, as hitherto dealt with, into a marketable substance.

In all the schemes proposed for dealing with the deposit of sewage, the one idea hitherto has been to convert it into manure. The chemist may have demonstrated that the fertilising ingredients of the deposit are in themselves almost valueless, owing to their being necessarily laden with an immense proportion of worthless matter; he may have shown that the deposit, though it may have increased value given to it by the introduction of fertilisers, gains its improvement in a very wasteful manner; but the idea still holds its ground, and within the last few days another sewage manure scheme has been announced to the public.

As early as 1861, the Sewage of Towns Commissioners stated that, "the value of the solid portions of sewage being small, all attempts at realising profits from its preparation have signally failed;" and, in 1870, their successors, the Rivers Pollution Commissioners, express a similar opinion. They tell us that, "experience has warned the manufacturer of these feeble manures that the value indicated by chemical analysis cannot be counted on in the market." Dr. Odling speaks of another sewage manure as "so extremely poor." Krepp says, "These instances are enough to prove that solids extracted from fluid sewage cannot be manufactured into dry manure so as to pay for the trouble;" and Mr. Corfield, the author of the "Treatment and Utilisation of Sewage," gives his testimony that "the manures that they produce are in every case very inferior, as may be expected from the known value of the sewage constituents that can be precipitated." Nevertheless, sewage manure schemes prosper, showing this—if they show nothing more—that the object aimed at—viz., the satisfactory utilisation of sewage slush, is one of the utmost importance to the community, and this must be my apology for bringing my own scheme before you this evening.

It must be conceded that the plan for dealing with the question which I am about to propose will, at first sight, appear even less calculated than the manure schemes to accomplish the desired object; but a very small amount of chemical knowledge, and a few words of explanation, will render the reasonableness of the process evident, and remove any objection which ignorance may raise to the employment of a material so prepared.

Before entering, however, upon the explanation of the process, I desire to call your attention to one feature of my plan of dealing with sewage, not *necessary* to the successful treatment of the sludge, but conducive to good results, and highly desirable from a sanitary point of view.

The attention of the public was forcibly called, towards the end of last year, to the evil results which may arise from the escape into our houses of sewer gases, generated by the decomposition of the organic matters in sewage; and any method which would tend to lessen the probabilities of the danger which the nation then incurred from this cause is well worthy of its attention.

In the precipitation of sewage, and for its deodorisation, it has been the practice always to introduce the necessary chemicals at or near the depositing tanks, and to employ mixing machinery to agitate the chemicals with the sewage water to be operated upon. However perfect such machinery may be, the mixture, when large bodies of fluid are present, remains incomplete, and much of the material introduced passes off in the effluent water without doing its work. To obviate this, I have introduced the chemicals at a point of the sewer at a long distance from the outfall, and have taken advantage of the motion of the water to procure their thorough admixture with the sewage.

The first impression, when such a plan is proposed, is that the precipitation will take place in the sewer, and that an accumulation in the bottom of the drain of the precipitated matters must result, but this is not the case. On the contrary, the slimy glutinous nature of untreated sewage is destroyed by the precipitation, and in lieu of the slime we obtain a sort of curdling, and a multitude of small floating particles are produced, which actually clean and scour the drain instead of choking it. Thus it follows that no fecal matter is left to fester and putrify on the sides and bottoms of the sewers, and the whole of the sewage is delivered at the outfall in a fresh condition, deodorised in the most effectual manner which the chemical employed can bring about. At Ealing, where this system is being carried out by my brother, Mr. T. W. Scott, subject to the supervision of Mr. C. Jones, the engineer of the Local Board, the results are very striking. The sewerage has two main branches, one from the railway station end of the village, the other from Ealing Dean, and the lime is introduced in the former one at a distance of three minutes' walk from the station and twenty minutes' walk from the tanks. In this branch the drain is clean throughout; from the Ealing Dean sewer, with each flooding from heavy rains, we get down a quantity of decomposing sewage, and the drain is found to be greasy, slimy, and coated with black deposit. Moreover, in the first drain, the formation of sewer gases being arrested by the rapid removal of matters which might otherwise putrify, the atmosphere of the drains is found to be so inoffensive as to occasion little annoyance to the workmen who visit them. The importance of these results cannot be over-rated, and this mode of introducing the chemicals has no less an authority in its favour than that of the President of the Civil Engineers, who recommends its adoption for Birmingham.

All processes for the precipitation of sewage depend for their efficiency upon a very simple action. Sewage, as has been said, is slimy and glutinous. Though the grosser particles in the liquid will subside on standing, the liquid will not clear itself unless a coagulation is produced in it which can lay hold of the solid suspended matters. The effect of adding chemicals which will unite with some substance in the fluid, or with each other, is to produce this coagulation. It thus happens that, with the mineral matter so formed, the whole of the fecal matters are entangled and subside, leaving the liquid more or less colourless and bright. These fecal matters consist in large part of organic compounds, which, when dried and distilled, yield great quantities of inflammable gases. In India, indeed, they have been used for illuminating purposes. The dried slush will burn freely when collected in some quantity. This fuel plays an important part in my process, as will hereafter appear.

Various methods have been employed for the precipitation of sewage, and the mere enumeration of them would occupy more time than we have at our disposal. Many of them clarify and deodorise the sewage in a very satisfactory manner, but the expense of the chemicals necessary, and the worthlessness of the products obtained, have been a bar to their successful application. They have, consequently, one after the other, been abandoned, and have often been pronounced unsatisfactory, owing to the economical views of the governing bodies of the places which have tried them, and which have led to such a reduction of the chemicals used as entirely to vitiate the process. It is manifestly, therefore, of importance that the chemicals employed should be of the cheapest possible description; for in proportion to their value will be the likelihood of the recurrence of such economy when the slightest difficulty or delay arises in the advantageous disposal of the product; and this difficulty has been one of the worst drawbacks to every process yet tried. Of all the precipitating ingredients yet employed, lime has proved the simplest in application, and least costly. Dr. Letheby, writing in the medical press, observes on it:—"In a sanitary point of view, the careful precipitation of sewage with lime has undoubtedly been very successful, although it has not been found a success commercially; for the precipitate is chiefly composed of carbonate of lime and non-nitrogenous organic matter." Wherever, indeed, this process has been fairly tried, a remarkable improvement of the neighbouring streams has taken place. "The Tottenham Local Board of Health," says Dr. Letheby, "were so pleased with the process, that in the early part of 1857 they published a testimonial to the effect that Mr. Higgs was treating in a most satisfactory manner the sewage of from thirty to forty miles of sewers, and discharging the supernatant water in a comparatively pure state into the river Lea, so that the Board were thus enabled to sewer and drain their populous district without annoyance to anyone. At Leicester, also, in 1858, three years after Mr. Wicksteed's works had been established, the river Soar had become changed from a most foul and pestilential stream into a comparatively pure river, for before the sewage was purified by Mr. Wicksteed's (lime) process, the water of the river was black with decomposition, all the fish and aquatic plants had been killed, and persons exposed to its influence were constantly ill. At the Belgrave Mill, which is just below the point were the sewage enters the river, the foulness of the stream was such that in summer time the water of the mill-dam appeared to boil with putrefaction, and the stench was intolerable. So large indeed was the quantity of sulphuretted hydrogen evolved from the water, that the silver in the men's pockets turned black in a few hours, and, as might be expected, those who worked at the mill were constantly affected with diarrhœa, and rapidly fell off in health. One man only, out of thirty, in eighteen years, had been able to withstand the effects of the effluvium, and he it was who gave us an account of the matter. But soon after the lime process had been adopted, the river presented an entirely different appearance, for aquatic plants had begun to flourish, the fish had returned, the black mud had ceased to accumulate, and the mill-dam was no longer offensive. All along the stream the people spoke of the change with satisfaction, for the process had evidently fulfilled the requirements of the local Act of Parliament, which demands that the sewage water discharged into the river from the works shall not occasion a nuisance, or be injurious to the health of those who live or are employed upon the banks of the stream." Dr. Letheby goes on to say:—"At first the patentees of this process were so sanguine of commercial success, and entertained such extravagant opinions of the fertilising power of the dried sewage precipitate, which they called "sewage guano," that great and unnecessary expense was encountered in the construction of the works at Tottenham and Leicester. They were built, in fact, with a view to commercial profit rather than for sanitary purposes; and, therefore, as soon as it was found, from experience, that the manufactured product had little or no agricultural value, and that the undertaking was unprofitable, the works were abandoned by the patentees and transferred to the local authorities. In the case of Tottenham, the machinery and plant, erected at great cost by Mr. Higgs, was purchased at an almost nominal price by the local board, who could, therefore, well have afforded to use their property for sanitary purposes; but instead of this, although ample proof had been afforded of their sanitary capabilities (as witnessed by the testimonial of the Board to Mr. Higgs in the month of February, 1857), yet they were so neglected and improperly managed as to have become at last a mere pretence of the objects for which they were designed and employed. The contrast, indeed, between the condition of things in 1857, as described in the testimonial of the Board, and subsequently was most marked; for at that time—to use the language of the testimonial—the supernatant water was discharged in a comparatively pure state into the river, so that the Board by these means was able satisfactorily to sewer and drain their populous district, and dispose of the sewage without annoyance to anyone. Almost as soon, however, as the works had passed into the hands of the local authority, the process was so imperfectly conducted that the trustees of the River Lea were obliged to commence legal proceedings, on account of the pollution of the river and the nuisance created by the discharge of foul, undefecated sewage from the works, and this at last became so serious that an injunction was obtained to prohibit the offensive practice of the Board."

Dr. Letheby then states that at Leicester also the process had recently been seriously neglected, and that at the time of a visit which he had paid to the works *the estimated quantity of lime necessary was not being used*, and the river was fast returning to the unwholesome condition in which it was before Mr. Wicksteed established his works. The annual cost of conducting the works being about £1,400, and the sale of the manure amounting only to £400, the loss had led to greater and greater neglect in the conduct of the works, and, as Dr. Letheby adds, "It is not unlikely that the foul condition of the river may be wrongly attributed to a failure of the lime process *per se*, rather than to the carlessness and false economy of those who have had the management of it."

The precipitation of sewage by lime, however, has been generally regarded by chemists as satisfactory, whenever a sufficiency of lime for the purpose has been employed. Dr. Hofmann, Mr. Witt, Dr. Clark, Dr. Crace Calvert, Mr. Versmann, Dr. Frankland, Dr. Odling, Dr. Augus Smith, Mr. Aiken, Dr. Alfred S. Taylor, Dr. Normandy, and Dr. Miller, have all testified to its efficiency when fairly used; and wherever it has failed, the failure, as Dr. Letheby says, is entirely due to the carelessness and parsimony of those who have hitherto had the management of the process. Lime is one of the principal precipitating ingredients of both the phosphate and sulphate of alumina systems.

At the commencement of my paper, I suggested that the civilised being preferred taking the chance of poisoning his neighbour who lives below him on the river, to having his own senses of sight, or smell, or his sentiment, outraged; and I might with equal truth have added that the philanthropy of Local Boards and other parish authorities begins and ends at home. A measure which would, for the benefit of other communities, tax the ratepayers who elect them, can never find favour with such bodies, and amongst the evils of the water carriage is the facility which it gives for transferring the whole of one's own nastiness to the dwelling of one's neighbours. Even that great and good man, Dr. Johnson, could not resist the temptation of throwing the snails he found in his own garden into the garden adjoining, and it is improbable that any place in the kingdom will be found sufficiently unselfish to tax itself for the sake of the health and comfort of the next parish. Injunction and compulsion are the only remedies available.

In such matters, however, the probable influences of parsimony on the success of a process ought not to be neglected, and it is among the advantages of the process I am proceeding to describe to you, that the materials employed are not only the cheapest available for the purpose, but for the particular object to which I apply them no saving is effected by scamping their use.

We owe the lime process to a treatment for softening and purifying water patented by Dr. Clark, in 1841. He showed that carbonate of lime, being to some considerable extent soluble in solution of carbonic acid gas, and scarcely so in pure water, it was only necessary to add to water thus impregnated a sufficiency of quick lime, to combine with the free carbonic acid gas, in order to precipitate both the dissolved carbonate of lime and that which is formed by the combination of the quick lime added and such carbonic acid. It was also found, in the application of this process, that the precipitate thus produced removed from the water a notable quantity of dissolved organic matter, as well as impurities held in suspension, and hence its great value as a precipitant of sewage. Now, a much smaller amount of lime than is sufficient to throw out of solution all the carbonate of lime present will suffice to produce clarification after standing. There are phosphoric acid and various fatty acids, besides carbonic acid, present in the sewage water, which will produce precipitates with lime; and, until the carbonic acid is saturated, each quantum of lime added will produce a double quantity of lime in the deposit, by throwing out, as has been said, not only the carbonate of lime in solution, but also the introduced lime, by its combination with the carbonic acid, which up to the period of this addition held the carbonate of lime in solution as a bicarbonate. Consequently, if the mineral deposit thrown down by the lime has any commercial value—and I hope to show you that, in the minds of those best capable of judging, it has—there is an economy in not being too niggardly in its use.

Another substance which has a recognised purifying and decolorising action, and which is at the same time generally available, and of nominal cost, is clay. Clay has been used for defecating sewage, both in its ordinary conditions and partially dissolved in sulphuric acid. In the A B C process, out of 2,581 parts by weight of precipitating compound, it is specified that 25 parts shall be burned clay, 1,900 parts ordinary clay, and 600 parts of alum, of which alumina—an important ingredient of clay—forms part. Again, in the sulphate of alumina process, for every 100,000 gallons of sewage, Dr. Anderson used, according to Dr. Letheby, 9½ cwt. of sulphated material, compounded in the proportion of 1 part of common sulphuric acid to 2 parts of ordinary clay, mixed with its own bulk of water; and, in some form or other, clay is an ingredient specified in many other sewage processes. In fact it is a well-recognised fact that alumina and oxide of iron, even in the condition in which they exist in common earth, have the power of absorbing noxious gases, fixing soluble organic matters, and of otherwise purifying sewage.

In lime and clay, then, we have these two substances readily obtainable everywhere—the one at little cost and the other at a nominal price—and well calculated for precipitating and defecating sewage. Moreover, those substances react on each other, and thereby increase the effect which each separately is capable of producing. Supposing we have finely divided clay suspended in pure water, the addition of lime will cause the particles of clay instantly to collect and precipitate. There is, in fact, considerable affinity between lime and clay.

It so happens that these ingredients, carbonate of lime (the substance precipitated on the addition of lime to ordinary sewage water) and clay, are the chief components of those limestones which yield on calcination hydraulic limes and hydraulic cements. This discovery was first made by Smeaton, the celebrated engineer, who says, "I have never found any limestone containing clay in a considerable quantity but what was good for water building." Subsequently, Vicat determined the proportions of clay which it was necessary limestones should contain, in order to yield limes possessing in greater or less degree the property of setting in water. He found that limestones containing from 8 to 12 per cent. of clay yielded, on calcination, limes *feebly* hydraulic; that limestones containing from 15 to 18 per cent. yielded hydraulic limes; and those containing from 20 to 25 per cent. of clay yielded *eminently* hydraulic limes. Acting on these principles, Vicat established a factory at Meudon, near Paris, at which artificial limes are made by calcining mixtures of chalk (carbonate of lime) and clay in the proportions necessary to give the required results. In this country also, and abroad, the so-called Portland cement has been made by calcining at a high temperature 75 per cent. of chalk (or carbonate of lime ground to powder when chalk is not available) intimately mixed with 25 per cent. of clay. The process commences by triturating together in a wash mill chalk and clay in those proportions with a large quantity of water. From the chalk mill there is an overflow by which the water, which is constantly running into the wash mill, may pass off, carrying with it some of the chalk and clay in suspension. The milky fluid thus produced is allowed to run into large tanks or is pumped into them, the coarser particles being detained in the channels leading to the tanks by catch pits, or some other means. When the tanks are full, the solid matters are allowed to subside, the top water is drained off as far as possible, and the operation of running the mixture into the tanks is again commenced. As the matters in suspension do not very readily settle, the process of filling the tanks with the mixture is slow and tedious; owing, also, to the greater fineness of the division of the clay than can be produced by reducing chalk to a powder, there is a considerable tendency to separation between the chalk and the impalpable particles of clay, which is rectified as far as may be by subsequent admixture of the compounds, either in the process of removal for drying, or after the mixture has been burned to cement and ground to powder.

It will be readily seen that there must be a great similarity between the compound thus produced and that which results from introducing quick-lime and clay, in the proper proportions, for cement or hydraulic lime, into a drain at some distance from the settling tanks, or into suitable mixing vessels, where the ingredients can be thoroughly incorporated with the sewage water and with each other.

The chief points of difference, which are entirely in favour of the sewage process, are:—

1st. The more intimate mixture which can be brought out in the sewage water, owing to the impalpable nature of the precipitate of carbonate of lime which takes place on the addition of the lime.

2nd. The more rapid settlement of the sewage precipitate than the mixture of chalk and clay.

3rd. The amount of organic matters which is carried down from the sewage with the carbonate of lime and clay, and which will serve for the fuel to burn the mixture to lime or cement.

The amount of fuel, indeed, which the slush will afford is so large, that in the absence of any better mode of getting rid of the nuisance, and in consequence of the loss which results from attempting to deal with it as a manure, it has been proposed to destroy it by burning it.

Mr. Thomas Hawksley, President of the Institute of Civil Engineers, for instance, gave in evidence, a week or two since, before the Committee of the House of Commons on the Birmingham Sewerage Bill, the opinion that "it was practicable to burn the sludge, which contained a great deal of combustible matter," and Mr. F. J. Bramwell, C.E., also gave evidence that "the sludge deposited at Saltley contains about 15 per cent. of solid matter, and of that 40 per cent. is combustible, and therefore could be used as fuel." Professor Abel, one of the members of the Council of this Society, who has for many years given great attention to the question of limes and cements, after witnessing one of the earliest experiments, gave the points we have been considering careful attention, and arrived at the conclusion that the gain in lime and other mineral matters derived from the sewage water, the collection from the sewage of combustible matter required for the burning of the deposit into cement, and the thorough incorporation of the cement-producing materials, must combine to render the production of cement, through the agency of this method of sewage treatment, a profitable business in large towns.

After the mixture of the ingredients has been made, and the top water drained off, the subsequent operations are similar, whether the process is that ordinarily employed for making cement, or the one now proposed. In each case the mixture has to be dried, and this operation may be performed most readily on tiled floors, with heated flues beneath them, such as are used in the potteries for drying clay.

It might be supposed that the process of drying the sewage matters which are precipitated with the lime and clay would be a very disagreeable one, but it is not so. I here exhibit to you some of the deposit in question, a portion of which is also undergoing the drying process on the table, and you will find them quite inoffensive. Even after four months, we have found that the deposit is still without smell; and though the time of the year at which the experiment has been made may have been very favourable, yet it can hardly be doubted, that even in the heat of summer, the deposit would remain free from smell for some days, and it could be treated, if necessary, day by day. In order, however, that on so important a point as this you may have the fullest evidence, I will again refer you to that recently given before the Committee of the House on the Birmingham Sewerage Bill on this question. Dr. Voelcker, consulting chemist of the Royal Agricultural Society, stated:—"Experiments as to making cements from detritus according to General Scott's plan, are by no means a nuisance." "The suspended matters in sewage are always very offensive, and that is the reason why populations are so anxious to get rid of them. If they were allowed to accumulate, they would, of course, get into a state of putrefaction, but you can use chemical action upon them, and even when they accumulate for a certain time—by General Scott's plan, especially—they can be kept free from putrefaction." Dr. Frankland, Professor of Chemistry at the College of Chemistry, and one of the Rivers Pollution Commissioners, says of the lime and clay process of precipitation:—"The deposit, also, would be absolutely inodorous;" and Mr. F. J. Bramwell, C.E., states:—"No injury would be likely to arise in the way of nuisance from dealing with the sludge in the manner proposed."

Having cleared away, as I trust, any doubts you may have as to the inoffensiveness of the process of drying, I proceed to the last stage of the manufacture, in which also some very unfounded suspicions may naturally exist in the minds of those who have not had the advantage of that technical education concerning which so much is said and so little done. Before, however, taking up the question of calcination of the dried deposit, I ought to call your attention to the fact that in the dry condition the compound has by no means a disagreeble odour. I can hardly say of it, as it is said of the Chinese "tafo," a somewhat similar material, that it has the smell of violets, but I am quite certain that no one would have the least suspicion of its origin, either from its appearance or odour. Some visitors to the works, indeed, have pronounced that it has the smell of new bread; but I leave it to you to judge of this for yourselves. I have provided a small store of the compound for distribution. The compound may be either completely dried on the flues, or it may, when it has reached a certain consistency, be made into bricks and allowed to dry in the air, as has been done with the specimens which I have passed round for your examination. In this dry condition, the deposit can be preserved for any time without creating the slightest nuisance, and it is hardly necessary to point out that, from the commercial point of view, it is of no small consequence that the raw material should be inexpensive, especially when it is possible that the finished manufacture may remain on hand for some time. To give an example of what I mean, I may explain to you that the deposit which they are now obtaining from the Leeds sewage is not being disposed of as it is produced, and, as I understand, it is the intention of the Native Guano Company to preserve it for twelve months, in order to improve its quality by fermentation. Now, the value of the materials required for precipitating 252,352 gallons is, according to the Rivers Pollution Commissioners, £1 18s. 5d., without assigning any value at all to the 1,155 lbs. of clay used, and the 7 lbs. of blood, whereas the value of materials, including the clay, used in the cement process for the same quantity of water would not exceed, in the generality of cases, 4s. 6d., and could not in any place in the country exceed 7s. 6d.

On these data, a year's supply of chemicals at a place like Leeds would, in the A B C process, which is now being tried there on a portion of the sewage, cost upwards of £30,000 per annum. The supply of materials for the same period for the cement process would not exceed £6,000 or £7,000. I say nothing about the value of the manure resulting from the A B C process, or the cement produced by mine, the point to which I desire to draw your attention here being simply the amount of capital required for the purchase of the materials in the two cases.

For the phosphate of alumina process the cost of the chemicals would exceed £45,000 per annum in such a case as Leeds, and for the sulphate of alumina system would considerably exceed £20,000 per annum.

To return, however, to the question of calcination. It has been constantly objected, by persons unacquainted with the elements of chemistry, that cement derived from such a source must have some of the objectionable qualities of sewage, and must therefore be unsuited for plastering the walls of our houses; but people do not consider that to employ the material as manure for the vegetables they eat is, in itself, far more repugnant to our natural feelings. I am told that when some cement, prepared from sewage was a few days since exhibited to a party of gentlemen, some of them could not be induced to touch it, though they were informed that the material had been subjected to calcination at a high temperature, and that every objectionable element which the sewage deposit may have once contained had been resolved into perfectly harmless inorganic compounds. I wonder if the same gentlemen had been informed that the vegetables before them at their dinner-table were from Mr. Morgan's sewage-farm at Barking, they would have turned from them with equal disgust? And yet, if the fears of some writers on the subject are well-grounded, disgust in the latter case would not be without some reason. Passing by the question whether water-cresses grown in sewage water produce diarrhœa, or feeding cows on sewage grass causes their milk to turn sour more quickly, or whether such feeding introduces parasitic disease into our beef and mutton, it must be admitted that organic life is materially modified by the food it lives upon, but no one with the slightest pretension to scientific knowledge would assert that a single particle of a deleterious nature can be left in sewage-made cement after calcination. On the other hand, many will be found who will contend that the practice of irrigation with sewage from which the fecal matters are not removed is liable to cause diseases of a serious nature, as well as a dreadful nuisance, and that the only certain way of preventing the propagation of the seeds of infection which may reside in the slush is to destroy them by fire.

I think I may venture to assert, in short, that the strongest advocates of irrigation or of filtration are in favour of the removal of the slush as a preliminary measure; that most of the authorities prefer that this should be done by precipitation; that few of the chemists who have studied the question of manures will admit that sufficient fertilising ingredients can be found in the slush to pay for the expense of collecting and drying the material; that the plan of burning the slush commends itself to most of the chemists and engineers who have considered the various modes of getting rid of its nuisances; and that the combination of the destruction of the slush by fire with the preparation of cement, for which the excellent precipitants and deodorisers, lime and clay, are precisely suited, offers the best prospect of turning an otherwise waste, useless, and noxious product into a marketable substance.

That I am not overstraining my case will be evident from the following testimony, not, be it remembered solicited by me, but given in evidence before the Parliamentary Committee which has just concluded its labours in the matter of the Birmingham Sewerage Bill.

Dr. William Odling, Professor of Chemistry at the Royal Institution, said:—"I don't think there is any commercial value in the matter to be extracted at Dunton, except in its use as Portland cement." And Dr. Edward Frankland, F.R.S., one of the Commissioners for Inquiry into the Pollution of Rivers, said:—"There are various modes of purifying the sewage, and I should prefer to deal with the sludge according to General Scott's system, namely, turning it into cement." "The process of treatment at Dunton, which I would recommend, is to mix lime and clay with the sewage shortly before it reaches the tanks. That would produce a complete deposit in the tanks, and would deodorise the sewage, which would flow on to the land without any smell arising from it; and the deposit also would be absolutely inodorous. That deposit would be dried and converted into Portland cement."

But it may be objected these are the theoretical ideas of men of science which practice would not justify. I therefore refer with satisfaction to the evidence to the same effect given by an eminent engineer. Mr. F. J. Bramwell, C.E., said General Scott's plan of "converting the sludge into cement is very satisfactory, and from what I have seen of the cement I have the highest opinion of it."

I have one more opinion to give you, and this, for obvious reasons, I have reserved for the last. It is given in the evidence of the distinguished engineer who occupies the chair this evening. If it is not what he really stated, he must blame the reporters, but the Birmingham papers give him credit for having asserted that "by adopting General Scott's process, it (the slush) could be converted into a very useful and valuable cement."

Let me say, in conclusion, that at the time when I requested Mr. Hawksley to take the chair this evening, I neither knew the opinion he had expressed nor the view he took of the matter. I believe, indeed, that his evidence must have been given and my note of invitation been written on the same day.

DISCUSSION.

Mr. F. A. Abel, F.R.S., said General Scott, in his paper, had so thoroughly and so fairly put forth the points of his case, and the merits of the process which he had brought forward, that he really found it difficult to add anything beyond the statement that, in the earliest experiments, having been consulted by General Scott as to his views relative to the probable success of what he then regarded from a somewhat theoretical point of view, he looked carefully into the various points of the process, and was particularly struck by the facility and the completeness with which it could be applied to the clarification and the precipitation of sewage. The process was at that time carried out certainly in no manner advantageous to its success, but the results which he (Mr. Abel) witnessed were conclusive in his mind, as far as the clarification and precipitation went. Further, he examined several of the products which were obtained by precipitating with a mixture, judiciously proportioned, of lime and clay. He examined them, not merely in regard to their power of being converted regularly into a species of cement, but also with regard to the quality of cement, and he found that it was equal to excellent Portland cement, or in another case to an excellent hydraulic cement of a different character, produced by another method. There was one point which the author of the paper had not touched upon, viz.:—That in removing the sulphur compounds from the sewage, which he did by this treatment, he added to the value of the product obtained by precipitation, inasmuch as the small amount of sulphate of lime which it thus ultimately disseminates through the sewage was undoubtedly a valuable cement ingredient, and he could, by modifications of lime and clay, form a quick-setting cement of peculiar properties, which was successfully produced in other ways. He (Mr. Abel) had endeavoured to satisfy himself thoroughly as to the utility of the process and the quality of the products, and he really believed that the plan was a successful and a profitable one.

Dr. Voelcker said that having had an opportunity of visiting the works at Ealing, he wished to bear testimony to the fact that the process of drying and manufacturing the dried material into cement could be carried on in the immediate neighbourhood of the town where the sewage was obtained without creating the slightest nuisance. The subject brought forward at this meeting in such an able manner by General Scott was one of very great importance, not only to town authorities but also to agriculturists; for he had come to the conclusion that agriculturists would never use sewage if they had to take it in the foul condition in which it had hitherto been delivered to them. But he was convinced that if sewage properly clarified were offered to the farmers, they would take it, and would find it a very useful liquid for irrigation purposes. General Scott had brought forward a matter which was intimately connected with the sewage nuisance. He (Dr. Voelcker) believed that the sewage difficulty would be at once solved if they had an effective and cheap process of getting rid of the slush. It struck him that this process presented some novelties which General Scott had not himself dwelt upon. Now in all the various clarifying processes either lime, or sulphate or phosphate of alumina, or some other chemical matter was used; but as far as he was aware, the combination of lime and clay simply had not been resorted to in any other process, and this certainly was a novelty. Then, again, another novelty was the comparatively large quantity of material which he employed. In all the clarification plans which had hitherto been put in practice, whether they were the lime, or the sulphate of allumina, or the phosphate sewage process, very little, comparatively speaking, of the precipitating agents had been used, for obvious reasons—reasons of economy. Now, in General Scott's plan, a very large proportion of earthy matter—clay and lime—was used, because the object was to bring out a useful product, and it was mainly due to this circumstance that the sewage slush did not enter into putrefaction. Now, the lime process had been described as eminently successful. He wished he could say the same thing. He thought it was successful so far in effecting a clarification of the sewage water, but, unfortunately, it created another nuisance, which was ten times worse than the unmitigated sewage slush. A little lime added to organic refuse matters hastened their decomposition, set up putrefaction, and created a very abominable nuisance. But in General Scott's plan a very large proportion was used, and with this was mixed a material which, like clay, possessed remarkable absorbing properties; generally speaking, for every particle of sewage slush, which contained, in a dry state, about 40 per cent. of combustible matters and 60 per cent. of mineral matters, 3 parts of additional earthy matter was added. The consequence was, that any products of decomposition, which no doubt would be formed, were absorbed and retained by the earthy matter. Be this as it may, it was certainly a fact that the material which was obtained by precipitation according to General Scott's plan, could be kept in a wet and pasty condition for two or three months. He had himself examined at Ealing some of the clay and lime sewage mud which had been kept for nearly three months, and he found it had no disagreeable smell. He did not think it was exactly like fresh bread, as some persons had said, but still the smell was not disagreeable in any way, and he was convinced that it might be kept any reasonable time without creating a nuisance. This led him to the third point, on which he would just offer a remark which perhaps might not have occurred to General Scott. It was this, that the material from which he made cement might be dried in the open-air without creating a nuisance. Indeed, he believed it would be found in practice that air-drying would be the most economical and probably the most efficacious plan of producing a material which could be burnt in a cement-kiln. There was a large quantity of earthy matter mixed up with the material which formed the sewage slush, and the consequence was that it got penetrated by air and dried itself; whereas one of the most difficult things in the world was to dry the deposit obtained by simple subsidence of the sewage slush obtained by the mixture of a small quantity of lime or sulphate of alumina. He knew of no substance which it was so difficult to dry, and, consequently, which it was so expensive to dry, as sewage slush; but by General Scott's plan, the deposit, being mixed with much earthy matter, was at once rendered porous, so that by exposure to air it dried itself, and this was a matter of very great importance, for, although no doubt sewage slush could be dried artificially and burnt, yet there was a great objection to this artificial drying in the expense which had to be incurred. The simple evaporation of the water was by no means a guide as to the expense. These were some of the points which had forcibly struck him as being in favour of General Scott's plan.

Mr. Andrew Murray said it struck him as a very important point that General Scott was able to combine his method with the different schemes which had been adopted for the disposal of sewage. Dr. Voelcker had very well said that the farmer would not agree to accept the sewage in its fœtid and disagreeable state. He (Mr. Murray) would go farther, and say that the objection to sewage farms, on account of the strong nature of the sewage, was in itself a sufficient obstacle to irrigation being the general mode of disposing of sewage. He could speak as a witness on this point, because he recollected that, when a youth, he tried the milk which was supplied from a sewage-farm at Edinburgh. That milk was got from a company that was established for the purpose of feeding cows on sewage grass. The result was that the milk very soon became bad, and there was a very perceptibly disagreeable quality about it. Undoubtedly an unlimited supply of sewage would, more or less, affect every crop produced. He did not at all dispute that if only the right proportion of sewage were supplied to the ground a suitable crop would be produced, but if that restriction were made, the main object of applying sewage to ground would be lost, namely, the disposal of the sewage, for the sewage could not in that case be disposed of in sufficient quantities. General Scott's plan relieved the problem from that difficulty, for, by his process of clarifying, he removed the offensive or strong quality from the liquid, and enabled it to be applied to the ground in such quantity, and in such a form, as would produce crops not affected by the deleterious properties to which he had alluded.

Mr. Varley said that as the subject had a connection with the purifying of rivers, he might state that he had observed that a margin of healthy vegetation along the banks of rivers and watercourses had a very beneficial effect in filtering in-flowing sewage, and preserving the water clear. It was, therefore, a mistake to attempt to entirely rid a stream of weeds, and the condition of the water was always deteriorated by the carrying out of such a measure.

Mr. White said that he understood General Scott's paper to raise the question whether the sewage material was most utilizable for the purpose of fertilising, or could be better employed for making cement. On the first question he knew nothing; but on the second point he wished to make an inquiry. He did not gather in the paper that the writer had given them any analysis of the sewage material, to enable them to judge how far that material itself, apart from any materials that might be added to it, was suitable for the purpose of producing cement. He took it for granted that it did not contain lime, and if a cement analogous to Portland cement was to be produced, 75 per cent., General Scott had stated, would have to be added to it. The question then came whether the sewage material itself contained the proper proportion of clay and aluminous matter which, when lime was added to it, and fuel was applied, would produce a cement of equal quality to Portland cement, or even hydraulic cement. It must be remembered that all sewage material would contain some considerable proportion of detritus in the shape of sand; and it was stated that it contained a large quantity of material that would burn, and, therefore, be available for the purposes of combustion. But he understood General Scott that there was a deficiency of carbon in the combustible material. Therefore, he presumed that some such fuel as coke would have to be added, in order to bring about the perfect combustion of the cement. He also wished to ask whether clay was to be added. If it was necessary to add to the sewage material lime and clay and coke, which were the elements of Portland cement, then he wanted to know what was the material in the sewage which was available for the purpose of cement making.

Mr. Robert Rawlinson, C.B., said General Scott, in the commencement of his paper, used the word "purification" when he thought he meant "clarification."

General Scott said he had misused the word. He meant "clarification." Another statement made below explained it.

Mr. Rawlinson said that must be so, because the fluid portion of the sewage, when it had been treated by this process, remained in a better condition for irrigation, as he gathered from the paper, than it was in before taking the solid out of it. Therefore if there was any chance of utilizing it for irrigation it had not been robbed of any of the properties necessary for the production of vegetation. The mixture of lime and clay were put in such proportions as were requisite to produce the qualities of hydraulic cement. They were added to the sewage, and, as was stated, caused precipitation, and combined themselves with the material from the sewage—not that sewage had any ingredients to create Portland cement, but to create a fuel, as he understood, necessary for burning the lime and clay into cement equivalent to Portland cement. Well, if that could be successfully accomplished, he did not think it was a pounds, shillings and pence question exactly. There was no process with which he was acquainted by which towns could treat their sewage so that it should be a profitable concern if they had to get rid of it without the means of putting it, by irrigation, to the land. The towns produced the sewage; it was a nuisance to the community, and it was necessary to the health of the community to dispose of it, and they must be contented to pay, by a rate in aid, for getting rid of that which was no benefit to them, and which, in its grosser form as discharged from towns, was an injury to the country. The sooner that was understood, and put on all fours, the better it would be for everybody. The doctrine had been preached that there was an enormous value in sewage. So there was as it was analysed in the chemist's laboratory. The excreta of an adult, it was said, was worth so much (6s. 9d.); then a Rule of Three sum was made of it, and it appeared to come to so much per annum. That was not exactly the problem which we had to deal with. We had to deal with another set of facts. There was the sewage in a gross form, mixed with many ingredients that were not useful; and it was quite true that sewage in its grosser form carried down to the outlet a vast mass of detritus, which General Scott had not mentioned, and which it must be assumed he did not intend to take into his account, or deal with in the way in which he proposed to deal with the truly sedimentary particles, because a vast amount consisted of grit, so palpable when deposited in the tanks as to enable the persons at the outlets to cleanse the sludge or sediment from it, and take it out again; and they had in some towns he was acquainted with used that grit for paving and other purposes. That was not in General Scott's process. Then he would only suggest to the General, as his purpose was to make a material of commercial value of a certain kind, whether if by mixing in the proper proportions of dry powdered lime and dry powdered clay, making the bulk, no doubt, larger, this would not absorb the water and get the bulk in a condition sooner fit for the kiln. Before he sat down, he would simply refer to one small allusion to the Chinese process, and, although it was a little wide of the present subject, he would like to say it. We were continually told that we must learn a lesson from China and Japan, but if people would only read the literature of those gentlemen who had had the good fortune or the misfortune to live in Japan or China, they would find that the Japanese and Chinese mode of dealing with the refuse of towns was of such an abominable character that the whole country was poisoned; and one writer went so far as to say that a ride or a walk in the vicinity of any town of China or Japan was utterly impossible if you wished to be free from the frightful stenches created along the sides of the road, and, if you wanted to get a pure atmosphere, you must go off so far as to traverse round the edges of their craters. He thought it was worth while to give that explanation, because the Chinese mode of dealing with the matter would not do to be introduced here. We must have our own mode, and that must be a mode by which we could avoid these great nuisances.

Mr. William Botly said he should not have risen to make any observations if it had not been that he wished to express his dissent from the fifth proposition in the paper, which stated that, however valuable sewage might be to the farmer at such times as he wanted it, still, if he were obliged to take it at all seasons, he would prefer being without it. He had gone over sewage farms within the last few months—one at Aldershot and one at Beckenham—where the use of sewage was very great indeed. He had given a description in the *Farmer* of the farm at Aldershot, and, as he had stated in that paper, the land had been letting at £25 an acre since the sewage irrigation; enormous crops were gained, and there was no nuisance at all. He would have given a statement of the various crops but for the length to which such a statement would have extended. The remarks of Dr. Voelcker on lime exactly coincided with what he said in that room a few weeks ago. He would repeat his entire dissent from the fifth proposition. At one farm the farmer assured him that, after straining the excreta and getting all the solid matter, the whole of it was, after fourteen days, brought into such a state that it was put over the farm in a very unobjectionable state, and that it only took fourteen days to decompose it suitably and fit for the operation.

Mr. W. Hope, V.C., said he had listened with very great pleasure to the paper of General Scott, who had made a very original, and he hoped useful discovery. The sludge was always a great difficulty in dealing with sewage, no matter by what process or theory. But he thought the General had been a little hard on others who had been longer in the field than he had, in supposing that any of them would have devoted so many years as they had done to the utilisation of sewage if it were true that farmers would rather not have it on the condition of being obliged to take it all the year round. He (Mr. Hope) was one of those farmers who were very glad to take it and pay for it on the condition of taking it all the year round. There was no sort of difficulty in so taking it. The contrary idea was one of the most mischievous prejudices that had ever been set afloat on this sewage question, and he really did not know on what it rested, if on anything at all. He could not conceive of any possible mode of agriculture which could not devise means of utilising sewage on every day of the year. If a farmer, knowing that he must do so, did not reserve some piece of land on which to do it, that man must simply be a fool. Then he had listened with some regret to a passage in General Scott's paper which was to the effect that he would pass by the theories as to sewage irrigation promoting parasitical diseases, and so forth. It was a very great pity that he should have alluded to it if he intended to pass it by, because there, again, was a most mischievous prejudice, founded upon nothing but Dr. Cobbold's fears. No doubt those fears were perfectly justified in the abstract, but, as a matter of fact, there had been no single case traced, even by Dr. Cobbold himself, of parasitical disease in connection with sewage irrigation. With regard to what fell from Mr. Murray about the cows fed in Edinburgh, he (Mr. Hope) thought that no sort of connection had been established between the bad milk and the food on which the cows were fed. In nine cases out of ten the bad results were produced, not by the food, but by the water which the animals were supplied with. He really felt ashamed of telling the same story so often, but last year he had an ox killed on his farm, after having been shut up in the house and fed on sewage grown grass for 22 months. That ox was dissected by Dr. Cobbold, assisted by Professor Marshall, of University College, and Professor Corfield, professor of hygiene; and although they examined the animal with the utmost attention, and even with the utmost jealousy on the part of Dr. Cobbold, they were entirely unable to find the smallest trace of any disease whatever. In addition to that, several veterinary surgeons and butchers said that they had never seen a more healthy animal. He attributed this result to the fact that the ox had had water from the house-well instead of from the horse-pond.

Mr. Lloyd said as the Society had done the members of the Metropolitan Board the honour of inviting them to be present, perhaps they would excuse his making a few remarks both as a member of the Society and as a member of the Board. He was sure that those fellow-members of the Board whom he saw around him must listen at all times with very great attention to anything that could at all elucidate the mystery which had to be solved in the utilisation of sewage. He gathered from the paper that the author proposed to utilise sewage by turning its result into cement. A very few days ago the members of the Board went down to see the works of the A B C Company at their outlet. The proposition of that company was to utilise the product by turning it into manure. The Metropolitan Board were perfectly free and unfettered in any way with regard to the A B C system or any other system of sewage, and were prepared to treat with that which could be shown to be the best for the benefit of the metropolis. He hoped he should be excused for saying this, for he had found that an erroneous impression had gone forth that the Board had something to do with the A B C Company further than allowing them to use their process on a portion of land belonging to the Board. That was the only thing to which they were committed. He thought it necessary and fair to make that statement. It appeared to him that there were two great problems to be solved. The first was so to clear sewage of its impurities that they might be able to turn it into water courses which carried off the effluent water. It must be so little deleterious that the water-courses would not be injured by it. And the next great problem was, whether the result or residue, if diverted from the water-courses, could be made a source of profit, so as to return something for the benefit of the ratepayers who had paid for carrying off the sewage. Those were the two great problems which ought to be set before scientific men; and when they had dealt with both in a satisfactory way, the Metropolitan Board and other nuisance authorities in the kingdom would only be too glad to step in and give aid. In the metropolis the sewage was already taken down to a point in the tidal river, where it produced no ill results, and therefore the first problem did not so much concern London; but it was a matter of great urgency in many places, because there was no possibility of carrying the sewage into such a stream as the Thames. The question of turning the sewage to account was the great question yet to be solved. He threw out these propositions in the hope that some of the gentlemen who heard him and who were intent on the subject, might use all their energies in solving them. Whether sewage should be carried still farther from the metropolis and delivered on various farms, or be dealt with by the A B C or any other company, time would show.

Mr. F. J. Bramwell, C.E., said he did not know that he had much to add to what had been already said upon this subject, except to draw attention to something which General Scott appeared to have omitted from his paper, but which he had communicated to him (Mr. Bramwell) when he had the pleasure of seeing the process at Ealing. He would say a word first of all in reference to an observation of Mr. White, although perhaps it would be doing what Mr. White had asked General Scott to do, viz., to answer a question. Mr. White put it, "Does the water contain lime, and does the water contain clay? If it does not then you are putting into it ingredients to make Portland cement. But why do that when you can make Portland cement without putting it into the sewer." Now he supposed most sewage contained lime, but if it did not, it contained something which everybody was desirous of getting rid of, and that was the gluey, sticky, filthy sludge. That was a thing which everybody had decided ought to be got rid of before the water should go into any channel. That being so, supposing it contained no ingredient whatever to make Portland cement, but supposing that the materials to cause it to become inoffensive were such materials as made Portland cement, then you put those in, not because you wanted to make Portland cement, but because you wanted to make the sludge harmless and inoffensive; and if you could afterwards make Portland cement why should not you do so. That he understood to be General Scott's proposition. As the object was simply to do that which he had stated, to get these matters deposited and the nuisance removed, there was a temptation, if they could not utilise the material resulting, to diminish the quantity put in, and thus the lime process, as Professor Voelcker said, had got into disrepute in a variety of places because it was endeavoured to be carried out at the least possible cost. But if they could, as General Scott had pointed out, get a saleable result, then the temptation diminished, and they got an entire deodorisation. The question he wished to put to General Scott was this, which, no doubt, he would be good enough to answer. Supposing the sewage came in with different proportions of lime at different hours in the day, how did he deal with what he put into it so that the result of the compound should make a proper cement? He believed the sewage brought down lime, and supposing that varied in per-centage on a dry day and a wet day, how did he regulate it so that it should always make, not Portland cement of necessity, but a good saleable hydraulic cement of some kind or other. Another thing he should like to ask was this. The sludge contained a considerable quantity of fuel, but he wished to know in practice how far that fuel was found sufficient for the purposes of drying and calcination, and how far it was to be aided by the use of coal and coke. With respect to the detritus, as Mr. Rawlinson had observed, that came down so rapidly when the settling tank was reached that it came out in the very first compartment, and therefore the fear in Mr. White's mind was that by no possibility could you get the ingredients you wanted, because the detritus mixed with them had no foundation, and we did, in truth, get the sludge unmixed.

Dr. Stallard said he wished to utter his protest against any such proposition as that the Thames was not polluted by the present system of London drainage. He thought it would be wrong if no medical man got up to express an approval of the principles of General Scott's admirable paper. It seemed to be a suggestion which, if it could be carried out to an economical success, would be extremely valuable in every way. He thought that irrigationists would be quite as glad to accept it for application to the land as the ratepayers would be to adopt it to avoid a nuisance. At the same time, he would venture to throw out a hint that they must not expect too much even from this plan. It would differ very much as regarded the cost of carrying it out in different parts of the country, and there might be difficulties in that respect which might prevent it from being the universal remedy which at first sight it seemed to be. However, he thought it presented a most important improvement upon any suggestion which we had hitherto had in dealing with this matter. He thought the principle laid down by the gentleman who had just preceded him admirably expressed the real matter before the meeting, namely that the lime and clay were put in not merely for the purpose of making cement by a roundabout process, but because that roundabout process had the effect of doing away with what was at present an intolerable nuisance.

Mr. Jones said that as he was connected with Ealing, it might be a matter of some interest for him to make one or two remarks respecting the subject of the paper, though not necessarily to corroborate that which General Scott had stated in his paper. He (Mr. Jones) had been an unbeliever in a great many schemes which had been brought forward, and he looked upon them with that feeling which one was apt to gather from many years' experience. He had watched General Scott's process for six months, and, in respect to many of the points of which he had considerable doubt when it was first introduced, he believed that General Scott had succeeded very well. The material could be dealt with after three months had passed away, as General Scott had stated. He believed that it might be retained without the slightest inconvenience for any length of time—even fifty years. At the works at which he (Mr. Jones) had made observations, there was not the slightest inconvenience felt in any way from the presence of the material. He had seen material turned out by the process which he should certainly pass as cement without the slightest hesitation. With respect to the question that had just been raised as to the use of materials, he took it that we had a nuisance to get rid of, and it certainly mattered not whether the sewage was used for growing cabbages or making cement, so long as it was disposed of so as to avoid an intolerable nuisance. The question of cleaning the sewers was a most important one, and the process certainly had a very salutary effect in getting rid of the sewer gases. He could walk through his main sewer without the slightest inconvenience from them. With respect to the expense, General Scott had not stated as much as might have been stated on that subject. Ealing was a most difficult place at which to carry on the process, because the cost of lime and coal was larger there than in many other places where the process might be introduced. He (Mr. Jones) believed that in a place with a population of 20,000 persons, double that of Ealing, the scheme would absolutely pay, and that was an important feature in connection with the subject. He had tried nearly every system at the Ealing works during the last eight or nine years, and he had seen none which had succeeded so well as that which General Scott had introduced. He believed that in towns where the separate system of sewage was carried out, there would be no difficulty whatever in the process. At Ealing there was a difficulty, because they took a large amount of surface water into the sewers. He had felt it just to make these remarks as to General Scott's proposition, and he made them as one who had watched the process, he might say, night and day for six months.

Dr. Odling, F.R.S., said that he had seen General Scott's process carried out at Ealing, and he must say that he was very much impressed with it. It appeared to him that whatever might be the ultimate disposal of sewage, there must be a large number of cases in which it would be desirable to separate the sludge from the liquid matter, and the manner of separating the sludge adopted by General Scott was certainly most complete. Then remained the question in what manner or for what purpose this sludge should be disposed of; and in dealing with that question General Scott had struck out a new line of work. He had availed himself of what Mr. Bramwell had called the "fuel" in the material, and he had availed himself of its other most valuable constituents, and he had recovered the material with which he effected the process in a form more valuable than it was before it was used. Economically, the scheme seemed to him the most promising of all which had been introduced for the purpose of dealing with sewage, and throwing down the sludge from it, and then dealing with the solid portion so as to convert it into a useful marketable article.

Mr. Grant said that anything coming from General Scott, with respect either to the manufacture of cement or to the utilisation of sewage, must be received with very great respect. At the same time, the subject presented itself to him (Mr. Grant) most forcibly as one at which they must look from an economical point of view. He hardly knew whether the General proposed this scheme as an economical way of making cement, or an economical way of dealing with sewage by making from it a valuable and saleable thing, namely, cement; and that although the cement by itself may not be made cheaper out of the sewage material than it would be out of the materials of which it is at present made, yet that it would be so far an economy inasmuch as it would be something left to pay for the process of dealing with the sewage. Cement was made of lime and clay in the proportion of two parts of the one to one of the other. The cost of the materials for making a ton of cement might be taken roughly as 7s. 6d. He should like to ask General Scott whether the materials he expected to get from sewage would reduce that cost. Could he make a ton of cement by his process at a cheaper rate than it could at present be made out of chalk and clay, which the cement manufacturers used? If not, how much must be put down against the process of dealing with the sewage, or how much was to be paid out of the second part of it? He had very great doubts of General Scott so treating the sewage of London as to make cement more cheaply than it was at present made by the cement manufacturers. If he had not had so much to do with the London sewage as he had, he might not have felt any doubt on the point; but all who had to deal with sewage on a large scale knew that the enormous quantities of matter to be dealt with was the great source of expense. Such a bulky thing as sewage, whether the solid or liquid part, could be moved only at a large cost. If they added to the solid part of it by putting lime and clay into it, they would add to it in the most expensive manner those materials which could be used for the purpose of making cement. He did not believe that 7s. 6d. would go far in mixing clay and chalk with the sewage of London, although by the usual process of cement making a ton of cement could be produced from materials costing that sum. For that reason he doubted the economy of the new process. He did not doubt the possibility of making cement out of the sewage. He had that evening seen specimens of cement which, as it had been stated, had been produced out of sewage; but there was no means of telling how much of that cement came from the sewage proper, and how much came from the chalk and clay which were added to the sewage. Unless they knew that, and knew it not simply as an experimental thing ascertained in the laboratory, but from working on a large scale and in actual practice, they were not, he thought, in a position to judge whether or not the system would pay. In what he had said he did not wish for a moment to retard General Scott or any one else in dealing with the sewage in this way or in any other way. He had observed what had been said by one of the members of the Metropolitan Board, which was that those who were interested in the drainage of towns would be glad to find any feasible mode of dealing with the sewage question, because even if it did not pay commercially, but paid approximately, it would be a god-send to them. He endeavoured to keep his mind perfectly clear in looking at any mode of dealing with sewage, whether in a liquid or in a solid form, or for farming or making cement.

Mr. Marshall said the remarks which Mr. Grant had made appeared to go to the root of the subject, and they were such as would obviously occur to any one who had anything to do with dealing with sewage. The first point was whether they could make cement out of sewage cheaper than they could make it in the ordinary way; and the next point was the effluent water. He feared that the process still left that question in the condition it was in before. They could clarify the sewage in the process of making the cement, which was really the lime process, but the effluent water would be as difficult to deal with as before. The great difficulty to be dealt with in this country was, that they could not discharge the sewage into brooks and streams throughout the country. It was stated that the lime process failed at Tottenham because there was not sufficient lime used. That was a total mistake. If too much lime was put in, it produced a lime water which was not fit to go into any stream whatever, and sewage containing it, if it went into a ditch, would become very shortly as bad as if it had never been treated with lime at all. If by the proposed process they could produce cement cheaper than by the use of ordinary water, then they had got something to which they might look for a profit; or if for the same cost they could produce a better cement than by the ordinary method, that also would be an advantage. These were things open to the chemist to settle; but if the sewage was clarified by lime and alumina throughout the country it must still be passed over land in some shape. He quite agreed with the remarks made with regard to passing the water over land. Irrigation was no doubt one of the best modes of dealing with sewage, but the plants ought not to be forced with it. An excess of it produced a black mark on the stalk of the plant, which took three weeks to clear away. He thought that a combination of General Scott's process with irrigation might be a solution of the difficulty. The point, however, still remained, whether the sewage would produce cement at a cheaper rate than it was made at present. Possibly it might be found that cement could be made from sewage without the addition of lime at all, and we might find that we could afford to plaster our houses inside and out with cement through the product obtained becoming a drug in the market. He believed that in dealing with the sewage of London enough cement would be produced to build the whole of London over again.

Mr. J. Grantham said he had had the means of watching General Scott's process a little. He had sent an inspector from the committee of the British Association, and they had a favourable account and report of it. At present there was not a good opportunity for making experiments, and he proposed that a further investigation should be gone into. General Scott had given every facility for making experiments. He looked upon it as a very great improvement and advantage if they could get rid of the sludge in some way or other, by drying processes, or by any other means which could be devised. General Scott's plan, as far as he was aware, was certainly the best, and he really hoped that it would prove successful, and be adopted in many parts of the country.

Dr. Letheby said that, in common with all who took any interest whatever in this question, he had had a good deal of satisfaction in listening to the paper read by General Scott, not merely because it seemed to offer a practical means of solving a great difficulty, but chiefly because it seemed to him to be the means whereby people of the most opposite inventions, and theories, and practices, might be brought somewhat into harmony. On the one hand, those who were advocates of the precipitating process would find in it the means of carrying out all they wished; and, on the other hand, those who were particularly anxious for the use of the sewage water or effluent water upon the land, would find an opportunity of using it advantageously. For thirty years men had been fighting, so to speak, over this great question, and had held those two opposite opinions in respect of it. It so happened that in 1842 the lime process was first patented by Mr. Higgs, and from that time to the present we had had a succession of precipitating processes, and some of the wildest and most enthusiastic theories, and hopes and expectations with regard to the results of those processes. On the other hand, it was exactly thirty years ago that Mr. Smith came to London to the old Board of Health, infatuated with what he had seen at Edinburgh, and through his friend Mr. Chadwick started this theory of universal irrigation. From that time we had had those two diverse lines of pursuit—one class of people arguing that nothing but irrigation—nothing but the use of sewage upon the land—was proper, and others that nothing but precipitation was proper. Now, as far as he (Dr. Letheby) could gather from the account of the process which had been given by General Scott, in the first place, and from what he had seen of the process himself, in the next place, at Ealing, it seemed that it offered a means of harmonising those who had held the most opposite opinions on the subject. There were two or three points to which he thought it essentially necessary that General Scott should direct his attention. In the first place, it was necessary that the treatment of the sewage should be by an intermittent process, and not by a continuous process. He did not mean to say that the matters to be used for precipitation should not be introduced into the sewer at a considerable distance from the precipitating tanks, but he did say that there should be tanks of such a size that you might, at a given period of the day, have something like an average quantity of sewage, and have an average product, and next that you should give an opportunity to the precipitating matters quietly to subside before the supernatant liquor was discharged. If that were not done we should be sure to have an accumulation of the sludge in the bottom of the tanks setting up secondary fermentation. It seemed to him to be essential to the success of the process that it should be an intermittent and not a continuous operation. In the next place it was advisable that there should not be too much lime used in the precipitation. At the time of his visit there was no doubt a very great precipitation of lime; in fact it was a saturated solution of lime which was passing away into the water. If that fell into any stream it would do much mischief. The stream would become turbid and disagreeable in appearance, and certainly where there were fish it would be deadly to them. Thirdly, there should be a careful attention to the quick removal of the sludge from the bottom of the precipitating tank. Wherever it remained more than two or three days it started decomposition of the supernatant liquor, and that decomposition was of a most disagreeable character. Fourthly, there should be a very quick drying of this sludge, for although it appeared, from the experiments which had been made up to this time, that sludge did not undergo offensive decomposition, nevertheless, from his experience of the lime process, and, indeed, of almost every precipitating process, the sludge would not bear to remain in the liquid state for many days. In the case of lime, the material was most offensive. Lastly, there was a difficulty which might arise in the course of these operations, and that was that, though upon a small scale, it did not appear that the burning of this material was attended with any very offensive emanation, yet he had had to do with nuisances through the manufacture of Portland cement where sewage mud had been used in the process of manufacture, and it had led to such an offence to the neighbourhood that injunctions in Chancery were granted to abate the nuisance. It was, therefore, a matter for future consideration how far the process could be carried on in the neighbourhood of towns without being offensive. He would grant that the sludge obtained from the precipitation of sewage was very different from mud that was dredged from the rivers, and particularly tidal rivers, inasmuch as the common salt present in the mud invariably produced a large quantity of muriatic acid through the burning of the cement, which was one of the main causes of offence; but in one of the cases which he had alluded to the action lay on account of the use of sewage mud. One other point had struck him during the reading of the paper and the discussion which had arisen out of it, and that was as to the quantity of cement that would possibly be produced from a given quantity of sewage. Now, looking at the experience which we had during the days of the old Tottenham works and of the works also at Leicester, it was found in practice that the proportion of solid matter that was obtained was invariably between four and five times that of the lime used. He calculated, therefore, that two tons and-a-half of this cement would be obtained from a million gallons of sewage. That would be about a ton for every 10,000 people per day. Well, he did not know what might be the demand for cement, but it did not strike him at first sight as being a very large quantity. Such a quantity might very well be used in building operations.

Mr. W. Smart considered that the Society of Arts would do good service to the community if they took this important question up.

Major-General Scott said, in reply, that the greater portion of his task had been already performed, for some of the speakers had replied to questions raised in the course of the discussion. Mr. White seemed to think there was some difficulty in apportioning the ingredients, in order to make Portland and other cements, if they were to be made through the intervention of a sewer. Now, he could not see any more difficulty in carrying out the process by throwing lime and clay into a sewer than there would be in throwing in chalk or clay in a wash mill in a manufactory. Mr. White might use white chalk in his manufactory, as he (General Scott) believed he did; but on the Medway the manufacturers used chalk containing various proportions of clay, in some cases 10 per cent., and in others nearly 20 per cent., and still managed to keep themselves pretty correct in their quantities. In the case of sewage, you have a somewhat varying amount of clay and lime present, but still, they were as constant as in grey chalk, or, at all events, so constant, that if he could not in all cases succeed in making Portland cement, he could succeed in making a cement of a very good quality, or, at least, hydraulic lime. In the case of Ealing, the two ingredients ran quite as closely together, if not more closely, than in the ordinary manufacture of Portland cement. In fact, he had mentioned in his paper a point which occasioned difficulty in apportioning the ingredients in making Portland cement which did not occur in sewer-made cement. The chalk and clay in the ordinary manufacture were ground to different degrees of fineness, and there was always a tendency in chalk to precipitate first, and it was customary to intercept the coarser particles, to prevent their going into the tanks. Now, that was not the case in the precipitation from sewage. Both the lime and clay settled down in so finely-divided a state that you could form a much more homogeneous mixture than you get in the deposition of chalk and clay. He never had the pleasure of visiting Mr. White's works, though he hoped Mr. White would give him an opportunity of doing so, but he believed Mr. White endeavoured to obviate this evil by means of a stirring apparatus in the settling tank itself—the large tank in fact in which the the clay and chalk were collected. Now if that was the case, it showed that there was a difficulty in Mr. White's factory in getting a complete mixture. Of course it was very difficult in a paper of this sort to follow all that was read, and he was not surprised that Mr. White had questioned him on a point which he had hoped he had explained. He had stated that sewage water contained a large quantity of carbonate of lime, held in solution by carbonic acid gas, and that if you added some lime to such water you got a precipitate out of it, because the lime which you added combined with the carbonic acid which was holding the carbonate of lime in solution, and by properly apportioning the lime added, you obtained a considerable amount of ingredients in that way beyond the precipitants introduced. He had been rather struck with the different points of view from which gentlemen who, in some way or other, were interested in cement, or who were interested in sewage, viewed this question. Mr. Grant and Mr. White, of course, looked at it from a cement point of view, and asked whether cement so made would be commercially profitable. Another gentleman who had spoken looked at the question entirely from a sewage irrigation point of view. Mr. Hope had taxed him with having "passed by" a very important question, viz., the possible injury that might arise to animals on sewage farms. Now, he could not see why it should be supposed that he had such an intimate acquaintance with the effect of sewage-grown grass as to be able to express an opinion on this disputed point. It was not his business to enter into such a question, and he passed it by simply because he could offer no opinion upon it, and, for the objects of his paper, it was unnecessary to express one. But he thought that if his paper had been more carefully listened to upon that point, Mr. Hope would have seen that really it stated that irrigation or filtration was the only complete way of completely getting rid of the contaminations of the sewage-water. He had said this:—"My scheme makes no claim to the complete purification of sewage-water, or to supersede the irrigation or filtration." Surely, if that meant anything it meant that he was rather an advocate for irrigation and filtration than the contrary. His real view was, that if farmers made use of sewage in proper amount, they would really get very excellent results out of it; but if the sewage was thrown on the land at all seasons, he was not so certain about it. He was, however, quite sure of this—that, notwithstanding what Mr. Hope had said, there were farmers who were using sewage, and who would not take it at all times. It was only the other day that he lost his way and got down to the Barking-road Farm, and had the pleasure of a conversation with the gentleman who managed it. He (General Scott) said to him "What do you do in very wet weather?" "I don't take the sewage," was the reply. "They tell me I must take it, and I say I won't." Mr. Bramwell had asked what would be done if the quantity of clay in the sewage varied. He had already replied, by saying that he should make hydraulic lime, or some other description of cement than Portland—not requiring the same accuracy in apportioning the ingredients. And that was really the reply to another remark which had been made during the evening, namely, that the amount of cement which he would make would be more than the country could use. The gentleman who made that remark must remember that he had shown that he could produce either Portland cement or hydraulic lime, and avoid throwing more cement material into the market than was required; he merely, in fact, passed the lime through the sewage, and brought it out in an improved form. Several questions had been asked with reference to the cost of the process. He thought that the gentlemen who asked those questions must admit that they were asking him, considering the varying conditions of the problem in each locality, a very difficult question indeed, but he could venture to say that in a place of five-and-twenty or thirty thousand inhabitants, with sewage works already in existence, and having lime and clay at the ordinary cost, there might be a profit of 20 per cent.; such profit must manifestly vary with the number of people in the place, the price of lime, the price of clay, and the condition of the sewage itself. It should, however, be borne in mind, as some of the speakers had brought out very strongly, though others appeared to forget it, that the first object was that the sewage should be purified; and the question was whether he was proposing to them a better plan than had hitherto been proposed for effecting that object. There were other theories and schemes, and he might have shown how good his position was by comparing his process with other schemes, but he had abstained, for obvious reasons, from making comparisons with plans which had been introduced by other people. He might say generally, with some confidence, that where a town was large, and where lime and clay were cheap, cement might be made with a considerable profit. On the other hand, in a small place like Ealing, he did not suppose for a moment that the process would entirely relieve the inhabitants from taxation for the disposal of their sewage. Since he had read his paper, a gentleman had asked him whether his scheme was applicable to a large isolated establishment in the country. He had replied to him, "My dear sir, you had better get earth closets." Manifestly, his scheme was not applicable to such a case as that. He believed that he had now replied to most of the questions, but in a little pamphlet which he had printed, but not yet published, he had gone into the figures as to the materials used in making the cement, and he found, as Dr. Letheby had stated, that from a million of gallons of ordinary sewage water, about two tons of cement or rather more would be produced in a day. He believed the cost of producing that quantity, for materials and labour, would be something like £2 at ordinary prices, leaving a pound for wear and tear, the first outlay, &c.

The Chairman said there was one point to which General Scott had not alluded. It was the question of Mr. White as to the quantity of additional fuel it was found necessary to burn the cement.

General Scott said that Mr. White would understand as well as anybody when he explained to him that his kiln was only about 4ft. 6in. in diameter, and 12ft. high, that he could not make any exact statement on that point. But he certainly got a most intense heat by means of the fuel which was in the sludge. As to the small heating power of the gas of sludge, to which Mr. White had referred, it was well known that the conditions in which hydrogen and carbon existed in fuels varied very much indeed. A body might be very rich in carbon, and yet give a very poor illuminating gas. The illuminating power of the gas, in fact, did not bear very much on the question of heating power, for though there might not be much carbon present in sewage gas, there was a good deal of hydrogen, which gave a more intense heat. In his small kiln, in which he put a ton of material, and from three to five bushels of coal, he had a flue carried under the drying-floor, and he was able to keep that drying-floor red-hot by this means, as well as burn the mixture to Portland cement. He believed that when he had got to the point of working a large kiln, his difficulty would not be a want of sufficient heat, but that he should have so much heat that he would have some difficulty in controlling it.

A vote of thanks to the author of the paper was unanimously accorded by the meeting.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts & Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

CONVERSAZIONE.

The Society's Conversazione is fixed to take place at the South Kensington Museum, on Wednesday, the 19th June. Tickets will be issued to the Members in due course.

TECHNOLOGICAL EXAMINATIONS.

The Sub-Committee for organising these examinations in relation to the manufacture of paper met on Thursday, the 9th of May, at four o'clock. Present:—Captain Donnelly, R.E., in the chair, Mr. F. A. Abel, F.R.S., General Cotton, Professor Thistelton Dyer, Lieut. Grover, R.E., and Mr. J. F. Iselin.

The Sub-Committee for organising these examinations in relation to the cotton manufactures met on Thursday, the 9th inst., at five o'clock. Present:—Captain Donnelly, R.E., in the chair, General Cotton, Professor Thistelton Dyer, Lieut. Grover, R.E., Mr. J. F. Iselin, Mr. Alexander Redgrave, and Dr. J. Forbes Watson.

DRILL COMMITTEE.

The Committee met on Tuesday, the 14th inst. Present:—Major-General F. Eardley Wilmot, R.A., F.R.S., in the chair, Mr. E. Chadwick, C.B., Mr. W. H. Fitzwilliam, Vice-Admiral Ommanney, C.B., F.R.S., Mr. Seymour Teulon, and Mr. E. C. Tufnell.

FOOD COMMITTEE.

The Committee met on Wednesday, the 15th instant. Present:—Mr. Benjamin Shaw, in the chair; Sir Antonio Brady, Mr. J. Jenkins, Mr. J. T. Ware, and Mr. J. A. Youl. The Committee had before them specimens of tinned meat (beef) from Queensland, prepared by Mr. Jones's process, being the first specimens by that process imported from abroad. The Committee had also before them specimens of tinned meat (mutton) from New Zealand, sent to them by Messrs. Suter and Co., the importers; also a specimen of tinned meat (beef) from Uruguay, prepared and imported by Albert Scott and Co.

Sub-Committee for the International Exhibition of 1873.

The Sub-Committee met on Friday, the 10th inst., at four o'clock. Present—Mr. Benjamin Shaw (in the chair), Messrs. W. H. Michael, F. W. Rowsell, J. T. Ware, and J. A. Youl. Mr. E. Craigie attended on behalf of Her Majesty's Commissioners for the Exhibition.

THE LIBRARY.

The following books have been presented to the Library:—

A Pamphlet relating to the Sewage of Towns. By J. Brough Pow, Esq. Presented by the Author.

Second Thoughts on Double Entry Accounts, or an Easy Coach and Key to the Science. By P. Simpel, Esq., R.R.R., M.A. Presented by the Author.

Geological Survey of Ohio. Report of Progress in 1870. By J. S. Newberry, Esq. Presented by the Executive Department of the State.

ANNUAL INTERNATIONAL EXHIBITIONS

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Austrian Jewellery.—Twenty-two boxes of Austrian jewellery have been received, and as soon as possible they will be arranged for public inspection. The specimens include some of the famed Vienese amber work.

The Indian Court opens this day. It has been arranged under the joint superintendence of Dr. Forbes Watson and Dr. Birdwood. It includes Dr. Birdwood's museum of agates, a collection of botanical forms which will be exhibited side by side with the native jewellery, which derives its shape and character from natural forms. There is also Dr. Watson's book on Indian ornaments, illustrated with the actual fabrics. Messrs. Farmer and Rogers exhibit in a side room a large collection of shawls, carpets, and other fabrics of a very high excellence.

The French Annexe was opened on Saturday last without any formality. A detailed account of the articles exhibited will be given in a future *Journal.*

The Belgian Annexe opens to-morrow, Saturday, the 18th.

EXHIBITIONS.

Special Loan Exhibition of Ancient Musical Instruments.—A meeting of the Executive Committee was held on the 14th inst. at Clarence-house. His Royal Highness the Duke of Edinburgh presided, and there were present Lord Gerald Fitzgerald, Mr. H. Leslie, Mr. P. C. Owen, and Mr. Alan S. Cole (Secretary). The private view of the exhibition will take place in the afternoon of Friday, the 31st inst.

The Paris Salon.—The annual exhibition of the works of living artists opened, as announced, on the 10th inst. As already stated, the space allotted to the exhibition is much smaller than in former years, and this fact, together with the views of the administration with respect to the duties of the jury, the total abolition of all former prescriptive rights of exhibition accorded to medalled artists, and other circumstances, have much reduced the extent of the collection of works of art in the *Salon* this year. The number of rooms is less than in former years, and the garden only occupies about half of the enclosed space; the garden has, however, been made unusually attractive by a grand show of palms, shrubs, and flowers, so that the sculpture is set off by beautiful surroundings. The total number of entries in the catalogue this year is 2,067, of which 1,536 refer to paintings, water-colour and other drawings, whereas at the last *Salon*, that of 1870, there were 2,991 paintings, 1,238 water-colour, chalk, and other drawings, &c.; and a total, including sculpture, architecture, and engraving, of 5,430 works, or considerably more than double the number of this year's exhibition. Taking all things into consideration, this is not at all surprising, nor, in some respects, regretable. The direction laid down the wise general rule that there should only be two rows of pictures on the wall, and if this has not been strictly adhered to, it was probably because of want of space, even for the comparatively limited number of works admitted. As was to be feared, a considerable number of the works sent in referred to late events, and some of them were of such a character that, although passed by the jury and hung on the walls, they have been removed at the instigation of the government, an appeal having been made to the patriotism of the artists, on account of the difficulty which still surrounds the political position of the country. It is highly creditable to the artists thus excluded from the *Salon*, that they have acquiesced without protest in the appeal made to them by the authorities. A noticeable point in the arrangement of the present *Salon* is the lavish use of Gobelins tapestry and flowers in the covering and decoration of wooden partitions, plain walls, and ugly corners. The tapestry has been brought from the State stores, and the flowers from the glass-houses of the admirable establishment near La Muette, in the Bois de Boulogne, which supplies the Paris authorities with the thousands and tens of thousands of semi-hardy and yet unacclimatized exotics with which the parks, gardens, promenades, and fêtes of Paris are so lavishly supplied. The setting cannot improve the "water" of the gem, but it certainly lends to it an additional charm.

CORRESPONDENCE.

ENDOWMENT FUND FOR THE SOCIETY OF ARTS.

SIR,—Charity had not played out its roll in relation to hospitals when it had founded those referred to in my last letter. Other classes still remained to be provided for in addition to the aged, infirm, imbecile and leprous, viz., the orphan, the foreigner, and the fallen sister. For the last-named some measure of relief had been instituted by the establishment of the Lock Hospital, but still further aid was given in the penitentiaries or industrial reformatory homes, which were next created. To the establishment of the Foundling Hospital it is more particularly my desire to refer in the present letter, as out of it, or as a consequence of its removal from Hatton-garden, where it was first established, to the site which it at present occupies, coupled with the work which was being done by the Society of Arts at the same period, the Artists of England owed much during the last century.

The Foundling Hospital appears to have had its origin in the following paragraph, written by Addison in one of his political essays, viz., that in No. 150 of the *Guardian*, in which he says:—"I will mention a piece of charity which has not yet been exerted among us, and which deserves our attention, the more because it is practised by most of the nations about us—I mean a provision for foundlings, or for those children who, through want of such provision, are exposed to the barbarity of cruel and unnatural parents. One does not know how to speak on such a subject without horror, but what multitudes of infants have been made away with by those who brought them into the world and were afterwards ashamed or unable to provide for them. There is scarce an assize where some unhappy wretch is not executed for the murder of a child, and how many more of these monsters of inhumanity may we suppose to be wholly undiscovered and cleared for want of legal evidence."

It was not till some ten years after Addison had pointed out the want of an hospital or home for the orphan and destitute children in the metropolis, that Captain Thomas Coram took it up. Captain Coram had constantly seen children left destitute and to perish in the streets, while pursuing his daily avocation at the water-side, and he set to work to see what could be done in mitigation of the misery and wretchedness he daily witnessed. After 17 years of unceasing labour he obtained a charter, bearing date the 17th October, 1739, which recites "That Thomas Coram, in behalf of great numbers of helpless infants daily exposed to destruction, had by his petition represented that many persons of quality and distinction, as well as others, of both sexes, being sensible of the frequent murders committed on poor miserable infants by their parents—to hide their shame—and the inhuman custom of exposing new-born children to perish in the streets, or training them up in idleness, beggary, and theft, had, by instruments in writing, declared their intentions to contribute liberally towards the erecting an hospital after the example of other Christian countries and for supporting the same." The hospital was accordingly opened in Hatton-garden, for the reception of children, on the 27th of October, 1740. Among the earliest supporters of the hospital was William Hogarth, who, on the 14th of May, 1740, presented to it his celebrated portrait of Captain Coram, and Handel subsequently enriched the hospital by his oratorios. Upon the opening, in 1745, of the west wing of the present building, which is situated in Guilford-street, Russell-square, the house in Hatton-garden was given up. The example set by Hogarth of giving works of art to the institution was followed by F. Hayman, R. Wilson, J. Pyne, W. Rysbrack, and others. The claims made upon the hospital soon exceeded the sums placed at the disposal of the managers by the charitable. Parliament was petitioned to aid it, and in 1756 granted to the hospital the sum of £10,000, on condition that all who were presented for relief, from two months to twelve years of age, were to be received, a condition which all but caused the destruction of the institution, as on the 2nd of June, 1756, no less than 117 children were received, and during the year 1,783 were adopted by the institution, and the following year 3,727 were admitted. During the period of three years and ten months, which the unrestricted system of admission lasted, no less than 15,000 infants were received. A trade was created through the country by unscrupulous people, who undertook to convey the cast-off children of vicious parents from towns 300 miles from the metropolis, and to deposit them in the basket suspended at the gates of the hospital, labelled, according to requirement, and there to leave them, at so much per head. The sum paid for bringing a child from York is said to have been eight pounds. The sum of £10,000 voted by Parliament was soon expended. The gross sum paid by the Legislature in support of the hospital amounted to £495,000, or equal to £33,000 per annum during the period it was so subsidised. The support obtained from the King, Parliament, and the nobility, soon rendered the Foundling Hospital a place of general resort for all classes, and the works of art presented by Hogarth and others, constituting as they did the first collection of British works of art, to which the public had the right of free admission, added to the fact that the Society of Arts was, at the same time, rewarding students in art, and exhibiting their works in the rooms of the Society, brought to the artists of both institutions whose works were exhibited numerous commissions from the patrons of art, and this led to an appeal from the artists of London to be allowed to collect and exhibit their works at the Society of Arts. The first exhibition of such collected works of art accordingly took place under the patronage of our Society in 1760, the works being contributed by 69 artists, among whom, as exhibitors, we find the names of Hayman, Reynolds, Woollett, Pine, Wilson, Roubiliac, Pingo, Morland, and others, whose works have rendered their fame known even in our own day.

As I fear this letter is already too long, I hope to be allowed to conclude what I desire to say in relation to the results of the establishment of the Foundling Hospital in my next.—I am, &c.,

H. G. H.

THE PATENT LAWS.

The Select Committee appointed to inquire into the law, and practice, and the effect of grants of letters patent for inventions, have considered the matters referred to them, and have agreed to the following report:—

"Your Committee have continued the investigation commenced last Session into the law, practice, and effect of grants of letters patent, and, after a careful consideration of the evidence on the respective branches of the inquiry given by eminent lawyers, patent agents, inventors, and manufacturers, of this and other countries, have arrived at the conclusions contained in the following resolutions:—

"1. That the privilege conferred by letters patent promotes the progress of manufactures, by causing many important inventions to be introduced and developed more rapidly than would otherwise be the case.

"2. That the same privilege leads to the introduction and publication of numerous improvements, each of a minor character, but the sum of which contributes greatly to the progress of industry.

"3. That in the absence of the protection of letters patent, the competition of manufacturers among themselves would doubtless lead to the introduction of improved processes and machinery, but that it would probably be less rapid than under the stimulus of a Patent Law.

"4. That it does not appear that the granting of pecuniary rewards could be substituted, with advantage to the public interests, for the temporary privilege conferred by letters patent.

"5. That the existing Patent Law of this country and its administration are in many respects defective, and require considerable improvement, in the interests of the public, of manufacturers, and of inventors.

"6. That protection for a limited period, and dating back to the time at which it is applied for, should only be granted for an invention on its nature and particular points of novelty being clearly described in a provisional specification, and upon the report of a competent authority that such invention, so far as can be ascertained by such authority, is new, and is a manufacture within the meaning of the law.

"7. That letters patent ought not to be granted for any invention so protected until the provisional specification has been open to inspection, nor until a complete specification has been deposited, fully describing the means of carrying it into effect, and such complete specification has been found by the same authority to accord in all essential particulars with the description of the invention in the provisional specification.

"8. That all letters patent should be subject to the condition that the manufacture shall be carried on within the United Kingdom, so as to fully supply the demand for the same on reasonable terms to the public, and with due regard to existing interests.

"9. That letters patent shall not be valid for an invention which has been in use in a foreign country, unless a patent for the same shall have been granted in such country, and unless such letters patent shall have been granted in this country to the original inventor, his assignee, or authorised agent.

"10. That the duties payable on patents should be so adjusted as to encourage inventors to the utmost to make known their inventions, and that their primary application should be to the purposes of a complete and well organised record of industrial progress, and to an improved establishment for the conduct of patent business.

"11. That no person concerned in the administration of the Patent Law should have a pecuniary interest in the number of patents applied for, granted, or refused.

"12. That inasmuch as the property created by the Patent Law, and the questions arising under it, are peculiar, the tribunal for deciding contentious matters in reference thereto should, both as to its constitution and procedure, be adapted to those peculiarities.

"13. That the present condition of the Patent Commission is open to serious complaints.

"14. That the Patent Law Amendment Act of 1852 provided that the Commission should consist of certain *ex-officio* Commissioners, viz., the Lord Chancellor, the Master of the Rolls, and the Law Officers of the Crown for England, Scotland, and Ireland, together with other persons to be appointed by the Crown, but no such other persons have ever been appointed.

"15. That the Lord Chancellor, the Master of the Rolls, and the two English Law Officers are now the only Commissioners, and, by reason of their other engagements, it is very difficult to get a meeting of the Commissioners, and practically an officer in the Patent Office does the duty of the Commission.

"16. That the law and its administration are defective:—

(*a.*) They admit of protection, and, subsequently, of a patent being granted for an invention which is not properly the subject of letters patent, not being a manufacture, or, being a manufacture, is not new, and of patents being granted for the same invention to several contemporaneous applicants.

"(*b.*) They offer no guarantee against patents being used solely or chiefly for the purpose of obstruction.

"(*c.*) The facilities afforded to an intending patentee for ascertaining whether his invention is new and insufficient.

"(*d.*) The time, trouble, and expense involved in proceedings affecting the rights of patentees and of the public are excessive.

"17. That the following operations of the law and of its administration is desirable:—

"(*a.*) That protection be not granted to any invention except on the report of a competent person or persons that the conditions of resolution 6, as to such protection, are fulfilled.

"(*b.*) That no warrant for sealing letters patent be issued until the conditions of resolution 7 are fulfilled.

"(*c.*) That in the case of several concurrent applications for a patent for the same invention, the patent be granted to the first applicant, unless it be shown to the satisfaction of the proper authority that he is not the first inventor.

"(*d.*) That all trials of patent causes should be before a Judge, with the assistance of skilled advisers (who may be Commissioners of Patents) and, as a rule, without a jury; but with power to the Court to order a jury for the ascertainment of facts in exceptional cases requiring the same.

"(*e.*) That the Commissioners be reinforced by the appointment of competent persons of legal, scientific, and technical experience, whose time is not occupied with other engagements to such an extent as to prevent their giving full attention to such administration.

"(*f.*) That the Commissioners should make rules, relegating to some of their body, together with competent assistants, among other duties, that of ascertaining as to every invention for which a patent is sought to be obtained, whether it is properly the subject-matter of a patent, whether its nature and the particular points of novelty have been clearly described in a provisional specification, and whether, so far as can be ascertained by them, it is a new invention; and, as to the complete specification, whether it fully describes the means of carrying the invention into effect, and accords in all essential particulars with the description thereof in the provisional specification.

"(*g.*) That all letters patent should contain the following conditions, not hitherto usually inserted therein—viz., that the manufacture be carried into effective operation within a reasonable time, within the United Kingdom, by the patentee or his licencees, so as to supply the demand therefor on reasonable terms; and that licences be granted by him to competent persons on fair conditions, as well as the fact of competency, to be determined in the event of disagreement by the Commissioners, due regard being had in such determination to the exigencies of foreign competition.

"(*h.*) That besides the assistance afforded to intending patentees by the examination of their specifications, and by the reference library of the Patent-office, more satisfactory indices and abridgments of specifications be provided, and, more particularly, that the practice of accepting, without control or revision, the abridgments prepared by the patentees themselves be abandoned.

"(*i.*) That the Court or Judges, having discretion in patent litigation, should avail themselves of the assistance of the Commissioners, for the better definition and limitation of the matters in dispute in respect of particulars of breaches and of objections respectively.

"(*j.*) That in all future appointments of officers concerned in the administration of the Patent Law, remuneration by fees should (as it has been in the recent appointment of her Majesty's Solicitor-General) be discontinued.

"18. That suitable provision should be made by Parliament for the remuneration of the Commissioners who do not act *ex-officio.*

"19. That this Committee are of opinion that there should be an assimilation in the law and practice in regard to inventions among the various civilised countries of the world, and that her Majesty's government be requested to inquire of foreign and colonial governments how far they are ready to concur in international arrangements in relation thereto."

ASPHALTE.

The *Engineer*, in the course of some articles upon asphalte and other pavements, says:—

"From the particulars already given it will be seen that the authorities of the City of London are disposed to afford an extensive trial to the asphalte pavements, at the same time admitting any other mode of paving which appears to offer any advantages. The Commissioners of Sewers have not even discarded wood, but are going to try the American system at a very important junction of streets, where failure would be exceedingly annoying. Trial is also being made of granite pavements jointed with asphalte, a method previously tried in Manchester and several northern and midland towns. The task of providing proper carriage-ways for the enormous traffic of the City is no small matter. Within this square mile, or thereabouts, there are forty-eight miles of streets. 'Of these,' says Mr. Haywood, 'about nine miles of carriage-ways are subject to the largest, most concentrated, and most destructive traffic in the world.' The wear from the traffic causes a large consumption of granite annually, and public convenience requires the use of a granite by no means the hardest and most economical. The expense of maintaining the granite carriage-ways of the City is very considerable. Exclusive of the foundation, a first-class granite pavement costs at the outset 16s. per square yard. In Cheapside and Moorgate-street it may last fifteen years, with relaying and repairs; in the Poultry eight years; and in Old Broad-street and Lombard-street twenty years. The average cost per square yard per annum, after reckoning the first cost and the repairs, and allowing for the value of the old stone at the end of the period, is 1s. 0½d. in Old Broad-street; 1s. 0¾d. in Lombard-street; 1s. 4½d. in Moorgate-street; 1s. 7½d. in Cheapside; and 2s. 9½d. in the Poultry. The last-named thoroughfare almost defies an estimate, but this figure is obtained by calculating that granite would last eight years at that spot if allowed to remain, subject to necessary repairs. In point of fact, a new granite pavement laid in the Poultry in 1865 with Carey's iron tooth-edged trams, was taken up in October, 1870, in bad condition, although the iron trams materially prevented the formation of the ruts to which the Poultry carriage-way is so greatly subject. Thus the granite pavement lasted scarcely five years. The Poultry was laid with wood in 1841 and 1843; with granite partly in 1846, and partly in 1852; and throughout its length with new stone and granite trams in 1859. In 1862 and 1863 came the cast-iron pavement and Redman's iron trams. In 1865 came granite and Carey's iron trams, followed in October, 1870, by the Val de Travers compressed asphalte. Since 1841 one pavement only has lasted as long as seven years, the average duration being of course less.

"The luxury of asphalte paving is undeniable. It is quieter and cleaner than granite, though not quite so quiet as wood. Consequent on the laying of the Val de Travers asphalte the roar of Cheapside has given place to the mere clatter of horses' hoofs, as if a regiment of cavalry had taken the place of the usual wheel traffic. The change is like the calm after a storm; but the process is at once reversed on quitting the region of asphalte and entering upon the granite roadways. In fact, the asphalte has the effect of a tramway, with the absence also of the grinding sensation which accrues from the flange of the wheel as it travels along the grooved rail. After being down for two or three months the asphalte has more of a ringing sound than at first, a result which is attributed to the consolidation produced by the weight of the traffic. Being impervious to moisture, the asphalte paving promotes evaporation, and as there are no joints to retain dirt, it is comparatively easy to keep the paving in a state of cleanliness. When slightly coated with moisture asphalte becomes peculiarly slippery. This condition of things seldom lasts more than a quarter of an hour, and as the asphalte becomes either wetter or drier the slipperiness is reduced. A slight sprinkling of sand—and a very small quantity is sufficient—serves to remedy this evil. The experimental patches of asphalte which are laid in London also have the disadvantage of receiving mud from the adjacent granite, and it is said that granite mud is more slippery than that which is formed on asphalte. During dry or wet weather scarcely any horses fall on the asphalte; but during the brief period of slipperiness many may happen to fall, and as they all fall nearly at the same time public attention is naturally directed to the circumstance. Observations extended over the entire day seem to show that there is no great difference in the slipperiness of the Val de Travers compressed asphalte and granite. The Limmer asphalte, being mixed largely with grit and sand, ought to be less slippery than the kind just named, and for the like reason the liquid Val de Travers is likely to have some advantage over the compressed. Barnett's liquid asphalte likewise has a large proportion of grit.

"Horses falling on asphalte are found to be less injured than if falling on granite, but have more difficulty in getting up again. A little sand, or a horse cloth, removes this disadvantage. So also it is somewhat difficult to start a heavy load on asphalte, or to pull up suddenly. As it is not easy to pull up, drivers proceed with a cautious slowness, which would be less necessary if brake power were employed. The use of brakes seems almost as needful on the asphalte as on the tramway. Neither should drivers expect their horses to make a sudden start on asphalte. Experience is wanting, and as it is attained the asphalte will be found increasingly acceptable. Horses are rendered timid by the numerous transitions which they now undergo from one kind of paving to another, and it is well observed that small detached pieces of asphalte are more likely to cause accidents than greater areas. The progress of opinion is decidedly in a direction favourable to asphalte. The secretary of the London General Omnibus Company considers that the number of horses falling on asphalte is not greater than the number which formerly fell on granite in the same thoroughfares. The inspector of pavements thinks that fewer horses fall upon asphalte than formerly fell upon the granite, and the Superintendent of Street Cleansing has the same opinion. Captain Shaw, who is familiar with the transit of heavy fast-going vehicles, speaks very favourably of the asphalte. Colonel Fraser, the head of the City Police, is, however, inclined to believe that asphalte is less safe than granite. Mr. Haywood himself is also disposed to think that, under an average of conditions, asphalte is not so well adapted for rapid travelling as granite or macadam. If this be so, we should be inclined to attribute the circumstance (apart from the question of gradient) to the absence of brake power, whereby it is necessary to observe a moderate speed if the vehicle is to be kept under due control. The impression as to speed, moreover, depends very much on noise. The rattle and jolting consequent on going "over the stones" is in striking contrast to the noiseless and gliding motion which characterises the asphalte. A passenger unaccustomed to the tramway vehicles is apt to think them slower than they really are.

"Proper care being taken, by a system of street orderlies, to keep the surface of the asphalte in a state of cleanliness, the use of the watering-cart may be dispensed with. This of itself is a great comfort to the public. The sloppy state of the granite carriage-ways in summer is a special nuisance, only tolerated because the alternative may be a blinding cloud of dust. With due care asphalte need have neither dust nor mud. The extra expense does not appear to be serious, taking into account the saving in street watering. One intolerable nuisance connected with granite paving is the quantity of fine gravel which is strewn over the surface for a week or a fortnight after the stones are laid. This gravel is laid on heavily, and becomes either a sea of mud or a mass of dust. A good deal of the stuff goes down the gullies, and has to be got out again at an expense, and the dirt is also carried by the traffic into adjacent streets. The whole affair is eminently uncleanly and disagreeable. From this defect asphalte is happily free. Compressed asphalte when laid is fit for the traffic in a few hours, and is left perfectly clean. Liquid asphaltes are ready for traffic as soon as they become cool. Even when granite carriage-ways are repaired there is the inevitable covering of gravel, sure to yield either dust or mud.

"The laying of asphalte depends greatly on the weather, and rain is often the cause of considerable delay. Moveable coverings have been employed, but wet weather is a great hindrance, despite all exertions to overcome it. The difficulty appears to relate less to the asphalte itself than to the concrete foundation. The latter must be dry before the asphalte is laid on. Small surface repairs can be made more expeditiously in compressed asphalte than in granite, and answer better. Liquid asphaltes require to be heated on the spot, however small the amount of work to be done; but it is believed that a good deal of improvement may be effected in this matter. The smell from the asphalte while being melted is an annoyance, though it may not be unhealthy. The Limmer asphalte, now in course of being laid in Cornhill, is heated in closed boilers, within which a sort of paddle-wheel revolves in order to stir up the mixture, two of these boilers being worked at one time by means of a small portable steam engine. As previously observed, the compressed asphalte, when brought to the spot already heated, gives forth only a slight odour.

"The durability of the asphalte paving is a question of much importance, and at present can scarcely be answered, though there is reason to hope for a favourable result. This element in the problem materially affects the question of comparative cost as between asphalte and granite. The City engineer concludes that the durability of asphalte will be less than granite, and in a report presented last year he calculated that, as a general rule, asphalte would be the more expensive. The great competition which has lately sprung up among asphalte companies, and the new inventions brought forward, encourage hope that the price will be reduced so as to turn the balance in favour of asphalte, unless the introduction of this material should itself tend to cheapen granite. Compared with macadam, it is believed that, where the traffic is heavy, asphalte would prove the cheaper of the two. A curious statement has been made by the municipal engineers of Paris, that gas escaping from the mains has been found to destroy the compressed asphalte by reducing it to a state of powder. Thus far we seem to be without experience on that point in this country. The effect of temperature does not appear likely to prove injurious in London, unless it be in the case of asphaltes of an inferior character. The mess of gas-tar and pebbles, which does duty for asphalte in some of the suburban pathways, is, indeed, horrible. Happily, the better class of asphalte is coming into use for some of the gravel paths, and the luxury of walking on a smooth, clean, and slightly elastic surface is worthy of appreciation. A slight smell of bitumen may be observable under a fervid sun, but the good qualities of the asphalte may be held altogether to outweigh this slight disadvantage.

"The revival of the use of wood may be deemed a somewhat singular circumstance. Improvements have been made in the application of this material for paving purposes, and it offers the advantage of a better foothold than asphalte. The steepest gradient for which asphalte has been used in the City appears to be 1 in 46, and Mr. Haywood hesitates to recommend it for anything more than 1 in 60. At all events there is a pretty good prospect that the extensive trial now being given to various descriptions of paving will demonstrate the question whether we have practically any other choice than granite or macadam. The success of asphalte would be an enormous benefit to the metropolis, in the cessation of the wearying roar which accompanies the passage of heavy traffic over paved roads, and in the comparative absence of dust and mud. The noise of the London street traffic cannot fail to exhaust and injure those individuals who possess a peculiarly nervous organisation, and perhaps all who are subject to the uproar are made to suffer more or less, even though they may be unconscious of the exact cause. Dust and mud are also real nuisances. The former cannot fail to occasion a very serious pecuniary loss in the damage done to goods and furniture; while as for mud, its presence on the foot-pavement, partly occasioned by the dirtiness of the road, is the occasion of much fatigue in walking. Even in riding, the jolting effect of the paved roadway is a source of distress, in addition to the noise. Let any one ride in an omnibus going westward through Cheapside, and notice the kind of shock occasioned by the transition from asphalte to granite. Horseflesh is also to be considered. M. Leon Malo, a French engineer, has computed that if all Paris were paved with the Val de Travers compressed asphalte the saving in wear and tear to horses and carriages would be £340,000 per annum. How far the calculation is correct may be difficult to say; but of the economy of asphalte in its effects on horses and vehicles there can be no question. Its general use is a consummation much to be desired, and the present competition will doubtless tend to reduce the cost of this luxurious improvement in the art of road-making. Our only fear is whether it will stand the hard work demanded of it; though it must be remembered that granite often has to be patched and mended, and what is called 're-laying' is a formidable affair."

GENERAL NOTES.

Italian Literature.—A periodical, called the "Economista di Roma," is now published in Rome, and contains papers upon finance, agriculture, commerce, trades, public works, and statistics.

Raphael's Cartoons.—With a view to preserve accurate copies of the cartoons of Raphael, the Lords of the Committee of Council on Education, acting through a committee, propose to select nine artists to make preliminary studies of given parts of three of the cartoons. Artists will first be required to complete an accurate copy, either in water-colours, tempera, or oil, of a photograph, full size, of a head, selected from the "Beautiful Gate." These will be sent in to the Secretary of the Science and Art Department by the 31st July, 1872. From the candidates so competing nine may be selected to make accurate coloured copies from the cartoons themselves of portions set out by the committee as a final test. Candidates will be allowed £2 per week for not more than eight weeks to complete these copies, which will be the property of the Science and Art Department. If the competition prove satisfactory, a further selection of portions of the cartoons will be made to continue the work of reproduction.

The French Census.—The enumeration of the French people is usually taken every fifth year, but the late war caused it to be deferred from last year to the present. The method of taking the census is not the same as that which prevails in England and Belgium, but is left in the hands of the municipal authorities. Many statisticians complain of the incompleteness of the French system, and have recommended the house-to-house plan of our own country. It may be mentioned, however, that a short time since an attempt was made in that manner in Paris to obtain a census of the religious persuasions of the inhabitants, but it resulted in total failure. The first enumeration of the people of France was made in the time of Charlemagne; the instructions issued on the subject still exist, but, unfortunately, very little is known of the results, which are but slightly alluded to in the Polyptiques. Sully, and after him Fabert, made unsuccessful attempts to take a census. The assertions to the effect that the numbers were taken in the time of Charles IX., and amounted to twenty millions, are not credited. The first regular official census of modern times was that taken in 1700, on a plan sketched by Vauban in 1697, when the total arrived at was 19,669,320. Sixty-two years later an individual enumeration was made, when the numbers had only increased to 21,769,163; but the previous estimate, being in fact rather guesswork, was probably exaggerated. In 1784 a third enumeration was made, under Necker's orders, but this was only based on the averages of the births. Since 1801 the census has been taken regularly at intervals of five years, but down to 1846 the only information consisted of the sex and occupation of the people; in 1851 it was extended to the ages, religious creeds, nationalities, and exterior and visible infirmities of each individual. The results of the census of 1866 were as follows:—

Natives—Men	19,014,079
Women	19,062,985
Total	38,067,064
Foreigners	635,495
Troops in Mexico, China, &c.	120,000

This census gave 127 centenarians for the whole of France. The schedule of avocations gave the following results:—

Agriculture	19,598,115
Industry	10,959,091
Commerce	517,158
Liberal professions, and people of independent property	3,607,295

In the interval of sixty-six years, from 1800 to 1866, the population of the whole country increased to the extent of 10,618,061, or rather less than 40 per cent. The result of the coming census cannot fail to reflect seriously the sad events of the last two years.

Granite Glass.—The *Baltic Journal* reports that there exists near several cities of Finland a kind of granite, called there *Cupakivi*, of which the composition is this:—Silica, 74 per cent.; feldspar, 12; oxide of iron, 3; lime, 1; alkalies, with traces of magnesia, 9. This being evidently a good compound to make glass, the first experiment was consequently made by melting 500 parts granite, and 200 limestone, and a white glass was obtained. The second experiment was made with 500 granite, 150 lime, and 75 of soda. This glass was more fusible, and at the same time harder. Both kinds were blown without difficulty, at a bright-red heat, while a dark glass was made by the addition of 70 parts of sulphate of lime or potash and 7 parts of carbon.

Improved Blowing Apparatus for Blow-pipe Operations.—The *Berg-und-hüttenmännische Zeitung* contains the following description of an improved blower, by Messrs. Armin, Junge, and K. Mitzopulos, of Freiburg. All workers with the blow-pipe are well aware how much the work is facilitated by a good blowing apparatus. In qualitative operations it can be dispensed with, but there are certain assays, such as concentrating cupellations for poor silver ores, which cannot be carried on without a blower, save with great exertion. For this reason, nearly every one who has quantitative assays to make provides himself for a blowing apparatus. The ordinary blowing apparatus consists of three parts, the caoutchouc bellows, the regulator, and the stand for the nozzle. The part which most easily gets out of repair is the caoutchouc regulator, for the operator, looking at his assay, often does not perceive how the regulator gets too much stretched by the blast; the consequence is that the regulator often bursts. When we recollect that such regulators are not to be had everywhere, and that a reserve stock is often useless, from the caoutchouc getting hard, it becomes important to find a substitute which will give as regular a blast, and can be made of a more lasting material. It is this that we have had in view in making our regulator, and we will proceed to explain its mode of construction for the benefit of those who might happen to want one. Our regulator gives a perfectly constant blast, which can be used either for the oxidising or the reducing flame, and after numerous trials we can say that it is in no way inferior to the caoutchouc regulator. At the same time it is so simple that it can be constructed with great ease and in a very short time. The arrangement is as follows:—A common wide-mouthed bottle is carefully fitted with a caoutchouc cork bored with two holes, into each of which passes a piece of glass tube bent at a right angle. On to one of these tubes is slipped the caoutchouc tube coming from an ordinary caoutchouc bellows, whilst the other is put in communication with the blow-pipe nozzle by means of four pieces of caoutchouc tubing joined by three pieces of glass tube, drawn to a fine point at each end. This forms the main peculiarity of the arrangement. When air is forced into the bottle by the blower in jerks, it finds a difficulty in escaping as fast as it comes in, on account of the six fine openings in the glass tubes that it has to pass through on its way from the bottle to the nozzle, and it thus acquires a certain pressure in the bottle and flows out towards the nozzle as a regular blast. The bottle may be about 6in. high by $3\frac{1}{2}$in. wide, with a neck $1\frac{1}{2}$in. in diameter; but of course the dimensions are of no great importance. On the whole a somewhat large bottle is better than a small one. The pieces of glass tubing we use are 2in. long by $\frac{1}{3}$in. in diameter. The apparatus will be stronger if instead of a glass bottle a tin cylinder is used, about 4in. high by 2in. in diameter, with two tin tubes opening into its top. Small metal cylinders with a fine hole at each end may be used instead of the little glass tubes. A blowing apparatus constructed in this manner will deliver a perfectly regular blast, and will be of practical interest to those who are thinking of working in places where it is difficult or impossible to repair the ordinary instruments.

Lead in the United States.—Since the breaking out of the Californian gold fever, twenty-three years ago, the western lead-mines, which had up to that period supplied all the wants of the United States, have attracted very little notice, and the production of the states Wisconsin, Iowa, and Illinois, has rapidly fallen off, as may be seen by the following figures, which give the quantity of lead shipped from the Upper Mississippi mines, viz :—

	Pigs.		Tons.
From 1822 to 1831	664,118	or	28,244
,, 1832 ,, 1841	1,591.958	,,	35,718
,, 1842 ,, 1857	6,170.857	,,	215,979
,, 1852 ,, 1861	4,609,553	,,	161.334
,, 1862 ,, 1871	2,419,985	,,	84,700

It will be observed that from 1852 to 1861, there was a decrease of $25\frac{3}{10}$ per cent., and from 1862 to 1871 there was a further decrease of $47\frac{1}{2}$ per cent. It is not to be supposed that the mines are exhausted; on the contrary, it is known that many thousands tons of ore exist in mines that have not yet been touched, and which are held by the owners for prices that are not at present attainable, otherwise the production of lead might have been greatly increased, and a large amount of money saved that has been paid meanwhile for foreign lead (nearly 4,000,000 dollars were paid during the last year) besides furnishing labour to thousands of hands. The imports of foreign lead into New York alone have been as follows :—

	Pigs.
1852	272,657
1854	400,020
1856	301,536
1858	254.573
1860	362,031
1862	613.088
1863	212.661
1864	462.272
1865	226,791
1866	449,307
1867	415,757
1868	385.277
1869	535,790
1870	496.157
1871	516,912

A pig of foreign lead is fully equal to two of American.

The St. Gothard Railway.—The works of the St. Gothard Railway will shortly be commenced, and the company have already invited contractors to send in tenders by the 18th May, for the construction of the great tunnel, which will be 14.800 metres in length. The geological structure of the Alps, through which the tunnel is to be driven, is supposed to be as follows :—

	Metres.
Granitic gneiss..............	1,875
Gneiss	350
Black and green schist, marble, and granitic schist	2.790
Granitic gneiss..............	3,750
Gneiss	465
Granitic gneiss..............	2,300
Gneiss and mica scist	1,415
Schists	1,195
Dolomite and gypsum........	650
	14,800

It will probably be found advisable to sink a shaft about 300 metres in depth, about 3.550 metres distant from the northern entrance near Goeschenen, whilst the southern half must be driven entirely from the entrance near Airolo. Abundant water-power can be obtained from the Gothardreuss on the north side, and from the Ticino on the south. Signor Grattoni, the engineer of the Mont Cenis Tunnel, it is stated, is in treaty with the company for the construction of this tunnel, and it is said that an English contractor, as well as a Swiss firm, are also about to tender for this work.

Mushrooms.—The French are famous for mushrooms' as all the world knows, and their cultivation is conducted with great art and on a large scale. The method of production, says the *Gardeners' Chronicle*, is as follows :—"The spawn of the common mushroom is taken up with a moist camel-hair pencil, and laid on a damp strip of glass, so that it can be placed under a microscope, and the process of germination of the spawn watched during its modification. When the mycelium, or *blanc de champignon*, as it is called in France, is developed, it is placed in highly-manured earth, where the development continues; the finest specimens are afterwards selected and placed in a mushroom-bed in a cave or quarry, and covered first with a bed of sand 10 inches deep, and over that a layer of old plaster, about six inches thick, the whole being watered, with the addition of a small quantity of nitrate of potash. At the end of five or six days very large mushrooms will be obtained, clustered together in masses, and of delicious scent and flavour."

Light Coin Rejector.—Mr. J. M. Napier exhibited at the Royal Society's Soirée a beautiful little instrument which he calls the "electro-magnetic light coin rejector." It covers a space of only $8\frac{1}{2}$ by $5\frac{1}{2}$ inches. The coins are placed on a hopper or reservoir, and by merely turning a handle for each coin they may be passed on through the instrument at the rate of sixty a minute, the light into one receptacle, the heavy into another. The mechanism of the instrument is somewhat complicated, but the principle of action may be simply explained. Attached to one end of the balance for weighing is a pan for receiving the coin, and at the other a counterpoise, exactly what the coin ought to weigh. The first operation of the instrument is to place the coin exactly on the pan, the next is to set the balance free to weigh it, then if it is full weight it is lifted out of the pan and passed forwards over a horizontal piece of steel which is beveled to an edge, and is then so placed that it guides the coin to one of the two apertures below; but if on weighing, the coin is light, another part of the instrument is brought into play, the counterpoise sinks down and touches a communication with the electro-magnet, which acts so as to to alter the position of the horizontal piece of steel on which the coin is passed over, so that it falls into another aperture.

Ceylon Coffee.—The Planters' Association of the island of Ceylon have addressed a memorial to the House of Commons, praying that, "as an act of justice to them as producers, as an act of justice to the British consumer, in the interest of all that is honest and right, such legal measures may be adopted as will effectually check among traders of the United Kingdom the widely prevalent, nay, almost universal practice, of mixing and adulterating coffee with chicory and other deleterious substances." The memorialists point out the gradual decrease year by year of the consumption of coffee in this country, and this in face of annually increasing imports and an increasing population. In contrast to this, on the continent of Europe, in the United States of America, and in other countries, there has been a steady increase in the consumption of the article. They believe that the disfavour into which coffee has been brought in Great Britain is attributable mainly to the practice of adulteration, "which, in the case of this, as of many other articles of food, has become so prevalent as to make the genuine article unknown." They complain that, whereas in other countries effective measures have been taken to suppress adulteration, virtually no legal enactment of the kind is in force in Great Britain, where the dealer can with impunity introduce the most noxious substances into food, to the detriment of producer and consumer alike. They direct attention to the following facts, showing how the imposition and withdrawal of legal enactments preventing adulteration have affected the consumption of coffee here. The consumption of coffee in 1847, the greatest in any year up to the present date, was 37,472,153 lbs. In 1848, an agitation commenced against the sale of chicory and other deleterious substances mixed with coffee, but no prohibitory measures were adopted. The consumption fell to 31,226,840 lbs. in 1850. It, however, increased the following year to 32,564,194 lbs. on reduction of the duty. In 1852, the issue of a Treasury order prohibiting the sale of loose chicory, or of a mixture of coffee and chicory, was passed. An increase at once took place in the consumption, which in 1854 amounted to 37,471,014 lbs. The extra duty imposed during the Russian war was followed by a decrease to 35,500,000 lbs. On the 1st May, 1863, the Treasury order of 1853 was rescinded, and the sale of a mixture of coffee and chicory permitted. From that date to this there has been free-trade in the adulteration of coffee as of other articles in Great Britain. The consumption fell to below 33,000,000 lbs., in 1863, to 31,589,597 lbs., in 1864, and to 29,108,932 lbs., in 1869, or less than in any year since 1842, when the population was probably four or five millions less than in 1869. The market of Great Britain has been, the memorialists complain, for a quarter of a century past, more than half closed to them because of the dishonest practices of their own countrymen.

The Louvre.—The mode of bringing to light the long-hidden treasures of the Louvre, and making them subservient to art education, has been further discussed. The direction of the Beaux Arts, regarding the subject strictly in the light of a development of artistic instruction, has come to the decision that the dissemination of the surplus pictures and sculpture amongst a large number of provincial museums would not be productive of all the effect which is to be hoped for, and therefore it is proposed to divide the thousand or more works of art amongst seven or eight large towns only, Lyons, Nantes, Limoges, and Toulouse being of the number, the only condition being that each of the towns shall find rooms of sufficient size, not only for the pictures and statuary, but also for the public; and that the works shall be placed, not only in a good light, but with the proper aspect. It is hoped that this mode of disposal will create several important art-centres, such as already exist at Rouen, Havre, Montpellier, and some other large towns; this plan seems to be promising, and will certainly help provincial art, which, in spite of many disadvantages, furnishes Paris with a majority of her best painters and sculptors. The completion of the work only awaits the decision of the municipal authorities of the towns selected as recipients. Few facts could better give an idea of the magnitude of the collections in the Louvre than this offer of more than a thousand works of art, considered by two competent commissions as valuable as objects of study. It appears that the idea of removing the curiosities of the Musée des Souverains from the Louvre to the Cluny Museum has been given up, and that they will shortly be replaced in their old positions. It is hoped that the entire re-arrangement of the Louvre, and the revision of the catalogue, will be completed in a few weeks, but the task is a heavy one.

Apparatus for the Blind.—At a recent meeting of the Royal Scottish Society of Arts, a communication was read from Mr. Albert Meldrum, teacher of the blind, Alloa, describing an improved method of corresponding between blind persons. The invention consists of two parts—the upper having the types, with keys and levers for moving them, and the lower containing the paper-moving apparatus. The base of the upper part is a metal disc, with a circular hole in the centre. Around the central opening are arranged twenty-six little hammers, having on their striking surface copper types for embossing the paper. The types are so arranged that they all strike at the same place, viz., on the opening in the disc, and each hammer, after striking, is pulled back to its original position by an indiarubber band. Each of the keys represents a letter, and when any particular key is pressed down the corresponding hammer strikes, and the type makes a mark on the paper, which is stretched on a revolving drum in a drawer below the disc. When one letter is impressed the drum is moved round by a handle in front of the machine, and a plain surface is presented for the next stroke. When a line is finished the drawer in which the paper moves is pulled out one line. The machine is constructed to print Moon's type, but its principle is equally applicable to any other, especially to Braille's. After the paper had been read the machine was exhibited in operation, and worked very satisfactorily.

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evening at eight o'clock.

May 22nd.—"On Painted Metallic Hangings for Mural Decoration." By G. Clark, Esq.

May 29.—Derby-day. *No meeting.*

CANTOR LECTURES.

The Sixth Lecture, on "Silicates, Silicides, Glass, and Glass Painting," by Professor Barff, was delivered on Monday evening, May 13th. The concluding lecture will be given as follows:—

Lecture VII.—Monday, 27th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

Monday, the 20th, being Whit-Monday, there will be no lecture.

INDIA CONFERENCE.

On June 7th a Conference will be held at half-past four, on "Engineering Education in India," to be opened by Mr. Hyde Clarke.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon......Anthropological, 8.

Tues. ...Civil Engineers, 8.
Statistical, 7¾. 1. Mr. Stephen Bourne, "On the Official Trade and Navigation Statistics." 2. Mr. John Glover, "On Tonnage Statistics, 1861-70."
East India Association, 3. (At the House of the Society of Arts.) Dr. George Birdwood, on "Competition and the Indian Services."
Royal Institution, 3. Mr. E. B. Tylor, "Development of Belief and Custom."
Pathological, 8.
Zoological, 9.

Wed.....**SOCIETY OF ARTS, 8.** Mr. G. Clarke, "On Painted Metallic Hangings for Mural Decoration."
Geological, 8. 1. Rev. O. Fisher, "On the Phosphatic Nodules of the Cretaceous Rock of Cambridgeshire." 2. Mr. W. Johnson Sollas, "Some Observations on the Upper Greensand Formation of Cambridge." Communicated by the Rev. T. G. Bonney. 3. Mr. George Henderson, "Notes on Sand-pits, Mud-volcanoes, and Brine-pits, met with during the Yarkand Expedition of 1870." Communicated by Mr. R. Etheridge.

Thurs...Philosophical Club, 6.
Royal Institution, 3. Prof. Tyndall, "On Heat and Light."

Fri.......Royal Institution, 9. Prof. Clifford, "Babbage's Calculating Machines."
Linnæan, 3. Annual Meeting.
Victoria Institute, 4. Annual Meeting.
Quekett Club, 8.

Sat.......Royal Institution, 3. Prof. Roscoe, "On the Chemical Action of Light."
Royal School of Mines, 8. Dr. Cobbold, "On Geology."
Royal Botanic, 3¾.

Journal of the Society of Arts.

No. 1,018. Vol. XX.

FRIDAY, MAY 24, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

PROCEEDINGS OF THE SOCIETY.

TWENTY-THIRD ORDINARY MEETING.

Wednesday, May 22nd, 1872; ANDREW CASSELS, Esq., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Garrett, Captain Newton D., R.A., East India United Service Club, 14, St. James's-square, S.W.
Higgins, William Henry, 31, St. Swithin's-lane, E.C.
Holland, John, 93, York-road, Lambeth, S.E.
Nevill, Richard, Felin Foel, Llanelly.

The following candidates were balloted for and duly elected members of the Society:—

Cheston, Chester, jun., Manor-offices, West Hackney, E.
Christie, Hector, Langcliffe-place, Settle, Yorks.
Fletcher, Rev. T., D.D., Park-house, Hampton-wick, S.W.
Howell, Charles A., Northend-grove, Northend, Fulham, S.W.
Jones, George Hugh, Buxton-college, Grove-house, Forest-lane, West Ham, E.
Lofts, Henry, 99, Mount-street, Grosvenor-square, W.
Pellegrin, Louis Antoine Victor, 36, London-street, Fitzroy-square, W.
Render, Frederick, Beech-house, Etchels, near Handforth, Cheshire.
Wybrow, William, Ravensbourne-lodge, Bromley-common, Kent.

The paper read was:—

ON PAINTED METALLIC HANGINGS FOR MURAL DECORATION.

By George Clark, Esq.

Of the many social evils, few are more intolerable than house-painting. When the painters take possession of a dwelling, the inmates are put to the rout, or exposed to certain misery for days, if they occupy any part of the building whilst painting is going on. What is more nauseous than the smell of paint?

The object of this paper is to bring under your notice a mode of house painting and decoration, which, in its nature, is novel, and probably destined, not alone to remove the evils of house painting as now executed, but to produce a revolution in mural decoration.

It may appear strange to assert that by this new method the painting and decoration for the walls or wainscots, the doors and windows of a house, externally or internally, are manufactured in the workshop in a portable form, and may be affixed to the surfaces to be covered with the same facility and dispatch as paper-hangings.

I pause for a moment, in pursuing my subject, to mention as a curious historical fact, with which I only to-day became acquainted, that nearly twenty years ago an ingenious decorative painter, Mr. H. Page, took out a patent for an invention which he entitled skins of paint, with the view of attaining the same object which has been accomplished by the invention now under consideration. As a proof of the merit of the invention, and its appreciation by the Society of Arts, a prize was awarded to Mr. Page. But, although his method was applied in practice in one or two instances, it was not commercially successful, by reason, I believe, of its being applicable only to plain surfaces. Mr. Page had not imagined the happy idea which you will presently learn is the essential foundation of the invention I am about to describe. The fact is curious, and I feel it a duty to allude to it as an evidence that so long as twenty years ago it was considered by the Society of Arts a desirable object to produce portable painted hangings.

Decorative painting, which occupies eight or ten days by the present system, may be completed by this new method in one-fourth of the time, with no smell of paint in the house, and with trifling inconvenience to the inmates. Indeed, they may continue to occupy the premises without suffering any annoyance whilst the work is in progress.

This new mode of house painting is so simple that a short description will explain it. An easy way to bring the nature of it home to the comprehension is to compare it with paper-hangings, the form and application of which are familiar to all.

In justice to our intelligent neighbours across the Channel, I wish to mention that the new art, of which you see the beautiful specimens around you, is a French invention. The first conception of the principle was the idea of a journeyman painter, who saw damp walls, intended to be painted, covered with tin-foil, but he was unable to realise and give a practical form to his crude idea. A gentleman of mechanical genius, who aided the painter, imagined and produced the tools, and invented the *modus operandi*, without which the work and production could not be economically done. An eminent Parisian decorative painter associated himself with the undertaking, and brought his experience to bear on its practical application. Their combined industry, intelligence, and perseverance brought to its present state of perfection the invention, of which a description follows.

Tin-foil in sheets, the thickness of ordinary writing-paper, is the material on which this new style of mural decoration, including gilding, is executed. Tin-foil is pliable and supple, sufficiently tough not to be easily torn, and offers a smooth and uniform surface. It forms an excellent base for the work executed upon it. It also possesses the advantage of being waterproof, a property well-known to architects and builders, who frequently use it to cover damp walls, on which without that covering any decorative work would soon perish.

The process of executing the painting on tin offers no difficulty. The sheets are manufactured of a width and in lengths suitable to their application on the surfaces to be covered. At the manufactory in Paris the ordinary widths made use of are from 30 to 40 inches, and the length 5 metres, or rather more than five yards.

The following are the processes, as I saw them carried out in Paris at the works of Messrs. Daniel and Co., Rue de Rocroy:—

A portable frame, corresponding in length and width to the dimensions of the painting intended to be produced, is placed on a solid table, made as true and level as a billiard-table. For the perfection of the work, the face of this frame is required to be perfectly level, hard, and smooth. A sheet of glass presenting these advantages in an eminent degree was at first made use of, but as this material is fragile and not safely removable, stiff card-board of the finest texture has been substituted for glass; and, after successive improvements, by using double card-boards of considerable thickness, with stretchers and braces between the two boards, an appropriate frame has been produced well adapted for the requirements of the manufacture, presenting a level, hard, and smooth surface, and conveniently portable. The sheet of tin-foil is carefully laid on and extended over the frame from end to end, and is smoothed down to the surface of the frame with a suitable tool, being secured at both ends to stretch and keep it from shifting. The coating of ground colour, whatever it may be, is laid on the tin sheet with a brush in the ordinary way of painting, so as to cover the metal with a good coat of paint. This process being completed, the frame is removed into a drying-room, where a regular temperature of 80° to 90° Fahr. is maintained by a system of heating, which sends a current of hot air through the room, and speedily dries the coat of paint. For the next process, when the paint is quite dry, the frame is taken out of the drying-room and placed on the table before described. The execution of what may be termed the decorative coat of paint is produced by mechanical means, which may be familiarly described as stencilling and printing by means of sheets of thin copper for the former, and rollers for the latter, much after the manner of staining paper-hangings. The exact nature and the mode of producing these two kinds of tools, which are the most important instruments for the artistic perfection of this new decorative work, I will presently describe; but to give an idea of the celerity and precision with which the process is effected, it may be mentioned that the stencil plate, of the same width as the sheet of tin, is placed over the ground coat, and the painter produces the pattern by painting with the brush over the stencil plate. Or if the roller be used, it is charged with colour, and being passed over the ground coat, produces in like manner the required pattern. Both these tools are sometimes alternately used to produce certain patterns or effects, but, as a rule, the imitations of woods are stencilled, and those of marbles printed. No grainer, however skilful, could attain the same perfection, or do the work in a tythe of the time. The best graining is not an imitation of nature, it is a conventional representation of wood or marble, but could hardly be taken for nature itself. Whereas the imitations, of which specimens are before you, are so exact that skilful judges might take them for reality. The frame is now again conveyed to the drying-room, and when sufficiently dry is brought back to the table, and the paint is covered with a coat of varnish; this again being dried as before, the painted sheet of tin is ready for use. If more highly-finished work is required, as in the case of imitations of the finest woods and marbles, a second coat of varnish is laid on, and this, again, after being dried, is brought to the highest state of finish by being polished on the frame. The painted sheets, of any degree of finish, are removed from the frame, and after being dusted with soap-powder, are rolled on cylinders, being now in a merchantable form ready for sale and application with the same facility as paper-hangings. But it is well here to observe that the difference between painted metallic hangings and paper-hangings is, that on the former the decoration is oil-painting, and when applied to any surface is more durable than painting on such surface by the ordinary method, whilst the base or lining being metal the painted decoration is effectually protected from damp. These advantages make it superior, not only to ordinary painting, but, in a much higher degree, to paper-hangings, which are stained with water-colours of much shorter duration, and subject to the effects of damp both in the walls and externally.

The application of the painted metallic hangings to either wood, stone, plaster, or iron surfaces, offers no difficulty. The operation is somewhat similar to putting up paper-hangings, with this difference, that with the latter the paper is pasted over at the back before being hung, and with the former the surface to be decorated is covered with a thin coat of adhesive varnish, on which, after it has been left to dry partially, the painted tin is affixed with great ease. So little is the difficulty that any skilled paper-hanger can, after a few hours' practice, do the work successfully. From the extreme flexibility of tin-foil, mouldings and cornices are covered with the metallic hangings in the most perfect manner, and with a smoothness of surface and sharpness of outline at the edges and mitres which the painter's brush cannot rival.

These last effects are obtained by covering undulating surfaces with the painted material, of dimensions slightly larger, say $\frac{1}{8}$ to $\frac{1}{4}$ inch in length and width, than the superficial measure. By this contrivance, when the painted tin-foil is affixed on any surface with the varnish, the excess of length or width is cut away along a straight edge with a sharp knife, which leaves the edge of the work clean, and invisible where two edges meet. It is thus that the close joints are obtained in mouldings and mitres as in the specimens exhibited.

The varnish used for fixing the material is of the nature of gold-size, but more adhesive. Being of itself "hydrofuge" it adds to the protection of the paint against damp.

The manufacture of the tools before mentioned (the stencil-plate and printing-roller) deserves notice as an ingenious mechanical contrivance. The first operation in their production is to make a drawing of the grain or pattern of the wood or marble. For that purpose a selected slab is placed before an artist, who traces an exact copy of the pattern on prepared paper, from which the drawing is transferred, when a stencil is required, on to a thin sheet of copper covered on both sides with a coat of wax.

Then, with a graving tool, as in etching, the wax is removed from the lines, and spots, and figures of the pattern, whereby, in those places, the copper on that side is laid bare. The sheet of copper is afterwards plunged into an acid bath, in which the design of the pattern is bitten through, thus producing a perfect stencil of the imitative copy of the original slab. The tool is now ready for use. When a roller has to be made, the drawing is transferred to a stout piece of buff leather, of equal thickness throughout, and the material between the lines and marks of the pattern is cut away, as in wood-engraving, the pattern remaining in relief. The leather so prepared, being fastened to a large wooden cylinder, this tool is also ready for use. Being charged with colour, it reproduces the pattern of the wood or marble on the tin-foil, in the manner before-mentioned.

The process is successfully applied to gilding. Gold leaf is laid and fixed on a sheet of tin, in the workshop, in the usual way, without any waste of the precious metal, whilst in ordinary gilding the loss is usually estimated at 25 per cent. The gilded foil, which may be produced burnished or matt, being cut in strips to the required dimensions, is readily applied to frames, mouldings, poles, or rods, previously coated with adhesive varnish. The foil being remarkably flexible, easily follows the sinuosities of the work, and the gilding thus produced is equal to the best gilding by the ordinary method on wood or plaster, and superior on iron or zinc, nor being liable to oxidation, which, in time, eats away the gold laid on those metals.

About a year before the late war, the first application of painted tin hangings was successfully made in several houses in Paris. Soon after order was restored in that city, this new style of decoration was adopted by several French architects, and especially by M. Blondel, one of the most eminent, who now introduces it in preference to decorative painting with the brush, for the works he undertakes, a handsome saloon in his own house being so decorated.

Looking at the beautiful and highly ornamented specimens exhibited in this room, it might be supposed that painting on tin is more especially adapted for artistically finished decoration; but commercially it compares advantageously with ordinary house-painting, whether plain or graining work, as by the mechanical means employed it is economically manufactured, besides its advantages of promptitude of execution and avoidance of nuisance whilst the work is in hand. For embellishing walls or ceilings, pictures, designs, or medallions may be painted by the artist in his studio, or printed by chromo-lithography on pieces of the painted tinfoil destined to form panels or cover reserved spaces. The work is executed in a higher style, and at much less cost than would be possible if the embellishments were painted on the surfaces with the brush. Specimens of the designs referred to are in the room.

For imitation veneer of fine woods, marble, mosaics, and inlaid work, including tortoise-shell and mother-of-pearl, applied to furniture and fancy articles, as work-boxes and tables, or paper and dressing-cases, the new invention is artistically and commercially of much value. Some notion of productions of this kind may be formed from the specimens on the table.

This method of mural decoration being practically unknown in this country, where it has not been introduced at an earlier period in consequence of the disastrous influence of war on industry of every kind, I am desirous to show that the art is by no means in its infancy, or even in that preparatory state which is the inevitable condition of every new invention before it is applied in practice. I will venture to refer to letters, addressed to the patentees of this invention, with the view of establishing the fact that in France the use of painted metallic hangings is not an embryo scheme, but an established industry actually in operation, from H. Blondell, architect; Charles Morell, architect; M. Merchadier, proprietor of a café restaurant; Madame Leotard, haberdasher, Paris; Count d'Alcantara; Charles Bury, architect; and M. Albertini, Consul of Peru at Paris; all of whom admit that the new process combines all the advantages that could be desired, that is to say, the most perfect imitation of nature, rapidity of execution, and durability, without any inconvenience, and that on damp walls it is particularly successful.

During a recent visit to Paris, I had the privilege, by the courtesy of the occupiers, to view the premises referred to, and having examined the work carefully, I am able to say the statements I have read to you are correct.

Reviewing the characteristics of this remarkable industrial invention, of which, in a scientific and artistic sense, I fear, from the want of technical knowledge of the trade it relates to, I have not given so complete and lucid a description as it deserves, and as will bring its merits home to your minds, taking the commercial view, I will briefly enumerate its advantages.

1st. It supplies mural painting in a portable form, superseding the use of the painters' brush for decorating any part of a building.

2nd. Painting and decoration of every kind can be executed with more skill, artistic effect, and finish, than by the painter on stone, plaster, or wood surfaces.

3rd. When walls or wainscots are finished by the mason or carpenter, instead of the painter being engaged many days in covering them with coats of priming, paint, and varnish, for drying each of which an interval of one or more days is indispensable, the painted sheets of tinfoil are, by means of adhesive varnish, attached to such walls and wainscots with the same facility and expedition as paper hangings.

4th. The painted hangings being finished and perfectly dry before leaving the workshop, there is no smell of paint in the building where the work is applied, and they are so securely fastened to stone, plaster, or wood surfaces that they cannot be detached without scraping off the metal.

5th. The material on which the work is produced being metal, preserves the most elaborate painting and delicate ornamentation executed upon it from the effect of damp, so that walls not dry may be painted by this method without damage to the work.

6th. The durability of the work, and its exemption from injury by time and weather, inside or outside a building, are greater than ordinary house-painting, the colours in the former case not being absorbed or deteriorated by the material forming the base, which is a metal, as they are in the latter case, where the material is wood, stone, or plaster.

7th. Highly finished painting and decoration, including imitations of fine woods and marbles, panels enriched with gold and coloured mouldings, fillets, designs, devices, and pictures, are executed in an artistic style, in greater perfection and at less expense than by painting on the surface to be decorated.

8th. In repainting the interiors of buildings, rooms or sections may be finished in a short time at convenient hours, one after the other, with only trifling disturbance to the inmates, and without the anoyance of the smell or injurious effects of paint. Or a shop, warehouse, hotel, or public building may be painted and decorated without suspending business or soiling the clothes; the work of a week by the old method being executed in a day.

9th. Embellishments in the Watteau and Boucher style can be executed in greater art-perfection, and at much less expense, than by painting on the walls.

10th. Being readily applicable to buildings, without skilled labour, it is valuable as an article of commerce. Made up in rolls which may be kept in stock without deterioration, it may be supplied to provincial towns where skilled painters are not to be found, and may be exported to distant countries, where decorative art is rare.

11th. Decorated furniture, imitating polished veneers, marqueterie, or inlaid work, and buhl, not to be distinguished from the real, can be manufactured at one-third the price of the latter.

12th. For gilding or covering with imitation veneers of fine woods, it offers special advantages, applicable to picture and looking-glass frames, mouldings, curtain-poles, and rods of any kind.

Estimating the value of the new method of mural decoration, which I have had the advantage of bringing under your notice through the Society of Arts, an institution to which the country is so much indebted for the advancement of art manufacture, I think I shall not go too far in saying that this will prove to be one of those remarkable and entirely novel inventions appearing at distant intervals, which, after they are thoroughly tested, appreciated, and brought into practical use, revolutionise and improve an important industry.

The skin of paint referred to by Mr. Clarke was brought before the Society in the year 1846, and the following is the account of it in the *Transactions* of the Society:—

"The integument is manufactured in the following manner:—I take (observes Mr. Page) a piece of fine elephant or any stout paper, rather larger than the skin required, and if one piece is not sufficiently large, I join another piece to it with the mixture used in preparing the paper, which, when of the required size, is coated (on one side only) with gum arabic, treacle, and water. When that is dry, I give the paper on the same side a coat of paint made with boiled oil and white lead, and after that has stood for two or three days, I go over it again with the same kind of paint. I find two coats sufficient for general use, and the specimens accompanying this paper are of that thickness; but if the work is heavy and large sheets are required, I should recommend three or four coats. When the paint is dry, it is fit to receive the design or finishing stroke, and after that it may remain for months or years before taken off the paper. I always complete the work before I remove it. To separate the skin of paint from the paper, I lay it down on a clean board with the painted side downwards. I then wet the paper at the back with clean water, and after it has stood a few minutes, I take hold of one corner or end of the paper, and remove it entirely away, leaving the skin on the board. The same paper will do again 30 or 40 times.

"The candidate was in attendance, and stated that since the communication was first made to the Society, he had painted the shop-front of Mr. Wildbore, of Shoreditch, and also that of Mr. Ross, of Bishopsgate-street, with his skin; that the cost of painting with the skin is the same as by the ordinary process; that the size of the skins is 12 ft. long by 3 ft. broad. It can be used for plain cornices, but not for carved work. Has had his patent taken out for about twelve months. A number of specimens of the skin in various states were exhibited to the Committee, one of them showing with what exactness the joints can be made."

A specimen of this skin may be seen by any member who may call at the Society's House during the next few days.

DISCUSSION.

The Chairman asked Mr. Clarke if this foil could be securely attached to damp walls, and what adhesive substance was used for the purpose.

Mr. Clarke said it was a varnish of a similar nature to gold size, made with gum lac and spirits of wine. It would hold perfectly well on damp walls, as had been shown in the case of the Count d'Alcantara's house in Paris. He was very anxious to get into his new house as soon as possible, before the walls were in a fit state to to be painted in the ordinary way. Having heard of this process, he applied to the inventors, and had the walls covered, and though three years had now passed the decorations were still in a perfectly sound condition.

A workman of M. Daniel's, from Paris, then exhibited the process to the meeting, producing several specimens very successfully.

The Chairman said he could understand there was a great saving in fancy work, but he should like to know what would be the cost of this material as applied to the surface of large rooms.

Mr. Clarke said from the description he had given of the production, the cost of labour was very small, and the tin-foil cost about 5d. a square yard. By this system, instead of requiring three or four coats of paint, which were necessary in ordinary wood-painting, only two coats were required—the ground coat and the decorative coat—which were produced with great rapidity. A workman had before him a frame five yards long, upon which he stretched the tin-foil; he then took his brush and put on the ground in the usual way, which was then dried in a stove. If every coat of paint and varnish was not thoroughly dried, the work was not perfect. After the first coat was dry, the second, or decorative coat, was put on with a brush and stencil-plate, as mentioned in the paper, and this also had to be dried. Then they applied one or two coats of varnish. As to the cost, comparing this new mode of decoration with ordinary oak or wainscoating, they could produce the work in a greater degree of perfection at the same price, but they did not pretend to execute it at a lower price. But with highly decorative painting the case was entirely altered. Any decorator knew that for imitating walnut or oak root, with a figure upon it, the charge of the grainer was very high—as much as 3s. or 4s. a yard. In the case of this invention, the imitation of the finest wood cost very little more than ordinary wood, and being intended for superior work was executed with more care, and he was sure no hand-work could equal it. In Paris the invention was making its way rapidly. Decoration in marble was not so much in vogue here as in Paris, where staircases were often done in Scagliola. It, however, had this disadvantage, that being on plaster it was liable to crack. This process was now becoming quite popular in Paris for such purposes. It cost rather more than marble paper, but the durability was much greater. M. Blondel, a celebrated architect in Paris, had told him he did not know how to limit its durability; the paints being mineral, and painted on a metallic base, they became incorporated with one another; and whereas, with ordinary paint, a house ought to be re-painted every six or seven years, with this process he would guarantee it to last for twelve years.

Mr. W. Smart said he should have inquired as to the expense if the Chairman had not done so, but it certainly appeared more applicable to high class and costly work than to ordinary purposes. He should like to know, also, whether, in case of the wood warping or splitting, which if not well seasoned it might do, the tinfoil would not crack and give the work an unsightly appearance. Again, the wood might expand, which would stretch the tin-foil, and if it afterwards contracted again it was a question whether the tin-foil would then present an even surface. He would also ask whether there was any probability of a chemical action being set up between the tin-foil and the colours placed upon it. He had once seen a picture-frame very nicely finished by having ornamental net stretched over it, which was then sized and gilded, and he thought some such plan might be usefully added to this process in some cases.

Mr. Clarke repeated what he had before said about the relative cost of this process, as compared with graining, adding, that for ordinary work, the grainer could be supplied with metallic sheets at a price which would enable him to execute his work at the usual rate, but in a superior manner, and in far less time, while obtaining the same profit. As to the wood warping or splitting, those were natural accidents which could not be completely guarded against any more than in painting; but if any action was going on tending to split the wood, the tin foil and varnish, by their combined strength, would tend to counteract it, and the chances were that where the wood without such protection would split, in this case it would not, or if it did, instead of one large split there would be a number of small interstices, which would not open the tin-foil. Besides, restoration was exceedingly easy, because the edges of the foil could be brought together so as to be almost invisible, and therefore such an accident could be repaired by adding some little ornamentation which would cover the defect. It must be remembered, however, that such accidents did not apply specially to this method, but equally to all kinds of painting. If, however, instead of splitting, the wood were to decay and gradually become rotten, the damage would not become apparent until it almost fell to pieces, as the tin-foil would hold it together, whereas if such a process went on in an ordinary panel, the painting would soon become damaged and peel off. With regard to the colours, it was found impossible to get the colours off without scraping away metal and all. He was not prepared to say how far photography might be combined with the process, but chromo-lithography had been applied, the chromo being printed on the tin-foil in an ordinary press, with oil-colours, and then varnished.

The Chairman, in proposing a vote of thanks to Mr. Clarke, said he could quite appreciate one feature of his process, for it so happened that the offices of a bank with which he was connected were now in the hands of the painters, and the consequence was that he had had a headache for the last week. Any system which would remove the evil must have great charms for the public in general.

The vote of thanks was carried unanimously.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first subscription list is given below, amounting to £351 3s.

	£	s.	d.
Ainsley, S. J.	0	5	0
Abel, F. A.	1	0	0
Alsop, J. A.	0	5	0
Ames, E. L.	0	5	0
Ames, H. St. V.	0	5	0
Ames, L. and Mrs. ...	0	10	0
Amhurst, W. A. T. Mrs., Miss, Sybil, Florence, Margaret, Alicia, Geraldine, and Beatrice ...	2	5	0
Andrew, W. P., Mrs., Capt., and W. R. St. C.	1	0	0
Arnold, H.	0	5	0
Ash, H. C.	0	10	0
Ashton, J.	0	5	0
Atkinson, W.	1	0	0
Atkinson, Mrs.	1	0	0
Austin, J., Edwin, Edgar W., and Francis ...	1	0	0
Baillie, T. and Mrs. ...	0	10	0
Baker, E.	0	5	0
Balfour, Major-General Sir G., Lady, Mrs. R., H., Edith, and Mrs. Bathae	1	10	0
Ballesteros, J. M. & Mrs.	0	10	0
Barff, Prof.	0	10	0
Barnes, J. R. and Mrs. ...	0	10	0
Bartley, G. C. T., Mrs., Geo. H. C., Lilian C., and Douglas C. ...	1	5	0
Barron, F. and family ...	1	5	0
Baruchson, A. and Mrs....	0	10	0
Bateman, J. F., Mrs., Miss and Agnes E.	1	0	0
Bath, C. and Mrs. ...	0	10	0
Baume, C....	1	1	0
Beanes, E., Mrs., Rebecca, Anita, Julia, Frederick, and Charles	1	15	0
Beattie, J. H., M. H., C. R., and G. H. ...	1	0	0
Belcher, Vice Admiral Sir E.	0	5	0
Bennet, J. L., Mrs. & Miss	0	15	0
Bennoch, F.	0	10	0
Bentley, J.	1	0	0
Billinghurst, Dr. H., Henry G., Wm., and Herbert H.	1	0	0
Birch, J.	1	0	0
Black, A., Mrs. & Miss M.	0	15	0
Blake, J. G., Mrs., Miss A. and P. A.	1	5	0
Bodkin, Sir W. H. and Lady	0	10	0
Bodkin, W. P. and F. E.	0	10	0
Bolckow, H. W. F., Mrs., C. and Mrs., H. W. F., jun., Harriet, and Caroline	1	15	0
Borrett, T., Mrs. & M. P.	0	15	0
Botly, W.	0	5	0
Boutcher, E., Mrs., Isabella, William, Ernest, Emily N., and Clara E.	1	15	0
Boyle, R. V.	0	5	0
Bradley, C. L., Chas. S., and Beatrice M. ...	0	15	0
Brady, Sir A., Lady, Rev. Nicholas, and Elizabeth K.	1	0	0
Brearey, P. T. & family	1	0	0
Breillat, E., Marian, Blanche, and Florence ..	1	0	0
Bridgeman, G. D. O. ...	0	5	0
Briggs, H. and family ...	1	0	0
Briggs, T., Mrs., Mary, and J. Fredk.	1	0	0
Brooke, J.	1	0	0
Brooke, T.	0	5	0
Brooke, W.	0	5	0
Brooks, H.	0	5	0
Brooks, H. and family ...	1	0	0
Browell, E. M., Mrs., and family	2	0	0
Brown, Dr. C. B. and Mrs.	0	10	0
Brown, G., Sarah, & G. M.	0	15	0
Brown, H. and Mrs. ...	0	10	0
Browne, Dr. W. and Mrs.	0	10	0
Brownfield, W., Mrs., Miss, and W. E. ..	1	0	0
Burton, D., Eliza, Helen Wood, E. J. Wood, Jane Wood, Jesse Pott, Mildred A. Smith, and Emily Drummond ...	2	0	0
Burr, D. H. D., Mrs., H. Higford and Mrs., E. Burr and Mrs., and Arthur S. Burr .	2	0	0
Butler, W.	0	5	0
"B. N." and family ...	1	10	0
Campbell, J. and family	1	10	0
Candy, C., Mrs. and Miss M.	0	15	0
Canton, R., Jessie E., Florence, and Adelaide	1	0	0
Cary, F. S. and Mrs.	0	10	0
Carreras, J. J., Mrs., and J. M. A. Junr.... ...	1	0	0
Carttar, C. G.	0	5	0
Cassels, A., Mrs., May G., Augusta, Lilian E., Violet M., Herbert W., and Keneth S.	2	0	0
Cavell, E. S.	0	5	0
Chadwick, Edwin, and family	1	0	0
Chapman, T. and family	1	0	0
Chappell, T., Mrs., Thos., and Emily	1	0	0
Chappuis, P. E.	0	5	0
Chatfield, F.	0	5	0
Church, J., Mrs., Ellen M., Kate, Florence E., and Minnie	1	10	0
Clare, C. J. and Mrs. ...	0	10	0
Clark, F. J., Mrs., Fredk., Alfred J., Harding T., Florence, and Alice ...	3	7	0
Clarke, Hyde	0	5	0
Clauson, C.	0	5	0
Clowes, G., W. C. K., Rev. G., M., A. A., W., C., E. A., and E. S. ...	2	5	0
Cole, A. S. and H. W. G.	0	10	0
Cole, Henry, Mrs., L. M., H. L., R. O., and C. B. G....	1	10	0
Collyer, Col. G. C. & Mrs.	0	10	0
Colman, J. J. and Mrs....	0	10	0
Compton, W. & W. M'G.	0	10	0
Conder, E., Mrs. and family	1	0	0
Constable, G. S., Mrs., Sefton, and Miss A. ...	1	0	0
Cooke, C.	0	5	0
Cooke, Sir W. F. & Lady	0	10	0
Cooper, Sir D., Lady, and family	2	0	0
Corbett, J., Mrs., Roger and Walter, and Miss, Camille and Kathleen...	1	15	0
Costa, Sir M. ...	1	0	0
Cow, P. B., jun. and D.	0	10	0
Cowper, Sir C., Lady and Miss	0	15	0
Cowper-Temple, Rt. Hon. W. and Mrs.	0	10	0
Cox, R. and Mrs. ...	0	10	0
Crawford, T. and Mrs. ...	0	10	0
Cresswell, A. J. B., Capt., Miss., and Miss E. J. ...	1	0	0
Crowe, W. L. and Mrs....	0	10	0
Darby, A. and Mrs. ...	0	10	0
Dashwood, Capt. F. L. and Mrs.	0	10	0
Dashwood, T., Helen, Alfred, and Percy T....	1	0	0
Daubeney, Maj.-Gen. Sir H. Charles B., Lady, Capt. Frederick S., Mrs. Fred. S., Rev. Giles, Mrs. Giles, Mrs. A. A., A. R., Major A. G., Major W. A., Dr. Henry, Mrs. Henry, Henry Giles, Hugh Frederic, Mrs. Francis, Frank, Mrs. George William, Rev. Chancellor, and Mrs. Jacomb, Chas., Charles William, Fred. Charles, Miss, Dorothy, and Mrs. Smith	6	5	0
Daubeny, H. A. & Mrs.	0	10	0
Davis, J., Mrs., Lucy A., and Charlotte	1	0	0
Dawbarn, R., Elizabeth, Jane, and Mary ...	1	0	0
Day, W., Mrs., Miss, and Alice	1	0	0
Debary, P. F. and Rev. T.	0	10	0
Denison, A.	0	5	0
Dent, W.	1	0	0
De Salis, Maj.-Gen. R....	0	5	0
Dibley, G. and Mrs. ...	0	10	0
Digby, G. D. W., Lucy M. W., John D. W., and Wm. G. W. ...	1	0	0
Dixon, J. and family ...	1	10	0
Dixon, T., Elizabeth, Alice, and Eliza ...	1	0	0
Docker, F. W., Mrs., Ellen S., Mary A., Frederick C., Edwin, & Alfred . ..	1	15	0
Donnelly, Capt. and Mrs.	0	10	0
Downes, C.	1	1	0
Draper, J. and Mrs. ...	0	10	0
Dresser, Dr. C., Mrs. and family	1	0	0
Drummond, Hon. E., Julia M., James, S., and Edmund C. ...	1	0	0
Du Cane, Capt., Mrs., R. H., and H. J. ...	1	0	0
Dunn, J. M., Mrs., and Misses S. A. and H. ..	1	0	0
Dutton, W. C., Julia M., Matilda M. Terry, and Matilda Terry	1	0	0
Eardley-Wilmot, Major Gen. and Mrs.	0	10	0
Eborall, C. W. and Mrs.	0	10	0
Ebury, Lord and family	3	0	0
Edney, W.	0	5	0
Elkington, F., Mrs., Herbert F., Gerard B., Emily M., Gertrude E.	1	10	0
Ethelston, Rev. C. W. ...	0	5	0
Exeter, Marquis and Marchioness of, Lord Burghley, and Lady I. Cecil	1	0	0
Eyre, Maj.-Gen. Sir V....	1	0	0
Fair, J., Mrs., Agnes R., H., Thos., K., John St. F., and Gertrude ...	1	15	0
Fairbairn, Sir Wm. and Lady	0	10	0
Fairlie, R. F., Mrs., Robt., Frank A., John S., Lilly, and Jessie McC.	1	15	0
Fane, W. D., Mrs., Grace, Millicent, and Wm. V.	1	5	0
Fernie, Capt. and Mrs. ...	0	10	0
Field, Col. G. T. and Mrs.	0	10	0
Figgins, J., jun.	0	10	0
Fildes, J., Mrs., S. W., R. J., and Miss ...	1	5	0
Filliter, F., Mrs., Sidney F., Wm. D., and Geo. C.	1	5	0
Fitzwilliam, W. S. and Maria	0	10	0
Fletcher, E., Mrs., Frances, and Eliza	1	0	0

	£	s.	d.
Follett, R. B., Wm. W., Spencer W., and Dora	1	0	0
Foord, J R.	0	5	0
Forshaw, T., Mrs., & T., junr., and W. A. and Mrs. A. Hodgkinson	1	10	0
Frost, M., Mrs , Eleanor M., Amy, Meadowes A., and F. A.	1	10	0
Fythe, J. L., Susan, Agnes M., and Albert	1	0	0
Gairdner, C., Hannah, Jessie E., Charles D., Agnes H., Jas. M., Marion E., Robert H., Anna L., & Lucy M. M.	2	10	0
Galloway, W. B., Mrs. W. E., and Rev. E D.	1	0	0
Galton, Capt D. & family	1	0	0
Gamgee, Prof. and Mrs.	0	10	0
Garrod, J. N., Mrs., Miss, and Mary	1	0	0
Gassiot, J. P., Mrs., Miss, and Miss A. W.	1	0	0
Gibson, H., Mrs., and family	1	0	0
Glynn, E. and Mrs.	0	10	0
Goding, C.	1	0	0
Godwin, G.	0	5	0
Goldsmid, A.	0	5	0
Goldsmidt, O., Mdme., and family	1	5	0
Goodyear, C., Mrs., C. junr., and Miss	1	0	0
Gordon, J. W., Mrs., Ada M. and Charles T.	1	0	0
Gould, C. A., Mrs., Fanny, Ada, Helena, and Alfd.	1	10	0
Graham, P., Mrs., George, Walter, Frank Edgar, Malcolm. John, Gwendoline, Nellie, and Ethel	2	10	0
Graham, T. B., Harry, Louisa, and Fred	1	0	0
Grant, A., Mrs., William, Marjory, and Isabella	1	5	0
Granville, Earl, Countess, and family	1	5	0
Green, J., Mrs., Eugenie, Oliver, and Sophie Oliver	1	0	0
Gumpel, C. J. and Mrs.	0	10	0
Gruneison, C. L. and Mrs.	0	10	0
Gushlow, G. and G., jun.	0	10	0
Gwynn, W. J. and Miss	0	10	0
Hamel, F. J., Mrs., Felix H., Egbert de H., Emilie M., Lancel V , Eliza A., and Année P.	2	0	0
Hamilton, Capt. H. G., Mrs., Miss, and Laura	1	0	0
Hanhart, M., C., M., & H.	1	0	0
Hankey, R. A.	0	5	0
Hannay, R.	0	5	0
Hannington, C. S., Saml., Philip, Jas., and Joseph	1	5	0
Harcourt, Col. F. and Lady Catherine V.	0	10	0
Harding, J. J.	0	5	0
Hardwicke, Admiral the Earl and Countess of, and Lady Agneta, and Hon. Alex. Yorke	1	0	0
Harington, Sir J. E. and Lady	0	10	0
Harris, C., and Edith R.	0	10	0
Harrison, J.	0	5	0
Harrison, W., Mrs., Miss, and Ada	1	0	0
Hart, Mrs. E.	0	5	0
Harmount, E. H.	0	5	0
Harton, S., jun.	1	1	0
Harvey, Capt. J.	0	5	0
Haworth, A.	0	5	0
Haworth, J.	0	5	0
Hatherley Lord (Lord Chancellor) and Lady Hatherley	0	10	0
Head, A. A. and Mrs.	0	10	0
Heberden, T.	0	5	0
Helme, R., Mrs., R. M., Miss, and A. R. and Miss Sharpe	1	10	0
Henshaw, W., Harriet A., Annie C., Helena, Wm F., Edith M.	1	10	0
Herbert, Rev. T. W., Geo., and Mrs. Mills	0	15	0
Herring, W. A. & Mrs.	0	10	0
Herron, G. M. and Mrs.	0	10	0
Hewlett, A, and family	1	0	0
Heywood, J., Mrs., and Miss	0	15	0
Hill, F. and Mrs.	0	10	0
Hill, Sir R., Lady, and Mr. and Mrs. Pearson Hill	1	0	0
Hills, H., Mrs , and Miss	0	15	0
Holland, W. H., Mrs., and Mrs. Walker	0	15	0
Holmes, H. M., Charles, Herbert M., jun., Geo E.	1	0	0
Holroyd, E., Miss, Miss C , and Capt. W R. M.	1	0	0
Hooper, G. N., Elizabeth, Francis G. F., Cecil H., and Ernest F.	1	5	0
Hopkinson, J. and Mrs.	0	10	0
Hopkinson, W. L., M.D.	0	5	0
Horniman, F. J., Mrs., Miss A. E., and E. J.	1	0	0
Hoskold, H. D.	1	1	0
Hoskyns, C. Wren, and Mrs.	0	10	0
Houghton, W. G. and W. F.	0	10	0
Howard, D., Ellen, Maria, and Constance	1	0	0
Howell, H. and family	1	0	0
Hubert, S. M. and Mrs.	0	10	0
Hughes, H., Mrs., Marion, Laura, Eveline, and Harry	1	10	0
Hutton, T. O., Mrs., Miss M. M. C. A., and Thos.	1	0	0
Hyde, J., Mrs., and John and Emma Routledge	1	0	0
Johnson, J. G.	0	5	0
Johnson, J. M., Edmund, James, Charles	1	0	0
Jones-Parry, Love, and Lady	0	10	0
Jones, J. W., S. Dealting, Alfred Lang, & Arthur Stockdale	1	0	0
Joyce, F. and Mrs.	0	10	0
Kime, W. T. and Mrs.	0	10	0
Kindersley, S. W.	0	5	0
Kingsford, S., Maria, and Ellen	0	15	0
Kirtley, M. and family	1	0	0
Lahee, S., & Miss Pringle	0	10	0
Latham, J., and Mrs.	0	10	0
Launspack, L. J. and C.	0	10	0
Lawlor, J.	0	5	0
Lawrence, E.	1	0	0
Lawson, A. S.	0	5	0
Le Breton, F.	0	5	0
Lee, J. H., Caroline, J. Theophilus, and Hy. H.	1	0	0
Lepard, S., Mrs., Misses H. G., S. G., and M. E.	1	5	0
Lermitte, E W., Mrs., and Miss B J.	0	15	0
Lock, F. and Frances	0	10	0
Lockwood, Ben., Mary L., Mary G. K., Beatrice M. A., Geoffrey F.	1	5	0
Longstaff, G. D., Mrs., L. W., and G. B.	1	0	0
"Loyal to Queen and Prince"	1	0	0
McBride, Dr. H.	0	5	0
Macclesfield, Mayor and Mayoress of	0	10	0
McKewan, W., Mrs., Miss A. E., & Ernest F.	1	0	0
McLeod, Sir D. F.	0	5	0
Macnaughten, S. and Lady E.	0	10	0
Manning, T. E.	0	10	0
Marshall, C.	0	5	0
Martin, H., Margaret, & Charles	0	15	0
Martin, P., Mrs. and Miss	0	15	0
Martyn, S. E. and family	2	0	0
Masey, T. and Mrs.	0	10	0
Mathew, Major E. W., Mrs., N. E. A., C. J. W., and Miss M. L. C.	1	5	0
Maudslay, T. H. and Mrs.	0	10	0
Melles, W., Mrs., & J. W.	0	15	0
Middleton, Capt. Sir G. N. B. and Lady	0	10	0
Miles, A. W., Mrs., Constance, Amy, Blanche, and Grace	1	10	0
Millar, J., M.D.	1	0	0
Miller, Capt. J. C.	0	5	0
Misa, M.	1	0	0
Montefiore, N., Emma, Alice, Leonard, Charlotte, and Claud	1	10	0
Moss, W. H. and family	2	0	0
Mouat, Dr. F. and Mrs.	0	10	0
Mounsey, Ewart S., and Mrs. Ewart	0	10	0
Napper, H. F.	0	5	0
Newdigate, A. L.	0	5	0
Newby, E. H., Mr. and Mrs. W., Miss, Mr. and Mrs. W. T., Henry W., and Edith A., Caroline G., Ellen M. and Frances M.	2	15	0
Newman, S. J., and Miss	0	10	0
Nicholls, H. F., Mr. and Mrs. Alfred and Miss Harris	1	0	0
Nield, J., Ellen F., Emily, Sarah S. Ellen T., Alice M., Edith F., and and J., junr.	2	0	0
Noble, J.	1	0	0
Normanton, Earl of	0	5	0
Norris, C. and Miss M.	0	10	0
Northbrook, Lord, the Hon. F., and the Hon. Emma Baring	0	15	0
Norton, J. S. Mary A., Marion, Edith, Thomas, and Maria L.	1	10	0
Oakes, W. T. S., Helen, Mary A., William H , Henry F , and M. P. R.	1	10	0
Oldershaw, Capt. R. P., Mrs., Miss H. G., and A. A.	1	0	0
Ommanney, Vice-Adml. E. and family	1	0	0
Page, C. H. and Amy C.	0	10	0
Paget, T. T.	0	5	0
Paget, Lord and Lady C.	0	10	0
Pagliardini, T.	0	5	0
Paice, B. A.	0	5	0
Paine, Mrs., Miss Manley, and Mrs. C. E., Eleanor, Mary Steward, and Mrs. H. F. B., Arthur, and Ethel Portman	2	0	0
Pakington, Right Hon. Sir J. S. and Lady	0	10	0
Parker, J , Horace, Arthur, and Amelia	1	0	0
Payne, C.	0	10	0
Pearce, A. B., Mrs., Miss, Arthur, and Duncan	1	5	0
Pearson, J. and family	2	0	0
Pegram, O. A., Mrs., Alice M., Edward S., Orlando, Fendall S., Henry, and Virginia B.	2	0	0
Phelps, C., Ann, and Wm.	0	15	0
Phillips, J. S., John, Henry F., Jas., Chas. M., and W. R.	1	10	0
Pickstone, W.	0	5	0
Pitman, F., Mrs. & Misses B. and C.	1	0	0
Port, H., Harriet, Eda, & Wm. H.	1	0	0
Portal, W. S. and W. W.	0	10	0
Porter, W. P., Mrs., Miss, and J. C.	1	0	0
Powell, Dr. A. J. & Mrs.	0	10	0
Powell, N.	1	1	0
Pratt, D., Mrs., Miss, and H. W.	1	0	0
Price, A. J., Mrs., Miss, and Miss A. E.	1	0	0
Pritchit, J. and Mrs.	0	10	0
Puller, A G.	0	5	0
Radcliffe, J., Mrs., Constance, and Maude	1	0	0
Ramsey, Dr. N. W. and R. Gordon	0	10	0
Ratcliff, C and Lady	1	0	0
Ravenscroft, F.	0	5	0
Ravenscroft, H., Mrs., Miss E. J., and S. H.	1	0	0
Rawlinson, R., and Mrs.	0	10	0
Redgrave, S.	1	0	0
Reveley, H. J.	0	5	0
Reveley, H. W.	0	5	0
Richardson, B., W. H., jun., Mary M., Anne E., Henry G , Martha H., and Benjamin, jun.	1	15	0
Rivett, J. C., Mrs. & Miss	0	15	0
Robbins, J., Louisa M., Percy J., and Ada M.	1	0	0
Roberts, C. W., F. A., & Wm. H.	1	5	0
Rogers, E and Mrs.	0	10	0
Roper-Curzon, Hon. H. and Hon. Mrs.	0	10	0
Rose, J. A. and Mrs.	0	10	0
Rosher, E., Mrs., and Mary E.	0	15	0
Rowsell, F. W.	0	5	0
Rumsey, W. S., Mrs. Wm., Wm., and Henry M.	1	0	0
Russell, J. J. and Mrs.	0	10	0
Saddler, J. and Mrs.	0	10	0
Salt, Sir T., Lady, Wm. H., Geo., Amelia, Edward, Herbert, Titus, jun , Helen, and Ada	2	10	0
Sampson, S., Mrs , S. Arthur, and E. Emma	1	0	0
Sanders, G.	0	5	0
Saul, G. T. and family	1	0	0
Schneider, R.	1	0	0
Scott. Capt. R. A. E.	0	10	0
Scott, Maj.-Gen. H. Y. D.	0	10	0
Selwyn, Capt. Jasper H., and Mrs.	0	10	0
Seyd, E.	0	5	0
Seyd, R.	0	5	0
Sevastopulo, P. A. and Miss A.	0	10	0
Shaw, B.	1	0	0
Shillito, G., Elizabeth, Mary Ann, Sarah, and Mrs. T. I. Warwick	1	5	0
Shirreff, G. W., Francis, Alexr G , & Frances E.	1	0	0
Shoolbred, F.	0	5	0
Shove, W. S , Mrs., Beatrice, Spencer, Ernest, Harold, Norman, and Ethel	2	0	0
Siemens, C. W., Mrs., and family	1	0	0
Silber, A. M., and Mrs.	0	10	0
Silk, R., jun.	0	10	0
Smart, J. J. and Mrs.	0	10	0
Smith, Rev. C L , Jane, Thomas, and Elizabeth	1	0	0
Smith, G. and Miss	0	10	0
Smith, R. M., E. S., and E. M.	0	15	0
Smith, W. H.	0	5	0
Smith, W. W., Mrs. and Misses	1	0	0
Snooke, W., Mrs. and family	1	0	0
Sopwith, T., Mrs., Miss, and Alice	1	0	0
Sommerville, W. & family	1	5	0
Sotheby, Mrs. & family	1	0	0
Spark, H. K.	0	5	0
Spencer, J. F., Mrs. and Miss E. B.	0	15	0
Spicer, W. R.	1	0	0
Spottiswoode, G. A.	0	5	0
Spottiswoode, W.	0	5	0
Spowart, T., Mrs., James, M. F. A., E. M. G., and E. H.	1	10	0
Stanton, G.	0	5	0
Stohwasser, J. & family	1	10	0
Styan, Capt. A , Miss, and Miss C. M.	0	15	0
Sutherland, Duke of	0	5	0
Symonds, J. and C. D.	0	10	0
Taplin, T.	0	5	0
Tappen, G. C. W. & Mrs.	0	10	0

	£	s.	d.
Taylor, J. and Mrs. ...	0	10	0
Taylor, W., Mrs., Thomas, Frederick J., Emma, Clara, & Fanny	1	15	0
Teulon, S. and Mrs. ...	0	10	0
Thomas, Dr. E.	0	5	0
Thorne, T. H., Mrs., Miss, and Dr. R. T.	1	0	0
Tilley, S.	0	5	0
Topham, J.	1	1	0
Treloar, Thos., W. P., Robert, and Isabella ...	1	0	[illegible]
Tudor, E. S., Mrs., Mary, and Dora	1	0	0
Tufnell, E. C., Mrs., Miss M., and Lieut.	1	0	0
Tyler, G , Chas and Wm.	0	15	0
Twining, T., Mrs., and Miss A.	0	15	0
Verity, J.	0	5	0
Vignoles, C. B., Mrs., Miss, & Chas. A. ...	1	0	0
Vulliamy, L. L.	0	5	0
Walker, Lieut.-Col. W. L and Mrs. ...	0	10	0
Waltham, E , John C., and Thomas ...	0	15	0
Warburg, F. E., Emma, John C., and Lily	1	0	0
Ward. H . Mrs . Miss A. B., and Herbert H.	1	0	0
Ware, J. T.	1	0	0
Warren, J. and W. ...	0	10	0
Warriner. H. and Mrs. ...	0	10	0
Wass, C. W.	0	[illegible]	0
Watkins. W., Mrs., Annette. William, John S . and Philip	1	10	0
Watkins, Z. and M. Osborne	0	10	0
Watson, Dr. Forbes and Mrs.	0	10	0
Watson, Sir Thomas and Miss	0	10	0
Webb, J. S.	0	10	0
Wells, S.	1	0	0
Whiffin, W. H. & W. E.	0	10	0
White, J and J. S. ...	0	10	0
White, W. W., Mrs., Misses F. A., E., and M. A., and Ernest A. ...	1	10	0
Wigan, F , Mary H., Amy M., Frederick W., Katherine, Ellen M., Ethel H., and Arthur L.	2	0	0
Williams, C., Mrs., Laura H. Doyle, and Charles Wm. Doyle	1	0	0
Williams, H. R., H. R., junr., Edith R., and Blanche E. E.	1	0	0
Willing, Jas	0	5	0
Wilson, C. T. and Mrs	0	10	0
Wilson, E., F.R.S., and Mrs. ...	0	10	0
Wilson, G. F., Mrs , Scott B., and Herman G	1	0	0
Wilson, J.	0	5	0
Woods, E., Mrs., Misses M. J and L M., Rev. F., E. H., and O. S. ...	1	15	0
Wray, G. W.	0	5	0
Wrentmore, F. and Mrs.	0	10	0
Wright. P , Mrs., Miss, & Miss Mary L.	1	0	0
Wright, P and W. A. ...	0	10	0
Wyld, G., and Mrs. ...	0	10	0
Yolland, Col. W. and family	1	15	0
Young, Fred., Mrs., Cecilia, and Ada Mary	1	0	0
Young, J. and Wm. ..	0	10	0

IMPROVED CABS.

The Council of the Society of Arts offer the following Prizes:—

One Prize of £60 for the best improved Cab of any description.

Two Prizes of £20 each for the next two best.

Two Prizes of £10 each for the next two best.

The competing Cabs must be exhibited at the International Exhibition, to be held in South Kensington in 1873, and on their delivery at the Exhibition Building they must be certified to the satisfaction of the Judges as having been in regular use in the streets of London for three months previously. They must be delivered on or before the first Saturday in April.

The Council consider that the Cabs now in use in London are especially defective in the following particulars:—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.

2. The seats in the four-wheelers are too high, not commodiously made, and the space underneath is lost.

3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.

4. The arrangements for opening and closing the window in the Hansom.

5. The confined space and want of ventilation in the Hansom when the window is closed.

6. Imperfect locking of the wheels in four-wheelers.

The Council desire to point out, for the consideration of those likely to compete, that in Continental and some English towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

A suggestion for a cab, to be used either closed or open, has been brought before the Council, and a model submitted. The principle might be adapted to existing four-wheelers, but the Council do not prescribe this model or any special form of carriage; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges may report.

CONVERSAZIONE.

The Society's Conversazione is fixed to take place at the South Kensington Museum, on Wednesday, the 19th June. Tickets will be issued to the Members in due course.

THE LIBRARY.

The following books have been presented to the Library:—

Statistics of the Colony of Victoria for the year 1870. Parts 8 and 9. Presented by the Registrar-General of Victoria.

A Sketch of the various Plans which have been proposed as a means to effect Puddling Iron by Machinery; the causes of failure pointed out, and the probable solution of the difficulty suggested. Presented by William Yates, Esq.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

CORRESPONDENCE.

ENDOWMENT FUND FOR THE SOCIETY OF ARTS.

Sir,—The success which attended the first exhibition of the works of the artists of London, in the rooms of the Society of Arts in April, 1760, was so great, that in the November following the artists again requested permission to be allowed to hold a second exhibition in the year following, "The object of the artists being to endeavour to raise a sum of money to be distributed in charity towards the support of those artists whose age and infirmities, or other lawful hindrances, prevented them from being any longer candidates for fame." The appeal made to our Society met with approval, and the second exhibition accordingly took place in 1761; but in the year following, 1762, a few of the artists engaged a room in Spring-gardens, where they thought that they could act with greater independence than while exhibiting at the Society of Arts, and they there held two exhibitions, under the title of "The Society of the Artists of Great Britain;" but they soon differed in opinion as to the appropriation of the profits arising from exhibitions. The exhibition at the Society of Arts, in 1761, resulted in a profit of upwards of £150, which was appropriated as follows:—

£50 to the Middlesex Hospital,
£50 „ British Lying-in Hospital,
£50 „ Asylum for Female Orphans,

and the balance to poor artists. The exhibitors at the Society of Arts formed themselves into a body, calling itself "A Free Society of Artists," associated for the relief of the distressed and decayed brethren, their widows and children. The object of the Society of Artists of Great Britain was to secure sale for their pictures and to divide the profits among themselves by appropriating the surplus profits as bonuses granted to such of the works as were sold during the exhibition at a price below the value placed upon them either by the artist or the committee having the management of the exhibition. Division still prevailed among them as to the disposal of the surplus profits arising from the exhibitions, but they desired their society to become a permanent institution, and solicited the King to incorporate the society by Royal Charter, but in 1767 Mr. Dalton, who was librarian to the King and treasurer to the Society of Artists of Great Britain, with others, formed a scheme for inducing the King to establish a Royal Academy of Arts; and in March of that year his Majesty was graciously pleased to declare his Royal intention of taking the Arts under his protection, and the Royal Academy was established in Pall Mall, in the house previously occupied by Dalton as a print warehouse. I have thus endeavoured, as briefly as I could, to trace the history and origin of the foundation of the present Royal Academy, which has ever since devoted annually large sums of money in relief of the necessitous widows and orphans of artists. It also became the possessor of the means and appliances used in the life school established in St. Martin's-lane, and in which William Hogarth took so large an interest, and of which his coadjutator at the Foundling Hospital, Mr. F. Haymen, was chairman, but into the history of which it is unnecessary to enter. The life school of the Academy is still in active operation, and in addition to charitable aid to artists, the Academy has from an early date after its foundation till the present day, provided the necessary funds to enable the gold medals of the Academy school to proceed to the Continent, there to complete their study and perfect their knowledge of arts.

The Free Society of Artists continued to hold their exhibitions in the Society of Arts' rooms till 1766, and subsequently in 1767-8 in a large room at the bottom of Pall Mall. The Society of Arts continued to hold its yearly exhibitions of the works of students in art, and to award medals for meritorious productions in art, till 1846, when, owing to the establishment of Schools of Design by the Government, and the attention paid to the promotion of art education in the schools of the Academy, the Society abandoned its previous field of action to turn its especial attention to the promotion and improvement of art in its relation to manufactures. The action thus set up in 1846 gave rise to the annual exhibitions of British manufacturers, and ultimately to the establishment of the Great Exhibition of the Industry of all Nations in 1851, which was again followed by the Exhibition of 1862. The Royal Commissioners appointed to conduct the Exhibition of 1851 were, at the close of the Exhibition, in possession of a large surplus profit, and a second charter was granted, incorporating them trustees for the application of such surplus. They are now carrying out a series of annual International Exhibitions of the arts and industries of the world, the second of the series of which exhibitions was opened to the public on the 1st of the present month.—I am, &c.,

H. G. H.

SCIENTIFIC INSTRUCTION.

SIR,—I am glad to see in the *Journal* that the Commissioners on Scientific Instruction recommend that a higher standard be insisted on for the title of "Elementary Science Teacher." I have long felt that this is desirable to the real success of science teaching and teachers. The standard at present insisted upon by the Department is far too low to ensure a satisfactory knowledge of the ground-work of any one of the subjects, it being far easier for a student to pass second-class in the advanced stage (and thereby qualify to teach) than it is to pass first class in the elementary stage. So low is the standard that I am fully satisfied that 50 per cent. of the teachers in practical geometry are not at all versed in the elements of geometry and descriptive geometry, on both of which the subject of practical geometry is founded.

I assert this on very good grounds. An instance which occurred at Sheerness a year or two ago, will go to prove this want among teachers. An excellent class was formed a few years ago, of not at all dull students, students of which a good teacher could have made a rich harvest. On one occasion the teacher had been giving a lesson in plane geometry, and among the questions was the following:—"To inscribe a square in another having two-thirds its area" (an old examination question); the method given was to "set off one-third the side of the original square from each of its angles in order, and join the four points thus found. Most of the pupils could see it was wrong, but could not see where; and when the question was raised, the answer was, "he (the teacher) had come to teach practical geometry and not the principles;" and this is the way he solved many difficulties (I have it from an old pupil), some of which were far more absurd than this. Now, had the teacher had the most elementary knowledge of geometry and its cognate branches, he would at once have proved the ratio to be 5 : 9 and not 2 : 3, and would easily have devised a way for a proper solution.

The raising of the standard will effect another great improvement, partially if not wholly, that is the abolition of monopoly and farming out classes, which is carried out at present, though not so much as formerly.

A few teachers in the metropolis and suburbs, who are entirely depending on science teaching, as soon as they start a class in any neighbourhood, set a former pupil, if he has previously passed in the 2nd class advanced stage, to teach this class, while the acknowledged teacher goes to another locality and starts a fresh class—doing the same with this—and so on, himself rarely teaching, but receiving the lion's share of the profits. In looking over a list of classes under one teacher a few weeks back, I saw two classes announced for the same time, on the same evening, and miles apart, and two others at consecutive hours the same evening, some distance apart. I have known classes which have entirely failed through this, the students being disgusted at the manner in which they are taught.

The raising of the standard will do much better service in putting an end to so much groundless discontent; for I find this class of teachers to be the leading persons in the meetings and deputations to Mr. Forster, to find fault with the small numbers of passes in the particular subject, geometrical drawing, on account of a change of examiner. The fact is, that under the old examiner a parrot-like knowledge was required, for, judging from the examination-papers and the book of which he is the author, I should say he was either ignorant of—or ignored—the principles so essential to the true success of a student in practical geometry; while the present examiner, especially by his paper of this year, appears to be alive to the real use of first principles; and I, for one, hope he will continue such papers, and it will then repay a teacher to give sound elementary rather than superficial and worthless knowledge.

There are rules laid down by the department which press far more heavily and unjustly on the teachers than this; such as fining us 6d. for every student who does not obtain 10 per cent. of the marks, and, worse still, for those who do not appear at the examination, circumstances over which we have no control; but it is not my intention to go into that subject here.—I am, &c.

A Science Teacher.

ON THE ECONOMIC AND EFFECTIVE APPLICATION OF REFUSE, ALONG WITH THAT OF ORDINARY EXCRETA, TO PURPOSES OF AGRICULTURE.

Sir,—The propositions which I am about to make will, if carried out, effect, I submit, a momentous and important innovation in agriculture. The present selling price of the liquid phosphate of lime is about £20 a ton, and that of ammonia from some £80 to £100 a ton. Quantities of these indispensable substances are imported from abroad and likewise fabricated at home. But all the different sources of supply, notwithstanding the amount of both, falls very far short indeed of the vast requirements of the soil. Everything—alimentary substances regarded—which the earth furnishes should be returned to earth. This plain and indefeasible canon, however, is violated, and the hungry, and, so to speak, expectant soil is refused its own. Fluid and solid feculance everywhere pollutes earth's surface and the interiors of human dwellings as well, or, gathered in cesspools or trailing sewers, contaminates the atmosphere, violating self-respect and dignity, and everywhere promoting stench, discomfort, and disease.

Agriculture, properly conducted, cherishes the soil, whereas too commonly it positively impoverishes it; so that foreign matters, as apatite from Spain or the Americas, and guano from various quarters, are needful to prevent the land from wearing out, as I have seen in Maryland and Virginia. Hence it is that the yield is vastly less than are our requirements, and prodigiously less than what forty to fifty millions of acres might be made to yield.

The better the soil is handled the more it will return; and the worse and more grudgingly the less will it return. Bad treatment involves bad and insufficing production, whereas good treatment involves copious production, abundant grain, and green crops; plenty of milk, butter, and eggs; any amount of legs and shoulders of mutton, ribs and rounds of beef, flocks of poultry, flitches of bacon, and, in short, bread and meat for everyone.

Notwithstanding our nine millions of horned cattle, our thirty-one millions of sheep, and four millions of swine, to say nothing of foreign cattle and imported meats, considerably more than half the thirty-one millions of persons who constitute the population of these islands never so much as taste butchers' meat. And yet with spade labour or machine labour equivalent, and housefeeding or feeding in covered courts, the corn-yield and the meat-yield of our acres might be doubled, possibly trebled, out of hand. As at present managed, the feeding of stock, horn cattle, sheep, swine, horses alike, is not judiciously managed; for the most part the possible manure supplies are to a very great extent dissipated and lost. But to create and save manure is quite as needful as to reap grain or feed stock; in fact manuring ought to be carried to as great an extent as the soil can profitably take it in. Therefore it is that, in addition to the proper storage and application of manure, in respect of which the practise of the Chinese in Java is greatly deserving of consideration, I herewith propose that both the solid and fluid excreta of man and brute should be commingled with and treated by a prepared humus or soil made up of the following ingredients:—

			Per centum.
Gypsum, calcined and powdered,	10	preferably	20
Alum	1	„	5
Copperas	1	„	5
Sulphuric acid	1	„	5

Dried humus or soil, in all, parts 100.

These ingredients, duly comminuted and commingled, at least until better can be devised, seem to me well calculated as a vehicle to ensure the desired results. The cost of earth or soil will be that of the labour employed. As for the gypsum, or sulphate of lime, it can be had I believe just now at 30s. per ton, sulphuric acid and sulphate of iron at 7s. 6d., and alum at 10s. per hundred weight. The humus or soil has its own great merits, and for the three sulphates and sulphuric acid along with them, they constitute an admixture singularly adapted to the effective conservation of the waste products of animal life, pending their restoration to the soil, grasping, indeed, the actual or possible ammonia compounds, and laying fast hold of the phosphates of transition.

I submit, therefore, that every farmstead should be provided, at the proper season of the year, according to requirements, with hundreds or thousands of this prepared humus or soil, in order to be made use of in the manner specified. The ordinary summer soil would answer as the main ingredient, but clays, calcined and levigated, in whole or in part, might be profitably resorted to. The waste refuse of brick and lime kilns, road dust and road-scrapings, the mud of estuaries, rivers, sewers, ditches, turf and coal ashes, soot, charred seaweed and charred peat, the refuse of foundries, factories, and of whatever economic processes, so far as the supplies went, might also be turned to account.

As for the economic humus itself, it ought to be turned to effective account in connection with every form of animal waste and decay and their depositories, as provision stores, slaughter-houses, sheep-pens, fowl-houses and yards, catgut glue factories, and tan-yards, knackers'-yards, pigstyes, cowhouses, stables and stable-yards, privies, cesspools, and urinals, pork and fish curing establishments—nay, to a certain extent, the streets and highways; in short, refuse of all kinds. The water-closet system—leading as it does to the formation of extended cesspools beneath the thoroughfares, poisoning the atmosphere and fouling the rivers and foreshores of the sea—ought to be superseded by sanitary humus, either alone or as commingled with charred sawdust, charred peat, or charred seaweed. The importance of common humus, or soil, was appreciated even by the ancients, nevertheless, by the moderns it has been very strangely ignored and neglected. The crowded cities of India are said to be infected with trodden-down ordure; the towns and villages of Europe, in some respects at least, are hardly in better case, and yet every feculance ought to be consigned to the soil, and in no case suffered to pollute the dwelling-places of our kind. I adverted in strong terms to the subject, in my treatise termed *Moral Sanitary Economy*, so many as 20 years ago. The admixture of feculance, fluid and solid, with sanitary humus, as in the sample which has been prepared, might be garnered in covered slate or brick-lined chambers until required. But I leave to architects, engineers, and contractors details which they will carry out better than I am able to suggest.

The recent bones of a horse or ox weigh from 80 to 100 pounds; of a man from 11 to 15 pounds; and of a sheep or swine in proportion. The phosphates, or, if we prefer to say so, the phosphorus of the bones and brain, together with the azotised excreta, which, guided by the laws of tissue metamorphosis, I calculate about one-half the amount of the phosphates, find complete transit in some 10 weeks or so, mainly through the kidneys, and, in consequence of our defective management, are almost totally lost and dissipated. I do not say that 10 weeks is the very exact period, but it is approximately so, for, in point of fact, tissue change or metamorphsis is very much more rapid in some individuals—children very especially—than others. Nevertheless, the calculations are founded on physiological data, and in the main correct. Now, the horse or ox, and other animals in proportion, sheds, during each and every year of its life, let us say 1,000 pounds avoirdupois of the phosphates, and as nearly as may be 500 pounds of the nitrogenous compounds. At present, these so important matters are as effectively lost and dissipated as if they were thrown into the sea, or as if the annual millions which the lost ammonia and phosphates of transition may be supposed to represent were squandered similarly. And yet, by the judicious application of sanitary humus, the nitrogenous and phosphatic compounds—the amount furnished by each individual unit, multiplied by the available living aggregate—might, I am firmly convinced, be effectively rescued and turned to account, thus supplying a source of wealth, contrasted with which all the gold and diamond mines in creation were trifles utterly. In effect, were the transitional waste which of necessity ensues in connection with the various processes of animal life, only turned to proper account, human health and comfort would be enhanced greatly, while the profitable yield of the soil would be multiplied to an extent to which I am quite unable to attach a limit.—I am, &c.,

H. M. C.

SEWAGE.

Sir,—I shall be obliged if you will allow the following to appear in the *Journal of the Society of Arts :—*

It is admitted that the chief difficulty in the disposal of the sewage of towns is caused by the mixture of the sewage with a great volume of water, and by whatever system the result of such mixture is treated, the purification cannot be effected except at a great expense. The question is, can the admixture of sewage with so large a volume of water be avoided? It has been proposed to substitute the earth-closets for water-closets, so as to avoid the admixture, but, as General Scott observed, "Large communities accustomed to the convenience and cleanliness of water-closets will not abandon the luxury if they can by any means retain it." Some other means must be adopted. The water that is mixed with the sewage (solid and liquid) consists—1. Of the water used in the water-closet (which is comparatively a very small quantity). 2. Water used to flush the drains. 3. The storm water. 4. The water used to moisten and flush the roads. 5. The scullage or house-water (meaning thereby the refuse water from cooking, washing, bathing, and cleansing). 6. The overflow water. All the above water (except that used in flushing the water-closets and sewers) is comparatively pure. The overflow water is as pure as supplied by the water companies. The greater portion of the scullage and storm waters is comparatively slightly soiled; and if all the above (except the water used to flush the water-closets and sewers) were collected and allowed to flow into a river, no nuisance would, I believe, be caused, but it is unnecessary to leave the matter in the regions of belief.

I would suggest two systems of sewers—one for the sewage matter, the other for the used and waste water. A drain would carry the water from the roads, and into such drain all scullage, storm, and waste water should be allowed to flow. At convenient places tanks could be erected into which such water would flow, the detritus from the roads would sink to the bottom and be removed. In those towns where hard water is used, the remaining water could be treated by Clarke's process, and the water thus purified (in twelve hours) be then allowed to flow into the nearest stream. In large towns, where water is valuable, the water, after suchpurification, might be filtered through animal charcoal, and used for manufactures, for flushing the roads, and drains for the extinction of fires, and generally for cleansing purposes.

The tanks and additional drains would be expensive to make, and "extraordinary expense must be limited by the worth of the occasion;" still it would be but the first expense, and there are many advantages to be obtained by such a course, sufficient, it appears to me, to justify the expense.

Some of the advantages are these: A considerable portion of the expense of cleansing the sewers would be saved; the detritus from the roads frequently causing a partial stoppage. The distance between the tanks and the proposed drains being comparatively short, the proposed drains comparatively large, and the water comparatively larger than in the present sewers, in consequence of the smaller quantity of solid matter, it would not be necessary to cleanse such drains by manual labour. There would be no difficulty in disposing of the detritus, it being, as I am informed, largely used in plastering the interior of houses. The public health would be improved. (1.) The stench from the gully-holes would be lessened by decrease of water; it has been stated that the mixture of a considerable quantity of water with sewage hastens decomposition, and largely increases the injurious effects of the sewage. (2.) By improving the ventilation of the sewers. It is stated that if there were a proper ventilation of the sewers there would be no noxious emanations, the injurious matters being oxidised. It is clear that if three-parts of the volume of water were removed from the sewer, the quantity of air would be larger, and ventilation more perfect. (3.) By disconnecting the house pipes and drains with the sewers. In nearly all houses the overflow pipes of water cisterns, and the waste pipes of sinks (internal and external), the waste of baths, and the rain-water pipes, are all connected with the sewage drains. It has been repeatedly shown that a heavy fall of rain, by filling the sewers, uses the house drains as a force-pump to force the sewage gas into the houses and cisterns. The draught of the fires also draws up the sewage gas through the traps, which are nearly wholly inefficient.

By the adoption of the proposed drains, the above evils would be prevented, as the proposed drains would not contain sewage matters.

By the proposed means the volume of sewage at the outlet would be so much reduced that, after the solid matters were precipitated, the effluent water could be disposed of either by filtration or irrigation, and would be much richer in fertilising properties. The water soiled by manufacturing processes would, according to its purity, be carried off by the sewers or proposed drains.—I am, &c.,

E. L. R.

London, May 20th, 1872.

ASPHALTE

Sir,—The principal objection to this mode of paving is founded upon the alleged slipperiness in certain states of the weather. But may I ask how it is possible to expect that horses who have travelled for miles upon rough roads shall not be liable to trip when suddenly stepping from a rough to a perfectly smooth surface? Let any man try to run off the rough shore, at speed, on to the ice of a frozen pond, and he will find it very difficult to keep his feet.

Now if the streets of London were asphalted throughout, there would be no slipping, for it is only the sudden change from rough to smooth that causes the danger; and even gradients or inclines would be free from inconvenience if horses were shod, as has already been proposed, with a hard composition of asphalte, because the foot-hold of asphalte upon asphalte is tremendous, wet or dry. No doubt break-power will soon be introduced (a power so beneficial in every case where repeated stopping at speed takes place), but here again improvement is required, for the sulphurous stench produced by the carbonization of the oak blocks is intolerable, especially in underground railways and tunnels.

In regard to cost and durability, improvements will of course be ultimately introduced, both in the manufacture of asphalte and in the laying down, but the misfortune is that we must wait until the expiration of previous patents before we can risk our capital in experimental improvements. Legal definitions of piracy and infringements are so very various and subtle, that lawyers themselves are often puzzled to know how to deal with them.

The complaint that asphalte is apt to run into holes and hollows, applies with much greater force both to granite paving as well as to ordinary macadam, a circumstance that strongly shows how much the foundations are neglected.—I am, &c.,

Henry W. Reveley.

Reading, May 20th.

MEETINGS.

THE INDIAN CIVIL SERVICE.

A meeting of the East India Association was held, by permission of the Council, on Tuesday afternoon, at the Society of Arts; Mr. Eastwick, M.P., in the chair.

Dr. George Birdwood delivered a lecture on "Competition and the Indian Services," in which he assumed an attitude of strong opposition to the present system of competitive examinations. He urged that the present system not only failed to secure the right men for the right places, but tended also to have a most deleterious effect on national education; and it is thoughtless of the interest of the failed—of the majority—who under this abominable system are forced to stake their all on the issue of an examination, as if competition were, indeed, but a cowardly and cruel shift to rid ministers of the multitude of place-hunters, and not, as was the intention and hope of the great illustrious men who advocated it and brought it to pass, a means of correcting the corruption of patronage without relieving ministerial responsibility, and for diffusing education throughout all classes of the people, and promoting national contentment and imperial aims. The express aim of a competitive steeplechase-examination is to trip up as many of the competitors as possible; to pluck, not pass, and, unfortunately, too often it plucks the very candidates that under a scientific system would have passed, the very men wanted in India, and passes those who ought to be plucked. Mr. Matthew Arnold writes:—"I once bore part in the examinations for the Indian Civil Service, and I can truly say that the candidates to whom I gave the highest marks were almost without exception the candidates whom I would not have appointed. They were crammed men, not formed men; the formed men were the public school men, but they were ignorant on the especial matter of examination—English literature." And English literature, in the sense of the Civil Service Commissioners, means the "Handbook of English Literature," by Angus, or Shaw's "Student's English Literature." Another distinguished examiner for the Indian Civil Service himself pointed out one of the successful candidates of the year in which he examined, and who stood almost at the head of the list, as the very type of an uneducated man. All that can be said of such a haphazard, "happy-go-lucky," and Philistine system of testing men for the public service is that, at its best, and under the most fortunate circumstances, it is better than the abuse of patronage when it is thoughtless or corrupt. At a competitive paper examination, Mr. Grant Duff would have been inevitably tripped up for calling London, as he did the other night, "this metropolis," and Mr. Gladstone for calling St. Paul's, as he did in the last "Queen's Speech," "the metropolitan cathedral." But it is when applied to a service for which there is no competition that this sham competitive system works unmitigated evil. The Indian Medical Service had long been out of demand before we copied the system of competitive examination from the effete Chinese, and it has repeatedly happened, since they were thrown open to competition, that the candidates for them have barely outnumbered the appointments offered to the public. This is simply to turn a service into a feast for the poor, and the maimed, and the halt, and the blind. It was not denied that men of the highest accomplishments and scientific and professional ability have entered the Indian Medical Services under the new system; but it was a startling fact that contemporaneously with the institution of the competitive system the Indian Medical Services have ceased to be scientific, have ceased even to write on professional subjects. The old directors' system of patronage was the very system for keeping up the efficiency and high tone of an ill-paid scientific service, whilst competition, "first come, first have," applied to such a service cannot but destroy it. The present system of competition has necessarily severed this personal tie which bound old India-house and Company's servants together. It cuts that tie, and suppresses the salutary interest in their servants which all masters by nature desire to take, and without which it is unreasonable to look for loyalty, independence of spirit, and discipline among men. The old interest of the India-house in their servants and their reverence for the house, and the old *esprit de corps* which bound the members of the services together, have all been destroyed at one blow by competition. When a young man was freely given an Indian appointment he was laid under an obligation to a fellow man for life to him out of the very circumstance, the goodly pattern to whose perfect mould he would fashion himself as comely as he could. He might never see his benefactor again in this life, but in all his service his thought would all the more be to justify the selection of himself made by him, and if ever, with the opportunity, he won credit to himself, the chief pleasure of it would be in the satisfaction it was sure to give the directors who had served him. And these old directors stimulated this sentiment of personal loyalty to their government by following their servants with their goodness all their lives. Under the old directors, when a young man landed in India he was taken in charge by a paternal serjeant-major, or by personal friends, who put him up to the ways of the country. But now, on landing, the young competitor, nobody's relative, had to shift for himself, without an idea how to do it. He was cheated right and left, outraged, defied, possibly incurred debts that he could never throw off again, and almost as certainly an inveterate hatred of the country and its people. He had known this neglect and suffering kill young men outright. Then, under the old system, when the Indian service man came home, it was part of the etiquette of their paternal system for him to call upon the directors. It would be sheer impertinence for any Indian officer to call on the directors of the new India-house as an act of simple homage. In France and Germany the governments in this way collected much useful information indirectly which they could not come by directly, and acquired a hold on the services which bound them and the governments together in the unity of a vital organisation. But now-a-days, if the Secretary of State for India wanted civil servants, medical or other officers, he advertised for them. If they passed the conditions of the advertisement they got a letter by post to say so, and after a longer or shorter period, if they had miraculously escaped the dangers of that terrible middle passage, another letter came telling them to proceed to their destination at the other side of the globe. The Secretary of State could not and did not take any interest in servants he did not appoint, whom he did not see, and whose rights, privileges, and interests were being in consequence sacrificed one after the other, until at last the civil service of India was becoming as little sought after as the medical. It would be a complete compensation, indeed, for the apathy and indifference of the India-office if the competitive system was diffusing an interest in the Indian services and in India throughout the people of England. But this the present system of competition had emphatically failed to do. India had been thrown wide open through unrestricted competition to the people of England, and they simply would not have it. The supply of young men was merely kept up by one of the tricks of the trade of crammers. They impressed, crimped, quick, sharp boys for the service, and guaranteed their passing in consideration of a heavy premium. These boys must be quick and rich, or they had no chance. If a boy was not superficially clever, and could not pay their charge, they rejected him offhand. Competition, in short, instead of opening up chances for poor men to rise in life, yearly made it more and more difficult for any but the rich to attempt the public services. The training required was absolutely injurious, and was good only for the competitive examination itself, and worthless for all else beyond as well as below it. To fail in the examination was bankruptcy in purse, in mind, and in soul. This system was really the closest nomination and closest monopoly, the gang of crammers being the directors of the new East India Competitive Examination Dodge Company (strictly limited), but which not even its undoubted success could make honourable. Some of the Indian services still remained closed against competition, and it was remarkable that, although paid infinitely less than the competitive services, they attracted better men. Thus the very best official Europeans in India were found in the uncovenanted services and educational departments and ecclesiastical establishments. The university and public school men systematically avoided the civil services, and the accidental presence of any one of them in those services was owing to his being the son or nephew of an old Indian, the very man who of old would have received a nomination from a director; and thus already the administrative service of India was being out-matched and literally overpowered by the open professions—the law, the press, and commerce, all of which attracted superior men from England. The abuses of competition might be readily corrected by throwing the public services open to the public schools, the government inspected schools, and universities throughout the country. He would distribute the appointments vacant in the service, in turn, to every public school, college, and university in Great Britain, reserving a fixed proportion, say one-third of the covenanted and two-thirds of the uncovenanted appointments under the government of India, for the Indian universities and schools. The appointments to subordinate services and grades might be given to the elementary schools; clerkships to the grammar-schools; the higher civil and military appointments to the great public schools, such as Eaton and Harrow, Marlborough and Wellington; professional appointments to the professional colleges, and appointments to the diplomatic and Indian civil services to the universities of Oxford and Cambridge, Edinburgh and Dublin, Calcutta and Bombay, Montreal and Melbourne. The responsible Minister of State should determine the class of schools—primary, secondary, and the higher—from which the different public services should severally be filled; and the selection of the young men from the schools nominated by government should be made by the masters or governors of the schools of her Majesty's Commissioners for the Civil Service.

A discussion ensued, at the termination of which, Mr. **William Botly** moved a vote of thanks to Dr. Birdwood, which was seconded by **Mr. Rowland Hamilton**, and agreed to.

TEACHING OF MUSIC IN SCHOOLS.

The following circulars, relating to the examination in music of the students in training schools, and of scholars in elementary schools, have been issued by the Education Department. The first is addressed to principals of training schools, and the second to her Majesty's inspectors:—

"Education Department, Whitehall, May, 1872.

"SIR,—Adverting to the paragraph relating to music, in the syllabus for 1872,* I am directed to inform you that Mr. Hullah having been appointed Inspector of Music, will visit your training school this year for the purpose of making himself acquainted with your system of musical instruction, and of testing, in accordance with the syllabus, the practical skill of the students, now in the second year of residence, or who will leave at Christmas next, under Articles 87 (*b*) and 88 of the new code.

"With a view to forming some opinion of the general results of your system, Mr. Hullah proposes to hear all the students in residence (of both years) sing *in class*, under the direction of the regular musical instructor, with or without accompaniment, and in two or more parts, any music which they have previously studied.

"He further proposes that the practical test for the students who will leave this year should consist in—

(1.) Singing, or sol-faing *at sight*, according to the method in use in the training-school, simple part-music *in class*, under the direction of the inspector; and

(2.) Singing, or sol-faing, at sight, short passages of simple part-music *individually*.

"He will examine specially, and according to the circumstances of each case, any student whose practical skill in instrumental music (see syllabus*) requires to be tested.

"Mr. Hullah will also, at his visit, consult the authorities of the training school, with the view of reporting whether the standard of *theoretical* knowledge, now prescribed by the syllabus, ought not to be raised, and questions in harmony included in both the 1st and 2nd year's paper.

"He will give you notice of the date of his visit, which will probably be made after the Midsummer holidays, so as to give time to the second year's students to prepare for the test to which they will be subjected.—I have the honour to be, Sir, your obedient servant,

"F. R. SANDFORD.

"To ———, Principal of ——— Training School."

"Education Department, Whitehall, May, 1872.

"SIR,—The 3rd clause of the minute of 20th March, 1871, prescribes that—

"Grants to day schools which fall due after the 31st of March, 1872, shall be reduced by one shilling per scholar, according to the average number in attendance throughout the year, in those cases in which the inspector does not report that vocal music forms a part of the ordinary course of instruction.

"This clause is now embodied in article 32 (d) of the new code (1872), which will take effect in the schools visited after the 1st of May, with reference to the grants due on and after the 30th April, 1872.

"My lords have consulted Mr. Hullah, the Inspector of Music, as to the manner in which the results of the Musical Instruction in Elementary Schools ought to be tested.

"Mr. Hullah recommends that in all schools the inspector should, in the first place, ascertain that singing forms part of the regular school work, what time is given to it, and on what system it is taught.

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* A paper on this subject is not given to any student who does not produce a certificate signed either by an inspector or by the principal of the training-school, that "he or she has such an amount of musical skill, vocal or instrumental, as is sufficient for the purpose of teaching children to sing from notes.

"He should then, in the case of infant schools, call for a list of not less than six simple songs, known (by ear) to the scholars; he should select one or two of these, to be sung by the children, and should satisfy himself that the notes are sung fairly in tune, and the words plainly articulated.

"In schools for older children singing 'by ear' may also, for the present, be passed, as satisfying the code.

"The inspector should, in such schools, call for a list of (say) 12 vocal pieces, of whatever kind known to the scholars, who should sing at least two of them. Not less than two-thirds of the scholars present should join in this exercise, and the inspector should be satisfied that the notes are sung fairly in tune, and the words plainly and correctly articulated.

"This standard of examination will hereafter be considerably raised; but my lords think that it may be accepted for the present, and till experience has shown what results may fairly be required from elementary schools in which the children receive systematic instruction in vocal music.

"Special questions on the subject will be inserted in your form of annual report (X.); and notice of these requirements will be given (in form VIII.) to the managers. In the meantime, and till new forms come into use, grants will be paid without deduction to those schools in which you state, on page eight of the present form (X.) that the scholars are taught to sing, and that they can do so fairly.—I have the honour to be, Sir, your obedient servant,

"F. R. Sandford.

"To ———, H.M. Inspector of Schools."

OBITUARY.

Professor Morse died on the 2nd inst., at New York, United States. He was born in Charlestown, United States, April 27th, 1791. At an early age he was sent to Yale-college, and graduated from that institution in 1810. Passionately fond of art, he determined to become a painter, and for this purpose in the following year he sailed for England, in company with Washington Alston, in order to study under the direction of Benjamin West. Here he formed a friendship with Leslie, and in 1813 received from the Society of Arts a gold medal for a cast of the "Dying Hercules." He returned to America in 1815, and devoted himself entirely to his profession. He was elected Professor of the Literature of the Arts of Design in the university of the city of New York, and it was on his return to accept the position that the invention that has since made his name illustrious suggested itself to him. While at college he had devoted much of his time to the study of chemistry, under the supervision of Professor Silliman, and even in after years the phenomena of electricity and of electro-magnetism had been to him a source of considerable speculation; and during the voyage which was made from Havre to New York on the old packet ship *Sully*, Professor Jackson, the celebrated geologist, being a fellow-passenger, the conversation turned accidentally on the subject, in connection with a discovery that had shortly before been made in France of the correlation of electricity and magnetism. The thought flashed upon Morse's mind that this chemical relationship might be made practically useful. On reaching home he devoted the greater part of his time to making experiments on this subject. In 1835 he had succeeded in constructing an apparatus which enabled him to communicate from one extremity of two distant points of a circuit of half a mile; and he placed in New York University a model of his "Recording Electric Telegraph," and the public were invited to see it. In 1837 he filed his caveat at the Patent-office in Washington. It was not, however, until 1840 that the patent was perfected, and then Professor Morse set about getting his telegraph used. Four years, however, passed away before he succeeded, the first electric telegraph completed in the United States being the line between Washington and Baltimore, which began to work in 1844. Since that time the recording electric telegraph of Morse has been adopted over the whole country, and at the time of his death there were not less than twenty thousand miles of electric wires, stretching over the States between the Atlantic and the Pacific oceans. Mr. Morse's first telegraph was a chemical one, the electric current being used to decompose the acetate or carbonate of lead, or turmeric paper moistened with a solution of sulphate of soda. He, however, gave up this arrangement, and adopted the electro-magnetic system instead. This was, however, in his hands, a rather ponderous affair, his electro-magnet weighing 158 pounds, and the instrument was not sufficiently delicate for long distances. Experience enabled Mr. Morse to simplify his arrangements, and his "Simple Morse Circuit" was thought to be so complete, that in 1857 the French Administration of Telegraphs adopted the Morse instrument before all others. The "Morse Code," the "Morse's Transmitting Plate," his "Embosser," and Morse's telegraph worked by induction currents, are sufficient to show how his name is connected with telegraphic communication.

GENERAL NOTES.

German Marine Academy.—The Emperor has approved the plan drawn up for the establishment of a college or academy for the instruction of naval officers at Kiel. A peculiarity of this plan is that the academy is not to be a school for lads entering the navy, but, on the contrary, the students are to be selected from amongst the officers already in the service, the government selecting those whose conduct and talents seem to qualify them for superior scientific attainments, and, hereafter, for the filling of the most important posts. These officer-pupils will be required to give proofs of their diligence and progress by the production, from time to time, of theses and dissertations on scientific subjects given to them by the professors. At the same time, all naval officers will be permitted to attend the courses of instruction when their professional duties do not call them away. The course of study is to occupy two terms, each of twelve months' duration, with a vacation of three months for practical exercises. The subjects for the first term are :—Mathematics, natural philosophy, chemistry, the theory of naval war in all its branches, military tactics in as far as disembarkations are concerned, coast surveying, the theory of the formation of coasts, coastal defences, field fortification, the constitution of military courts, the principles of international, military, and naval law, the system of administration, sanitary science, especially with reference to life aboard ship and in different climates, the elements of logic, ethics, &c. The following subjects will be included in the second term :—Nautical astronomy, geodesy, theory of maps and charts, the history of war, with especial reference to naval war, artillery, shipbuilding, the construction of steam-engines (with practical exercises), the position and construction of naval ports, physical geography, the elements of geology, marine botany and zoology, and the general history of modern literature and civilisation, &c. The programme is a full one, and there is little doubt but it will be carried out with the same thoroughness which characterises the military organisation of the country. It is evident that the time is gone by, in Europe, for hap-hazard instruction and rule-of-thumb.

The Canal Cavour.—The ceremony of inauguration of the new branch canal from the Canal Cavour, for the irrigation of the Lomellina, took place on the 28th April, at the "Partitore" of St. Anna, where the main branch canal terminates, and the supply of water is regulated to the smaller branch canals by the Partitore, or sluice-house. The principal branch canal is 23½ kils. in length, and is 10 metres in breadth, and the volume of water it is capable of discharging is 30 centimetres per second. In its course from Novara to St. Anna it will dispense about 10 cubic metres of water, leaving 8 cubic metres to be discharged in the Mortara branch, which is 5 metres in width, and 12 metres per second in the branch now nearly completed for irrigating the districts of Gamboli, Tromello, and which will be ultimately carried to Garlasco. This branch is 7 metres in width. The number of bridges, culverts, aqueducts, &c., is about 100, and about 9,746 horse-power will be obtained from 23 falls, which regulate the gradient of the canal. The total cost of the work, including land, is about 1,600,000 francs. 1,200 horse-power of water-power has already been let by the company, on most advantageous terms, for the establishment of factories, and are in treaty with other firms for the use of a fall near Cilavigna, which will furnish upwards of 600 horse-power. The water is now in regular course, and several farmers near Mortara are irrigating new rice-fields with water from the Po, the Nile of Italy.

Superior and Special Education in France.—The means of raising the level of general education are being discussed in a useful manner in France, and it is to be hoped will be productive of some important results; at all events the arguments put forth are worthy of consideration. The greater portion of the thinkers and writers on the subject confine themselves to primary and secondary education, but it is well said that if good masters produce good pupils, then it is the object of superior education to instruct and form, not only professors of faculties, but also those of colleges, and through the latter, the true instructors of primary schools. M. Bréal says:—"A new spirit cannot enter into the Lycées unless the knowledge of the professors be enlarged and transformed; and the teaching in the primary schools can never become what it should be, unless the directors and professors of the normal schools lend themselves to secondary instruction. Our faculties of letters and science, which are usually looked upon as a kind of luxury, are the necessary organs for the renovation of our intellectual life." Of course the means of improvement suggested are as numerous almost as the writers and talkers on the subject, but nearly all the world is agreed that the level of superior education requires elevation, that pretentious eloquence and superficial vulgarisations are more evident than sound erudition and practical instruction. The lessons of the Sorbonne are declared to be more adapted to men of the world seeking an agreeable pastime, than for studious youths desirous of a guide up the steep hill of science. It is admitted that there are in all the faculties capable and energetic professors, but it is asserted that their efforts have been impeded and paralysed by old regulations still in existence, and that they have been deprived thereby of the mass of young and zealous pupils which otherwise would have flocked around them. In short, that superior education has no audience. M. Bréal, already quoted, estimates the number of really serious pupils in the five faculties at not more than 220; all beyond these he reckons as mere idlers. The causes, of this paucity of real students in these great schools are supposed to be the existence of so many special schools, such as the Ecole Polytechnique, Ecole des Ponts-et-Chaussées and Ecole des Mines, for science, and the Ecole Normale for letters; and the fact that the regulation which requires young candidates for University professorships to serve five years as teachers in a Lycée. These causes have almost depopulated the faculties, leaving no students but those few who are candidates for the degrees of licentiate and doctor. M. Bréal does not advocate the suppression of the special schools and the creation of one single *universitas scientiarum*, to use his own expression, but the giving more elasticity to the former and combining their instruction with that given by the faculties. He advocates the free admission of all applicants to examination for the Ecole des Ponts-et-Chaussées and other schools, the suppression of the limit of age, and the withdrawal of the privilege of a second examination in case of failure. M. Mazières, although he does not advocate such radical reform as M. Bréal, takes much the same view of the case. You cannot, he says, organise primary instruction without having first given a firm basis to superior instruction, from which all the rest must flow, and which alone can supply principles, methods, general views, and ideas. Any other road can only lead to partial and ephemeral results. If you would give to the population a love for instruction, the classes in easy circumstances must set the example, and commence by themselves honouring the high cultivation of mind. At present those classes do not give much support to superior instruction; they are too much occupied with titles and grades, and thoughts of employments to which they lead; they do not love science sufficiently for herself; and here as elsewhere the bureaucratic mania has done great mischief.

The Anti-Mildew Grain Protector.—An ingenious apparatus for preventing corn and seed in bulk becoming affected with mildew has recently been shown in London by Messrs. Adutt and Co., of Mark-lane. It is an invention by Mr. Joannides, and consists of an arrangement of perforated and solid tubes, on the principle of the syphon, whereby the air is passed through the mass of the corn as stored in the hold of a ship, in granaries, or in warehouses. It is well known that the commercial value of cargoes is frequently reduced by a portion becoming damaged, and then, as the samples taken from each hold are mixed by the brokers for disposal in the markets, with a view to ensure a fair average, the whole cargo thus really becomes reduced in price. This and many other illustrations which might be given would show that the prevention of mildew is not only of high importance intrinsically, but considerable expenses might be well incurred to avoid the deterioration of large quantities on the voyage. For hay-ricks, too, a good system of internal ventilation would go a long way towards preventing heating, or in facilitating drying. The apparatus consists mainly of a system of double tubes, one external, and perforated all over, the other internal and only perforated at the end of each branch. The arrangement is as follows:—There is first a vertical perforated cylinder, from which, fore and aft, and port and starboard, perforated arms extend in single or in two or more tiers. The cold air taken in at the bell mouth of the vertical tube descends, and finds escape partly through its own perforations, and partly through those of the branches, and thus intermingles with the grain through every interspace. When heated or under pressure in the closed hold, a portion of this air escapes by the internal tubes, and thus a constant circulation is maintained, as may be shown in the models by means of smoke. A full-sized machine ordered for Wallachia may now be seen at Messrs. Rotherall and Bastin's, Blackfriars. In length its tubes are 32 feet, across the ship 19 feet, the vertical tube being 13 feet, or, in other words, the tubes extend nearly across the hold in both directions; above the hatches the tubing to the bell-mouth will rise some seven feet. The cost of this apparatus will be about £150, a sum that might be saved in a single voyage upon an extensive cargo. For granaries and other magazines, where a full current cannot be encountered, as on board ship, a very ingenious Archimedean screw arrangement has been made for forcing down the air into the store amongst the corn. Experience will no doubt show other advantages and applications. The plan has the merit of simplicity and of working without need of any continuous attention.

A Novel Application of Photography.—The applications of photography are certainly very various. One of its most recent uses, as pointed out by the *Journal of the Photographic Society*, has been to aid army tailors in cutting the new-fashioned tunics which are to be worn this year by all regiments. Formerly it was the custom to forward to each master-tailor of every regiment a pattern coat, showing the alterations to be made, together with instructions as to the manner in which the lace and trimmings varied in the uniforms for the different grades. Such a proceeding was necessarily a costly one; for probably some two hundred pattern tunics were required for transmission to every battalion in the service. Instead of this, but one garment of each sort has been made; and this having been photographed in three different positions, copies have been distributed throughout the country. In this way, of course, every information is afforded to the regiment, without any great expense being incurred; and instead of complicated instructions about the depth of the lacing and style of trimming upon the tunics of sergeants, corporals, drummers, pioneers, &c., the master tailor receives three sketches, which show at a glance the whole nature of the alterations and modifications. In the same way pictures have been taken of soldiers wearing the new valise equipment, whice is to take the place of the old knapsack. The photographs will be distributed to all regiments, and will show exactly how the new equipment is to be worn, how every strap and buckle is to be adjusted, and, in fact, every little particular upon the uniformity of which so much stress is laid by all military men.

Vine-growing Statistics of Australia.—Victoria, New South Wales, and South Australia are the only Australian colonies fitted for this important industry, and for some years past they have been and are still changing places with each other in reference to it. In this, as in other things, Victoria is the premier colony, and has left New South Wales a long way behind, both in the acreage of vines and the quantity of wine produced. She has also a larger number of vines growing than South Australia, and is vigorously pushing this branch of industry, while South Australia is obliged to own to a decline. The following statistics are from the latest returns published:

	No. of Vines.	Grapes sold. cwts.	Wine made. gallons.
1862	3,818.335	16,972	47,568
1863	4.492.942	16,345	91,893
1864	6.943,551	15.656	120.894
1865	8.750,408	13,027	110,042
1866	8,199,618	18.063	175.959
1867	8,231,022	17,264	284.118
1868	8.639,725	34,459	459,072
1869	7.682.698	25,574	448,547
1870	9,230.531	24,980	577,287
1871	9,672.391	26,296	629,219

The above table shows the vines grown, grapes sold, and quantity of wine made in Victoria from 1862 to 1871 inclusive. The acreage of vineyards in Victoria in 1861 was 1.338 acres; it is now 5,446, or rather more than a fourfold increase. Acreage of vineyards and wine made in New South Wales from 1861 to 1870:—

	Vineyards. acres.	Wine made. gallons.
1861	1,583	90,791
1862	1,130	85.328
1863	1.459	144,888
1864	1,640	136,746
1865	1,849	161.298
1866	2,126	168.123
1867	2.281	242.183
1868	2,531	285,283
1869	3,115	412,587
1870	3,906	460,321

The acreage of vineyards in New South Wales has been more than doubled during the last ten years, and the increase in the wine made fivefold. The grapes gathered in 1870 amounted to 19,100 cwt., and out of the 3,906 acres, 679 acres were appropriated to table use. In addition to this, about 2,000 gallons of brandy were made yearly. The following table shows the acreage of vineyards and wine made in South Australia from 1861 to 1870:—

	Vineyards. acres.	Wine made. gallons.
1861	3,180	182,087
1862	3,918	312,021
1863	4,777	472.797
1864	5,779	606,365
1865	6,364	798,647
1866	6,629	839,979
1867	6,361	734,988
1868	6,209	863.584
1869	6,063	734.983
1870	5,823	895,795

If the colonies continue to make the present rate of progress in producing wine, they will not only force foreign wines out of these markets, but will have to seek other markets for their own wines.

Observatories in France.—The present government has by decree altered the arrangements respecting the astronomical and meteorological services. The work of the Observatory of Paris is thus defined:—1. The study of the laws of the universe, founded on the continuous and systematic observation of the stars, and the improvement of the methods of observation. 2. The study of meteorology and physics in France and abroad; the concentration, discussion, and publication of documents received from the various meteorological stations in France, or collected by Departmental Commissioners; the preparation of dispatches relative to the variations in the weather in the interest of navigation and agriculture. The new staff of the Observatory of Paris is settled as follows:—One director, four titular astronomers, three of whom are to devote themselves especially to astronomy, and the fourth to the meteorology and physics of the globe; six secondary astronomers, and two secondary physicists; with calculators, assistant astronomers, and physicists, and pupils, from amongst whom assistant astronomers may be recruited. The salary of the director is fixed at 15,000 fr., and that of the other officers from 1,500 to 8,000 fr. The director is to publish annually the astronomical observations of the preceding twelvemonth, with the reduction of such observations, and their comparison with existing theories. In addition to this it is his duty to facilitate the studies, of independent savants, astronomers, and physicists and, if need be, to lend them the aid of the observatory. The director to be nominated by the government on a double presentation of two candidates by the Bureau of Longitude and the Academy of Sciences, &c. The Observatory to be inspected annually by a commission composed of members of the Board of Longitude, not connected with the former establishment, members of the Institute, and five other persons appointed by the ministry. The new arrangements for the Observatory at Marseilles are similar, though, of course, on a comparatively small scale. Another kind of observatory is proposed to be established in the Puy de Dôme, on a plan proposed by M. Allnard, professor, at Clermont. The plan is to establish a meteorological station on the mountain there, with repeating and other apparatus at Clermont itself, and to connect the two stations by means of the electric telegraph, which would furnish the means of carrying on a number of important simultaneous experiments, and to send to Paris each morning the *resume* of the observations made at the same moment on the mountain and in the plain. The cost of these stations is calculated at £4,000, and the Minister of Public Instruction has given half the amount. The authorities of the Department of Puy de Dôme and the town of Clermont are expected to contribute the rest.

Australian Opium.—It has been tried recently in Victoria, successfully as to the quality. The sum of 10s. per pound is charged for duty, and as much as 30s. per pound has been realised.

A Prize awarded at the Olympian Games.—The members of the Society of Arts, to whom the great picture of Barry, in the lecture-room, is familiar, will hear with interest of the discovery, at Capua, of the vase which formed one of the prizes at the Olympian Games at Athens in the year 332 before the Christian era. This prize is a simple painted amphora; one side is a figure of Pallas Athenæ, standing between two columns, throwing a javelin, each column being surrounded by a figure of Victory; on the other side of the vase is a group of wrestlers, a youth looking at the struggle, an old man with a wand in his hand, and the judge. Above is inscribed the name of the chief magistrate of the City of Athens in the year quoted above, and these words:—" Prize of Athens." It was well known that prizes given at the Olympian Games consisted of wreaths and other objects of small value, though immensely prized, but probably this is the only instance of such a prize having come down to modern times with clear evidence on its face of its application. The collection of painted pottery of the period, in various museums, is immense, but few fictile vases possess more interest than the one now discovered.

Oxygen and Oxyhydrogen Gas.—A lively discussion is going on in scientific and other circles relative to MM. Tessié du Motay and Co.'s proposals for applying oxygen gas to the lighting of streets and houses, and also to manufacturing purposes. M. Tessie du Motay's process has been public for some time. It consists, in a few words, of charging elliptical retorts each with 300 kilogrammes of a mixture composed of three parts of manganate of soda and one part of oxide of copper intimately blended together. Those retorts are said to yield each 35 cubic metres of oxygen gas in eight operations, each occupying three hours. Eight such retorts are in working order at the company's works at Pantin. A steam-engine of 20 horse-power nominal is used to inject compressed air into the retorts, to compress the gas in the cylinders, and to supply the necessary steam for the disengagement of the oxygen. The applicability of the mixed gases to lighting purposes is discussed with much asperity, but this may be attributed in part to objections of the gas company which supplies all Paris, and naturally is tenacious of its monopoly. MM. Tessié du Motay and Co. have, however, applied to the Municipal Council of the city for permission to lay down mains and supply-pipes for the distribution of oxygen, and it is believed that the application will be acceded to. The price of the gas is also fiercely disputed. On the one hand, it has been declared that the actual working cost is not more than 15 centimes the cubic metre, while, on the other hand, it is asserted that it cannot be sold at a profit at a lower rate than 1f. 70c. the cubic metre; the Tessié du Motay Company would seem to have settled this latter question by issuing a public notice, to the effect that as soon as the mains and pipes can be laid down, oxygen gas will be sold to the public, either for lighting purposes, the smelting of metals, or other manufacturing purposes, and, above all, for the purification of the air in houses and hospitals, at a price not exceeding one franc the cubic mètre, the company taking upon itself the entire cost of the necessary means of supply. The subject is one of great interest, and as M. Tessiè du Motay and his partners ought certainly to know what their products cost, there seems a fair probability that pure oxygen will be placed at the disposition of the manufacturer at a moderate cost. The application of this gas to business purposes seems far more promising than that of its general use in street or house lighting. The necessity for two sets of pipes and two metres, one for each of the gases, and the nicety required in regulating their proportions, are likely to present considerable difficulties in practice.

The Coffee Plant for English Agriculture.—Mr. H. Grafton says, in the *Gardener's Chronicle:* "About 48 years ago a relative of mine, living in Canterbury, planted about an acre of coffee, which grew up to great perfection, and was looked upon by the surrounding farmers as a sort of 'ninth wonder;' upon my great uncle going one fine day to cut it down, he found to his dismay that the Excise officers had ruthlessly set fire to it all. 'Yes,' said his widow to me, showing me the spot, 'the law is as strong as Sampson; it has used foxes and firebands to burn down a beautiful crop, but its smoke and wrong have ascended on high as a sacrifice! You'll live to see coffee free—yes, and hops too!' stamping her feet only as a Kentish woman could who all her life had been under the Excise. Now, sir, I have lived nearly half-a-century after her prophecy about the hop has been verified, and I did think the coffee tax would have died a natural death too. Alas! no. But notwithstanding this, as the spring is now advancing, it will be well worth while if some of our Kentish or other farmers will make experiment and plant the coffee berry forthwith; then, perhaps, some one besides Mark-lane may see the benefit. The Canterbury level line, in the parish of St. Dunstan's, now works over this almost sacred bit of land."

CALENDAR OF MEETINGS.

ORDINARY MEETINGS OF THE SOCIETY.

Wednesday evening at eight o'clock.

May 29.—Derby-day.—*No meeting.*

CANTOR LECTURES.

The concluding Lecture, on "Silicates, Silicides, Glass, and Glass Painting," by Professor Barff, will be delivered as follows:—

Lecture VII.—Monday, 27th May.

Silicates as Painting Vehicles, and some other of their Useful Applications in the Arts.

INDIA CONFERENCE.

On June 7th a Conference will be held at half-past four, on "Engineering Education in India," to be opened by Mr. Hyde Clarke.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....**SOCIETY OF ARTS 8.** Cantor Lectures. Prof. Barff, "On Silicates, Silicides, Glass, and Glass Painting."
Social Science Association, 8. Mr. Edwin Chadwick, C.B., "On the Duties of Officers of Health, and the Separation of Private Practice from the Public Medical Service."
London Institution, 4. Prof. Bentley, "On Elementary Botany."
Royal Geographical, 1. Annual Meeting.
British Architects, 8.

Tues. ...Medical and Chirurgical, 8½.
Civil Engineers, 8.
Royal Institution, 3. Mr. E. B. Tylor, "Development of Belief and Custom."

Wed.....Royal Society of Literature, 8½.

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Institution, 3. Prof. Tyndall, "On Heat and Light."
London Institution, 7½. Mr. Walter Noel Hartley, "Experimental Evidence against the Spontaneous Generation of Living Things."

Fri.......Royal Institution, 9. Mr. E. J. Poynter, "Old and New Art."

Sat.......Royal Institution, 3. Prof. Roscoe, "On the Chemical Action of Light."
Actuaries, 3. Annual Meeting.
Royal School of Mines, 8. Dr. Cobbold, "On Geology."

Journal of the Society of Arts.

No. 1,019. VOL. XX.

FRIDAY, MAY 31, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

The following letter has been received by the Council from Mr. Thomas Twining :—

SIR.—I think I cannot better endeavour to promote the proposed formation of a permanent Endowment Fund, than by doing what is in my power towards enabling the Society to create at once a specimen of those active and practical operations which it would be the purpose of the fund in question to perpetuate. With this view, I take the liberty of begging you to submit to the Council the following proposal :—

I shall be happy to place at the disposal of the Council a yearly sum of £50 for three years, provided a sufficient further amount be secured, either by donations and subscriptions, or out of the Society's ordinary means, for obtaining for that period the services of a special officer of known zeal and abilities, for taking charge of the work to be done in the section of chemistry or physics, applied to manufacturing and commercial purposes.—I am, &c.,

T. TWINING.

Perryn-house, Twickenham, May 17th, 1872.

SIR.—On what ground can the Society of Arts ask persons who are not members to contribute funds ? Does the Royal Society, for instance, receive money except from the subscriptions of its own fellows ? Is it not beneath the dignity of science to receive contributions for purposes of public utility from the public ?—I am, &c.,

A READER OF THE "JOURNAL."

SIR.—It was my intention to have pursued the history and relation of the various hospitals established in and about London little more than a century since, and to have shown how intimately many of them were related to the industrial history and progress of the times. Thus the persecution which drove the silk weavers of France from their own country to settle in England created at Macclesfield, and also in our midst at Spitalfields, an industry that has ever since been one of the chief industries at the east end of London. At the same time that an industry was created for future generations of our own people, it was at the cost of much misery and wretchedness to those who, for conscience sake, had become settlers in a foreign land. Many were there who, reduced to poverty and suffering from the infirmities of age, or left destitute by the death of husband, brother, or friend, were driven as mendicants to ask for charitable aid. For the relief of such the French Hospital was established in 1708, and to French settlers and their descendants its doors are still open. It is scarcely necessary for me to add how large an interest the Society of Arts took in the weavers' art. A reference to the index of the Society's *Transactions* will show how numerous have been the awards it has made to Spitalfields weavers for improvements effected in the machinery and appliances used in their industry—an interest it still maintains. Our Society looks forward most anxiously to the time when some technically-educated, intelligent, and enterprising workman will develope and apply the enormous power of electricity which Bonelli has shown to be available, and capable of being applied, not merely in the production of simple fabrics, but of so enriching them in an elaborate and artistic manner as to give a new character to the products of the loom, and open up fresh demands and new markets for the work of the silk weavers. An able account of Bonelli's loom, written by our respected Secretary, Mr. Foster, will be found at page 207, vol. 8, of the Society's *Journal*.

I must, however, refrain from proceeding with the review I had contemplated, from a fear that I may not merely tire your readers, but so far exceed the limits of space at your disposal in the *Journal* as to exclude my letters from its pages altogether. I will, therefore, merely add that the French Hospital was erected on land purchased in 1716, and known as "Golden Acre," situated in the parish of St. Giles, Cripplegate, in the city of London. The land was purchased from the Ironmongers Company, for a term of 990 years, and an additional and adjoining plot of ground, making in all about four acres, was also purchased from the Corporation of the city of London in 1736. The site thus preserved to us in the City was recently rented by the Corporation for the improvement of middle class education, and extensive schools were opened there, which owed their existence to the untiring energy and perseverance of the Rev. William Rogers, one of the vice-presidents of the Society of Arts. The old French Hospital buildings were altered and adapted for class-rooms, and a new hospital has been erected and opened by the corporation of the French Hospital in Wick-lane, Victoria-park, South Hackney. The Middle-Class Schools have recently been removed to new and more commodious buildings, which have been erected in Cowper-street, Finsbury.

The necessity for an improved education of the artizan of this country was made abundantly apparent on the visit of the French, German, and Swiss workmen to the Exhibition of 1851. To correct the deficiency of our own workmen the Society of Arts instituted its systems of examinations, and established the Union of Literary and Scientific Institutions.

The examinations of the Society of Arts and the prizes and certificates awarded in connection with them, led to the middle-class examinations of Oxford and Cambridge, which have since been established. To induce continuity of study in the classes of the institutions in union with the Society of Arts, the Prince Consort, then president of the Society, instituted and gave a prize of £26 5s. yearly, to the most successful student of three consecutive years, which prize is still continued by Her Most Gracious Majesty the Queen. The government have now enacted that every child shall be educated, and educational boards have been established throughout the country, to carry into effect the enactments of the legislature. The Society of Arts has not, however, relinquished its work for improving the education of the workman, but is now instituting a system of technical examinations, whereby to test the knowledge of the artizan classes of the relation of science to industry.

I have endeavoured briefly to point out a few facts showing the relation of hospitals to industry, art, and education, and the interest which the Society of Arts has, and is still taking, in such works, both from a charitable, artistic, and educational point of view. Our Society has raised some institutions and aided others, while it has at the same time been the pioneer of new systems of action which have led to the improvement of both the education of the artizan and the industries which they have followed, but to this I shall again have to refer. I had also purposed going somewhat fully into the history and work done by another class of institutions which exist in our midst, viz., the Trade Guilds, but the same reason which has induced me to draw what I had to say on hospitals to a close, compels me to confine myself to a mere recital of the history of their origin, and an indication of the work they were established to carry out, and that, with your permission, I will do as briefly as I can in my next letter.—I am, &c.,

H. G. H.

ANNOUNCEMENTS BY THE COUNCIL.

SHIPS' LIFE BOATS.

The Committee met on the 28th May, at three o'clock. Present:—Mr. Seymour Teulon (Vice-Chairman of Council) in the chair, Vice-Admiral Ryder, and Captain Ward, R.N. It was arranged that the actual trials should take place, in the presence of the Committee, on Tuesday, the 30th of July. Further particulars will be announced in future *Journals*.

CONVERSAZIONE.

The Society's Conversazione is fixed to take place at the South Kensington Museum, on Wednesday, the 19th June. Tickets are issued to the Members this day.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first subscription list amounted to £351 3s. A further list will shortly be published.

IMPROVED CABS.

The Council of the Society of Arts offer the following Prizes:—

One Prize of £60 for the best improved Cab of any description.

Two Prizes of £20 each for the next two best.

Two Prizes of £10 each for the next two best.

The competing Cabs must be exhibited at the International Exhibition, to be held in South Kensington in 1873, and on their delivery at the Exhibition Building they must be certified to the satisfaction of the Judges as having been in regular use in the streets of London for three months previously. They must be delivered on or before the first Saturday in April.

The Council consider that the Cabs now in use in London are especially defective in the following particulars:—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.
2. The seats in the four-wheelers are too high, not commodiously made, and the space underneath is lost.
3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.
4. The arrangements for opening and closing the window in the Hansom.
5. The confined space and want of ventilation in the Hansom when the window is closed.
6. Imperfect locking of the wheels in four-wheelers.

The Council desire to point out, for the consideration of those likely to compete, that in Continental and some English towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

A suggestion for a cab, to be used either closed or open, has been brought before the Council, and a model submitted. The principle might be adapted to existing four-wheelers, but the Council do not prescribe this model or any special form of carriage; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges may report.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

CHANNEL PASSAGE.

Swing Cots for Sea-voyages.

The late Sir John Herschel took much interest in this subject, and the following correspondence, in which he took part, is extracted from the *Journal:—*

I beg to submit, for the consideration of the Society of Arts, the following mode of suspending a cot on shipboard, where a whole cabin is disposable as a sleeping apartment (the cot being removable in the day time), as having, from experience in a voyage to the Cape and back, found it productive of a degree of comfort far surpassing any of the ordinary arrangements of swing cots or beds on jimbals which I have seen adopted; affording an invalid, in the roughest weather, the most complete immunity from all the ordinary causes of complaint arising from the pitching and rolling of the vessel, and entirely obviating any tendency to sea-sickness. Its principle is the reverse of free or jimbal suspension, and relies on friction as a means of deadening oscillation. As the figures annexed will speak for themselves, no lengthened description will be needed; and I will only add, as regards expense, that it may be fitted up by any ordinary carpenter and blacksmith at the cost of a very few shillings.

Fig. 1 is the interior view of a cabin with the cot, *g, h, i, j*, suspended by the clews, *v, p, s, t, u, w*, from the hooks, *v, w*, at the end of the cot-pole, *e, f*, which is itself suspended by cords or light iron rods *a, c, b, c, a, d, b, d*, of precisely equal lengths (when equally stretched), and which (if cords) are firmly knotted (so as not to run) to the rings, *c, d*, on the upper side of the pole, and are furnished with hooks at their upper ends, *a, b*,* attachable when in use to rings screwed on the starboard and larboard side of its medial line, or right athwart ship, into the ceiling of the cabin, the planes of which should be adjusted fore and aft. The cot-pole should lie exactly horizontal, and truly fore and aft when the ship is at rest, and the lengths of the cords or rods, *a, c, b, c, a, d, b, d*, should be adjusted accordingly.

l, e, m, m, n, n, o, f, k, is a friction band (cord is better than woollen list, which creates too much friction), attached by loops, *k, l*, to the fore and aft walls of the cabin, and passing into, through, and round the cot-pole in the manner represented in Fig. 2 and Fig 3; the latter being a section, through the axis, of one end of the cot-pole, showing the channel through which the friction-band enters and emerges at either end. It is needless to remark that all this part of the work must be smoothly rounded, to avoid cutting the band.

p, q, r, s, is a stout pack-thread attached to the cot at the foot, at *p, q*, and passing through rings *q, r*, screwed into the ceiling; the pack-thread being so tightened by trial as to destroy, by its friction on the rings, the effect of the ship's roll, as the friction-band, *l, m, n, k*, effectually does that of its pitch.

The figures are on no precise scale, which must depend on the dimensions of the cabin. The cot should hang about a foot from the floor, and the height of the pole should be adjusted accordingly. But every part here figured is essential to the well-working of the concern, and ought on no account to be departed from by the workmen employed to construct it.

In the day time the cot may be removed and stowed

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* These hooks should be well oiled, or they will scroop horribly.

Fig. 1.

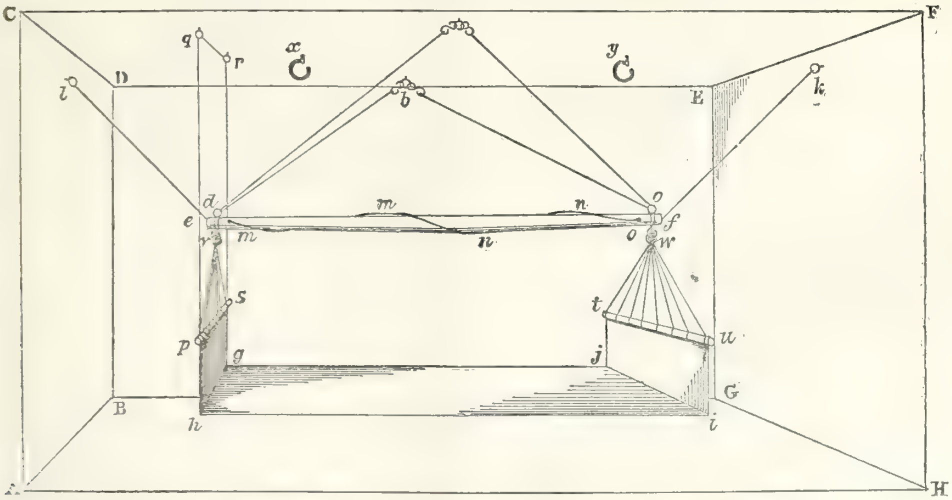


Fig. 2.

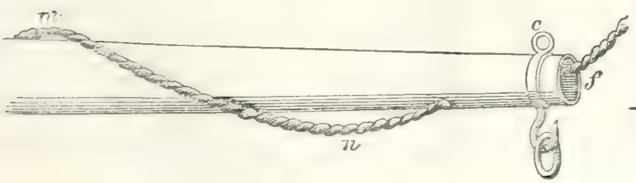
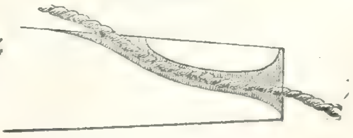


Fig. 3.



away as usual, and the cot-pole put out of the way on the hooks, x, y, under the ceiling, with the line rolled round it. When the bands wear they are easily replaced by new ones.

I venture to recommend the principle here employed (the quieting of oscillations by friction in lieu of perpetuating them by the usual modes of free suspension) with proper adaptation to the special case, for hanging ships' barometers; for suspending a chair for telescopic observation at sea (for which a stiff rope or end of cable fixedly attached at the upper end might be worth trying); for swing trays, lamps, &c., on shipboard.

I am, &c.,

J. F. W. Herschel.

Collingwood, Dec. 18, 1860.

Sir,—Will you kindly advise what I should do under the following circumstances:—I have been much interested lately in the papers published in the *Journal of the Society of Arts*, with reference to the Channel passage; and while passing a few weeks here I have been trying to overcome one great obstacle, or rather difficulty, that many passengers encounter. Captain Morgan, the superintendent of the mail packets, and the captain of *La France*, have kindly helped me to carry out my experiments. The weather has not been quite rough enough lately to continue them; but one day, when I crossed twice, there was a capital opportunity, and a heavy cross sea. I had a cot made on a principle that may, with many persons, prevent sea-sickness; it was rigged in the fore-cabin, where there was most motion. While I remained in the cot, I kept well; but when I left it, I was as ill as any of the rest; when I returned I was well again; though I daresay there is still room for improvement. As space is needed, it would only answer in state-rooms or special cabins, and would be more suitable for steamers or vessels much larger than the present mail boats. However, special cabins might be supplied and paid for accordingly. The point I desired to attain was, to have a berth that would keep horizontal under any circumstances. The difficulty to overcome was the independent motion, that is, either twisting or getting too much way on, after the pitch or roll of the vessel. The first, the twisting, is quite overcome by hanging the cot from two or four hooks, four being preferable, six or seven inches apart. The second, or independent swing, cannot quite be overcome, but it must not be stopped abruptly; therefore, below the berth, in the exact centre, directly perpendicular from the hooks by which it is hung, I placed vulcanised india-rubber springs, "accumulators," such as serve to keep doors shut. They "give," but yet always tend to bring the berth back steadily to the exactly horizontal position. They must not be too strong, nor too pliant. Further experiments would show how strong or how many might be best used. I think four medium-sized would suffice, but they should meet in the centre of the bottom of the berth, though it would be an advantage to have the other ends spread over the deck floor, so that all the power might not be caught at once. I only had two; one weak, one strong, first in line, then fastened together alongside; but even then they were not strong enough to overcome the swing in one direction, though a touch of the hand sufficed to steady the cot. As the eye would be affected by the motion of the ship, though the cot kept still, either curtains must be used or the eyes must be kept closed. I have therefore added curtains; they need not be quite opaque. An ordinary hammock hangs from both ends stretched out, not compressed, so that in one way the full motion of the vessel is experienced; by contracting nto six inches the motion that would be given to six feet, or 2½ feet length or breadth, a very nearly horizontal position can be maintained. In addition to the spring-band, a slack rope might be fastened below, to keep the cot within the extreme limit of the cabin; but if the rope has no spring, or is made too tight, the effect, of course, is a sharp stop; this the spring prevents. It will be for further experience to show how best to adapt the spring. I have carried the experiment so far that we can see reason to believe a great boon may be thus provided for many who suffer at sea; in fact there is no doubt but that small cabins as well as cots might be fitted on this plan, with more or less success. I have ventured to lay the particulars before you, trusting that you will excuse the trouble, if they do not interest you; but you will be able to tell me, I believe, what is the best plan to adopt, to prevent the idea being patented by some one who might make it a dear monopoly, at least the patentee might prevent others trying to improve upon it, so that the benefit might be restricted instead of extended. I fear that if I put myself in communication with any one who would carry out further experiments, he might wish to monopolise any good in it, or expect me to meet the expense of experiment and patent. I seek no profit, and want no loss. I estimate that it would require a cabin 11ft. by 5ft. 6in. to give the berth full swing. At first I made a working model, which answered well, but the practical test has been satisfactory with a full-sized cot. Yet frequent experiments in crowded steamers, full of sick passengers, test more than my philanthropy and the invention.

I am, &c.,

John Scarth.

Dover, October 4th, 1869.

Sir,—As Mr. Scarth, in the last number of the *Journal of the Society of Arts*, requested your advice as to the best course for him to pursue in bringing to perfection, and introducing into general use, his plan for reducing or annihilating the effect of pitching and rolling of a ship on a suspended cot, and so relieving landfolk of that scourge of comfort in voyages—sea-sickness, allow me to suggest to you, as one thing to which it may be desirable to direct his attention, a perusal of my communication to the Society on the same subject, entitled, 'A Swing Cot for Sea Voyages,' printed in the *Journal of the Society of Arts* for Jan. 4, 1861. At the time my plan was devised (in 1833), which, as there stated, proved completely successful, and a source of unspeakable comfort during a long vogage, often in a very agitated sea, the use of Mr. Brockedon's india-rubber ties had not become common. It is very likely that Mr. Scarth's proposal for their use may prove available (though, in case of fracture, on a long voyage, they are not so easily replaced as cord or pack-thread); and, in the event of their adoption, I would suggest the use of four such, radiating upwards from a ring in the cabin floor, vertically below the centre of the cot (to attach to its four corners), rather than downwards from the cot centre to four rings in the floor as proposed by Mr. Scarth. Being on the subject of elastic bands, allow me to refer to a suggestion which I took occasion to make some time ago, relative to the proposed transfer of a very delicate astronomical instrument over a long and rude land journey, viz., its suspension by a set of such bands, radiating from it in all directions—upwards, downwards, and sideways in the interior of an iron cage, free of all contact (Mahomet's coffin-like) the whole to be packed in a wooden case, for mule, camel, or coolie transport. For the cot, however, I hold to the cord and pack-thread system, not only as the cheapest and most readily replaced, but as being easily adjustable by trial to the exigencies of the case, by tightening or loosening, as circumstances may require, which the india-rubber bands in ordinary use are not. They require, too, no rings in the floor, which, in the day-time, when the cot is removed, and the cabin used as a sitting-room (as is very desirable in long voyages), would be much in the way.

I am, &c.,

J. F. W. Herschel.

Collingwood, October 30th, 1869.

CORRESPONDENCE.

COMPETITION FOR THE INDIAN CIVIL SERVICE.

Sir,—As one of the earliest promoters of the system of open competition, I feel myself bound to protest against the statements made in a report of part of a lecture by Dr. George Birdwood, in the *Journal* of the Society and elsewhere, as if these statements had passed unchallenged, whereas they received decided contradiction by myself, as to the alleged effect of the system of competition upon the general civil service, by a medical gentleman of long service in India, and as to the former condition of the medical service there before the system of competition was introduced.

The character of the representations made in the lecture as to the present condition of the Indian Civil Service, by implication, from statements as to what it will be under the system of competition may be judged of by the representations of what it was under the old system of patronage appointments by the Company's Directors, which he spoke of as "the very system for keeping up the efficiency and high tone of an ill-paid scientific service;" "that the present system of competition has severed the personal tie which bound old India-house and Company's servants together. It cuts that tie, and suppresses the salutary interest in their servants which all masters by nature desire to take, and without which it is unreasonable to look for loyalty, independence of spirit, and discipline amongst men." It must be confessed that men in high office no longer "remember Dowb;"—but he alleges "that the present system not only failed to secure the right man in the right place, but tended to have a most deleterious effect on national education," &c. Now, it is very proper to recall attention to the evidence of what really was done for India under that old system which is bewailed as having been so disastrously superseded. I cite the evidence of Sir Charles Trevelyan, given in 1853, before the committee of the House of Lords on the India Bill, given with the measure and restraint of a public servant. He said:—"The actual state of things at Haileybury in my time was this, and I believe is so still. The terms, that is, all who entered in one half year, consisted of from 15 to 20 young men. There were generally three or four among them who gave themselves up entirely to study, and were very distinguished. There were a varying number, six, eight, ten, or twelve, as it might be, who obtained very fair advantage from the institution; but there was always a tail and fag-end of 'bad bargains,' reprobates, and professed idlers and men of pleasure. Now, these men are perfectly well known. They were as well known to the professors as they were to myself and to other students, and that fag-end ought to have been cut off." The Earl of Harrowby asks, "But they equally went out to India?" "The great majority of them went out. The cases in which the students were finally dismissed were very rare indeed."

Now, it would surprise the public if they were informed of the extent of jurisdiction and power of life over the natives which fell to these 'fag-ends' and bad bargains. Sir Charles maintained that the competitive examination was the only trustworthy means for cutting off those same 'fag-ends.' His expressions on that subject were solemn, and I beg to re-call them:—"Looking at historical precedents, as well as the reason of the case," continues the noble lord examining, "do you think that the dominant race of the English in India would have still greater power and influence over the natives than we now possess, if our officers went out so highly educated and accomplished as to be able to aid the natives, and lead the way in the prosecution of their physical well-being?—They would have much greater power and influence, and probably the continuance of our dominion would be greatly extended. I may mention, as an additional reason for having the ordinary securities for the proper appointment and training of military men, that they are selected in great numbers for civil and diplomatic appointments, and that, in their individual character as Englishmen, each of them represents, in a great degree, the moral power of his country, and it is of the greatest importance that every Englishman in India, especially those in the service of the government, should be as cultivated and well-conducted a man as possible, both for the continuance of our dominion and for the benefit of the natives. But, beside the new advantages to be attained by putting this important matter on a proper footing, much positive evil has to be obviated. Direct appointments to the company's army in India, as they are called—that is, appointments which enable young men to be sent out direct to India without any check except that of passing a slight examination—are much sought after as a convenient mode of providing for young men who, owing either to misconduct or incompetency, are unfit for the English professions. In other words, although the great majority of the cadets are well-conducted and honourable young men, 'India is a sink towards which the scum and refuse of the English professions habitually gravitates.'"

"Do you not also think that, in proportion as we raise the standard of native education in India, it behoves us likewise, not merely as a matter of duty, but as a matter of expediency, with the view of maintaining our real supremacy, which is founded upon intellectual and moral superiority, concurrently and proportionately to raise and improve the character of our civil service?—Yes, I entirely concur in that. I consider that we shall not acquit ourselves of this remarkable trust in the eyes of the nations of the world, nor perform our duty to God, who gave it, unless we take that course."

And now, in consequence of that course having been taken, though not, as I conceive, in the best possible manner, the "fag ends," the "bad bargains," are certainly cut off; and now, certainly by reason of that same course, India is no longer what it then was, "a sink towards which the scum and refuse of the English professions habitually gravitated." The Council of India has borne testimony to the fair success of the system, and so has Lord Lawrence, and other distinguished officers. I take occasion, on the testimony of some of them, to aver in respect to the two great branches of service to which the principle was first applied, the Indian Civil Service and the scientific corps of the army, the Royal Engineers and the Artillery, that sufficient experiences have falsified the predictions of the adversaries of the principle and have justified the reasonable expectations of its promoters. Of old both branches presented examples of the brightest ornaments to the service of the country. There has not been time for the development of the effects of the new system in raising similar ornaments, nevertheless, men of distinguished merits are begining to appear. But it is undeniable that competition has raised the average of service; it has insured a more hard-working and steady average of officers, a more frugal and more moral average, a higher social average with fewer snobs. With important and valuable exceptions of a few men from the ranks, the social condition of the average, instead of being lowered, has remained if, anything, much the same, and rather advanced. Members of the aristocracy enter into competition, and, with the advantages of special culture, maintain their own. The Horse Guards bemoaned, in respect to the army, the prospect of having the service filled with mere feeble "bookworms." Earl Grey lamented this, which, he would have it, was an inevitable consequence of the new system. Now, the fact is, that the average not only exceeds the former average of the scientific corps in mental acquirements, but, what I confess I was not prepared to expect, it turns out a better average of men of bodily acquirement. The Woolwich cadets, who have a higher order of mental acquirement than those of Sandhurst, beat them in athletic exercises, and also beat their seniors, the non-competitives. The average of bodily attainment, with much more yet to do, has decidedly improved.

Whilst testifying to the advances made by the new system, I beg to take occasion to repeat what, upon much observation, I have represented, of the means by which I believe that further improvements may be effected. The common methods of competition are, no doubt, often attended with evils consequent on over mental work, which require correction. In the preparation for the annual rush, or mental Derby-day, young competitors often delay preparation until the last, when they work night as well as day, and are so exhausted that it requires some time after the competition to recover themselves for real work, and some do not recover at all, but fall back, and are not seen again, in the fore. This has been long observed to happen with first-class University prizemen.

One important corrective of injurious excess is the system of "*répétiteurs*," as in use in the scientific schools of France, who examine each day's work, and assign marks for it, which go to an account which is summed up at the end of the year, and determines the position. Colonel Rifaud, the head of the Polytechnic School of Paris, told me that he had had experience of both methods, of ours and of this, of the examination of the daily work, and that there could be no doubt of the superiority of the latter in making the work more steady and even, and checking the evils of excess, in the rush for one final examination. I expect that by this method the competitors are kept more closely together, and that there are not such wide distances between the heads and tails of batches, or such inequalities of qualifications, as from one to three, as are commonly observable with our competitions.

Another check to injurious mental excess, as respects the civil service, is by giving marks systematically for physical exercises. Properly regulated physical exercises are more conductive to mental work, as well as to the duration of mental working ability, than men of the cloister are aware of. These exercises have, moreover, a moralising influence, as shown by the effect of the volunteer movement upon young men of sedentary occupations, and in the emptying of wine-houses and saloons occasioned by the movement. At the Universities, and at some of our public schools just now, the bodily exercises may be carried to excess, at the expense of the due mental exercises. But that is by default of proper adjustment in accordance with the laws of psychology as well as physiology, both of which are flagrantly violated in our common school-courses, primary, secondary, and superior. It is true that on admission to some of our public schools a medical certificate of a sound physical constitution is required. But that does not satisfy sanitary principle. What is wanted is continued, well-regulated, physical exercise every day, even for the competitor for civil service, to counterbalance every day's mental labour and sedentary constraint. To some of the educational institutions gymnasia are attached, but the answer given to inquiries why they are so little used is, that they "do not pay," that is to say, they do not "pay" in marks.

At the instance of General Sir Arabin Simmons, the commandant of the Royal Military Academy at Woolwich, marks are now given there for physical attainments. I submit that we ought to urge that arrangements should be made for physical exercises, and that marks ought to be given for proficiency in them, in order that they may be regulated, and duly adjusted to the mental exercises. Such adjustment is especially required in the competitions for the Indian Civil Service, for which physical training and stamina are most needed, and where a man who has only a good seat at the desk is sometimes beaten in work by one who has also a good seat in the saddle.

With important reforms in the methods, I believe it will be found that large reforms are needed in the subject matter of examination.

Men of the cloister have conceived that if they could keep a boy or man nailed on a bench, as it were, before them, in an attitude of attention, they might go on and on all day long pouring in instruction, all of which would be received and retained. One old founder prescribed ten hours of strict daily desk work for young boys. But our recent practice of examination would show them that there are limits to the capacity of receptivity which cannot be transgressed without injury, and which are much narrower than they conceived. The effective working time of prize men at the University is proved to be under six hours of daily desk work. Our eminent psychologist, Professor Bain, states that at the Aberdeen University they have the hardest heads, and the hardest workers of any in the kingdom, and that four hours of daily head work is as much as is good for them. And yet such is the prevalent deplorable scholastic ignorance of psychology as well as of physiology, that six hours of daily sedentary brain work is commonly required in elementary education from little children.

The limitation of the capacity of receptivity creates a competition of subjects to be excluded. Increasing demands of professional qualifications for remunerative work are pressing for the occupation of these restricted limits of capacity of the recipient. The needs of the useful and the productive are pressing to the exclusion of the ornamental and the unserviceable. The pupils of the Roman Catholic seminaries in Holland, where long hours are occupied in church formularies, are found to go to the wall in competitions for the public service with Protestants, whose time has been more occupied with things mundane; and the Roman Catholics there are bitter against the competitive system, which has got root, with declared excellent results to the public service. Increasing practice shows that it is better that the subject matters of competition should be few and narrow that they may be deep and thorough as a discipline—rather than wide and diverse, and therefore, of necessity, shallow. Thus, if six topics of qualification be required for a service, it is better that four should be determined to pass examinations, and that the competition should be confined, if not to one, to two, the most essential and the most trying. There is an increasing pressure for the necessity of living science, as also for the living languages, to the exclusion of the dead. Under existing conditions, then, competitions must be ruled by the demands of service in the field or the office, rather than by the traditions and mediæval conceptions of the cloister. The pretensions of the English Universities in behalf of the dead languages as a discipline, and the curriculum founded upon them, are disputed in themselves and challenged upon the evidence of their average outcome.

Grim, perhaps the greatest of modern philologists, maintains that as a disciplinary instrument German is better than either Greek or Latin, and English better than German. Those who would see some of the grounds on which the pretensions of the classicists are challenged, may read an excellent pamphlet recently published at Aberdeen, on "The Claims of Classical Studies, whether as Information or as Training," by a Scotch graduate. As president of the Economic Section at the meeting of the British Association at Cambridge, I had to assert the claims of the vernacular, and to remind a gowned audience that they sent to the Commission of Inquiry a translation of the Latin statutes into bad English. The claims of the vernacular and of science, of the living language over the dead, were conceded by the meeting there. But if you would judge by the outcome of the classical studies, for which so much is claimed, take the testimony of members of Parliament of each other, as writers or thinkers, by asking how many there are who can be recommended for the examination of an important subject for eliciting testimony, and expressing the results in logical resolutions or expounding them, in good English, in a well-ordered report or State paper? What amount of actual creditable examples of such workmanship can be adduced? As a matter of experience in minor positions, managers of banks will tell you that, as a rule, men from the English universities, with much Latin and Greek, are beaten as clerks by men from the Scotch universities, and schools with less Latin and Greek, but with more arithemetic and more thrift for social position to be gained. To what, however, has the vast progress of this country during the last half century been due but to science and its practical applications in steam and mechanical power—to the steam engine, to railways, to steam navigation, to telegraphy, to mining, to textile and other arts displayed in the international exhibitions, and to engineering? And to which of those great improvements have the classicists or the men of the English universities contributed?

On such grounds I am prepared to submit that the competitions for the public service should be framed in strict reference to the service, to what is paid for, to the exclusion of the merely ornamental—that the curriculum of education should be made to conform more to the public service (and indeed to all private, administrative, and professional service), and that the service should in no wise be sacrificed to the existing mediæval conceptions and practice of the older unreformed schools.

It will follow, then, that the living language must have precedence over the dead in the examinations, and living and practical science over past or present literature.

The mastery of the English language, and its use as an instrument, including, as it ought to include, the great subject of logic, is difficult enough of itself, as Dr. Dasent, one of the Civil Service Commissioners, shows in his evidence before the Commissioners on Middle-class Examination, and may well occupy the time that can be given to it. But as a subject for examination, the literatures are great fields of cram, which ought to be entirely excluded. The first Commission of Military Education agree with me in confining the examination to the languages alone, and excluding the literatures. It is asked whether a youth ought not to be acquainted with the literature of his country? to which the answer is, that if he is made master of the language of his country, you give him the best means and inducement to acquire that literature as a relaxation, and that there is no time, nor is there any necessity, to impose the acquisition of it upon him as a labour. In respect to classical literatures, the fine models of composition, the poetry, what father of a family would read much of them outright to his children? and why should he be led to send his son to familiarise himself with that (which he mostly does) in a cloister which, if it were brought out anew in the vernacular, in Holywell-street, would be undoubtedly prosecuted by the Society for the Suppression of Vice? Why should he be set to imbue his son's mind with a theology which Mr. Gladstone acknowledges to be bestial and degrading, and to do so at the expense of science which is practically needed, which is free from pruriency and from savage passion, and is elevating?

Competitions for the public and other service ought, I contend, to be confined to what is required, and what alone is paid for commonly, the qualification of skill in the use of instruments, the instruments of language or of science; and in acquiring them perfectly there will commonly be enough to do. What is wanted of the corresponding clerk (or secretary) is that he should write English clearly and correctly. What head of a public department, or private employer, goes beyond that to ask whether he is well up in Macaulay, or in Byron, or Shakespeare, or any other? If the service be for French correspondence, what is wanted is that he shall understand and write the French language (not Latin or Greek) clearly and well—not whether he is well up in Molière, or Racine, or Voltaire, or knows anything about them. And so with the other topics, as the instruments of computation, account keeping, &c.

I submit that the introduction of histories as subjects for competition is unjustifiable, as occupying time mischievously to the exclusion of paying practical science. I go into an elementary school, and hear boys examined to show that they have been got well up in the genealogy of the Plantagenets, whereby it is shown to me that time has been wasted, to the possible exclusion of the acquisition of a chapter of economic science, of useful knowledge to the pupils of the generation of wages and profits, and principles important to their own and to the public welfare.

One of the objections arrogantly put forward against the new system by Dr. Birdwood is that "it is thoughtless of the interests of the failed, the majority, who under this abominable system are forced to stake their all on the issue of an examination, as if competition were indeed but a cowardly and cruel shift to rid ministers of the multitude of place hunters." I have entered at length into the subject on the present occasion, as this attack made in such terms upon the system may serve unscrupulous place hunters in the United States to declare, without saying upon what authority, in opposition to its proposed adoption there, that it has upon trial been utterly condemned in England. In my view, misdirected care has been bestowed upon "the failed,"—in keeping the competition too much upon the common general system of classical education, to the exclusion of the applied sciences, and the specialtities of the public service; whereas those very specialities and the sciences would serve better than the common scholastic curriculum, for the training and qualification of the failed, for other service in the open labour market, than the particular service for which they have competed. But where could the Doctor have been living, that he should imagine that the pains of "the failed" are a new evil peculiar to the new system, or that instead of being reduced by it, as they certainly are very considerably, they are augmented by it? Is he unaware that it was a political axiom that patronage meant for every appointment—the creation of one ungrateful man and a dozen enemies? The woes attendant on the patronage system, or the painful labour lost in the pursuit of the old and false standards of the favour of courts and courtiers, are an old theme of poets, and amongst others, of Spencer, who thus describes it in terms which might be addressed to the Doctor:—

> "Full little knowest thou who has not tried,
> What hell it is in suing long to bide;
> To lose good days that might be better spent,
> To waste long nights in pensive discontent;
> To speed to-day, to be put back to-morrow,
> To feed on hope, to pine with fear and sorrow;
> To have thy princes' grace yet want her peeres,
> To have thy asking and yet wait many yeares;
> To fret thy soul with crosses and with cares,
> To eat thy heart through comfortless dispaires;
> To fawn, to crouch, to wait, to ride, to ronne,
> To spend, to give, to want,—to be undonne.
> Unhappie wight, borne to disastrous end,
> That does his life in so long tendence spend!"

Instead of being "undone," as the poet under the patronage system deplored, and as the Doctor erroneously imagined under the competitive system, even as it is now conducted, and still more as it may be improved—the "failed one" will have spent his good days in the acquisition of endowments that will be of advantage to him in after life, and particularly of one endowment peculiarly valuable for a young man to obtain early, viz., self-knowledge—clear from dangerous illusions as to his comparative capacity—that will enable him to devote it more satisfactorily to the public in other directions than the service for which he has competed. Indeed, the institution has been made to serve as a means of testing the results of training and of qualifications for the open professions. In Scotland, wealthy parents sometimes send their sons to be tried in competitions opened for charitable bursaries, not to take the bursaries if gained, but just to test the qualifications of the youth satisfactorily. One young Scotchman, who headed one batch of successful competitors for the Civil Service in India, was found to possess such remarkable abilities, that it was thought he would do better with them at home, and he was withdrawn for an open profession. It has been a long-declared and standing grief of the military service in France, that its *genie* gets only the less successful of the competitors for it, as the more successful find a better market in general professions for which they leave the military service. Instead of injuring open education, the new system will, by these new and important testings of results, largely improve it.—I am, &c.,

Edwin Chadwick.

PRESERVED MEAT.

Sir,—Early in the year 1867, I saw at Professor Gamgee's a sheep killed by some chemical preparation, apparently without pain, and in the course of a few seconds. A bullock was partially killed in the same manner, but the bag containing the gas was torn, so as to allow it to escape, consequently the animal was killed finally in the usual manner.

Can any reader of your *Journal* state whether the plan succeeds generally, and if so, where it is adopted? Unless the meat is affected by the gas used, the plan seems preferable to the usual slaughtering by butchers, especially as to swine. The Governor of Dover Prison has testified recently in favour of the Australian preserved meat, as better than "fresh boneless beef," and in using it there is a saving of 50 per cent. All the prisoners have approved of it highly. The surgeon has stated it to be "good and nourishing." I believe, in St. Pancras Workhouse, this meat is eaten and approved of by the paupers.—I am, &c.,

Christopher Cooke.

London, 4th May, 1872.

STEAM HAMMERS.

Sir,—It is a somewhat singular fact that the foundations for the anvil of our colossal and still-increasing steam hammers have been left almost to chance, or to the skill of the builders, who, eminently acquainted with those required for the support of towers or high monuments, apply the same principles to such as are intended to resist the blows of a hammer, equal in actual weight and momentum to several hundred tons.

The two cases are widely different, for the broad basis is indispensable to ensure the future vertical position and stability of the edifice, but is of no use against the terrible shocks of the falling hammer, as is plainly to be seen and felt when it is in action—the foundation fairly trembles and jumps at every stroke.

Now, if half the metal usually employed to support the anvil were disposed in the form of a long cylinder or prism, there would be neither jump nor tremble; for it is well known to blacksmiths and boiler-makers that a long rod merely held in the hand is equivalent to a much larger mass of metal in one solid lump, however supported. Boiler-makers in confined places do frequently use a very large sledge-hammer as an anvil to close the rivets upon, but at every blow of the light rivetting hammer the sledge may be seen to jump and strike a secondary blow upon the rivet head.

In adopting this mode of resisting the blows of a steam hammer, a deep well, say 20 or 30 feet, according to its size and power, should be sunk under the site of the anvil, with a solid iron cylinder or prism bedded in it, wedged in with concrete, or other matter, from top to bottom. One mode of accomplishing this object would be to line the well with a temporary cylinder of sheet or cast iron, and by means of several furnaces to run it full of cast metal. Perhaps other means may be devised, but in every case the cylinder or prism must consist of a solid rod, without break or division from top to bottom.

It is a fact that the blacksmith's anvil is always supported upon a block of oak or other hard timber, grain up, a mode well adapted to their work, but wholly inapplicable to the steam-hammer. I have seen a lump of oak, eight or ten inches thick, pounded into smoking carbon by a few strokes of a powerful hammer, and all but in flames.—I am, &c.,

Henry W. Reveley.

Reading, May 25th.

Note to my Communication on Asphalte, May 24th.—In the event of the general use of asphalte for paving, and asphalte-shod horses, we shall find it necessary, in order to prevent accidents, to adopt the foreign fashion of furnishing the leading horse with a light breast apron, carrying the usual small spherical horse-bells, either of brass or silver, according to taste. Their sound, though readily heard, is not disagreeable, as is terribly the case with common bells and the steam-whistle, and on no account should they be applied about the horse's head and ears. H. W. R.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Over 50,000 persons visited the Exhibition in Whitsun week.

Among the manufacturing processes shown in the Exhibition is that of sewing thread. The cotton is received into the mill in the raw state in bales. The kind best adapted for making thread is that known as the "long fibre," or Sea Island, raised along the Southern and Eastern coasts of the United States; also a similar but somewhat inferior imported staple, termed "Egyptian." This cotton is taken from the bales and passed through a machine called a picker, which separates it and passes it out in a downy sheet, and rolls it up into a snowy-like bundle. It is then taken to the carding machine, where it goes through another separating and refining process, and leaves this machine like a continuous untwisted rope, coiling itself round and round into a circular tin can placed to receive it. From thence it is taken to a French comber, an ingenious machine, the peculiar duty of which is to select or separate the long fibres and reject the short ones, as the long ones only are used in the making of thread. From this machine or comber it passes through other machinery or processes of uniting, drawing, reducing, and partially twisting, necessary to its preparation for the spinning-frames, upon which it is finally adapted and placed. The spinning-frames (or mules, as they are called) are self-acting, drawing out the fibres and spinning them into a very fine thread or cord, six of which are twisted together to make the thread, and wind it, when spun sufficiently, upon small bobbins or cops. The spinning-frames used in this mill are about 90 feet long, and spin about 900 threads at once. When these bobbins are full, they are taken to a winding machine, and two of these little threads are wound together upon a large bobbin. When full these are taken to a twisting machine, the two threads drawn off and twisted tightly together, and again wound upon cops or small bobbins. This is the first process of twisting, and the second is similar to it, except that three of these twisted threads are wound off and again twisted together, thus making the six cords required to give the strength for which this thread is celebrated. The thread thus made is reeled off, and tied into hanks or bunches, and taken to the bleachery, where it passes through the different processes of boiling, bleaching, washing, soaping, bluing, and drying; or to the dye-house, where it is boiled and prepared, and coloured by various dyes, the colours being very rich, and some of them very costly, the dyes being the aniline colours. When a number of these variously coloured spools of this thread are placed together, they present every appearance of silk. After this process of bleaching or dyeing is completed, the hanks are again returned to the mill and wound upon large bobbins, and from these it is finally wound upon the small spools, where it remains until unwound by the busy fingers of industry throughout the world. Before leaving this subject of thread-making, it would be as well to speak of the ingenious machines used in the final process of winding the thread upon the small spools. These machines work automatically, or, in other words, go through all the motions necessary to wind the thread on the spool, cut the nick, insert and fasten the end of the thread, cut it off, draw off the spool, and drop it into a hopper, completed and well done. It also takes up the next spool, puts it on its spindle, and goes on with its winding. All that is required is simply to feed it with empty spools, and collect them when wound. These machines each wind eight spools at a time, or eight spools in a little over a minute of time, or 300 dozen per day. These finished spools are passed through various departments, where they are ticketed, assorted, and placed in paper boxes, neatly labelled, or in larger quantity (assorted) in the drawers of handsome black walnut cabinet-cases.

The Belgian Court is divided into two galleries, one is occupied by pictures exclusively, and the other by a miscellaneous collection of industrial work. In the latter there are some examples of stamped papers in imitation of leather, and a great variety of lace-work from Bruges, Ghent, and Antwerp. There are numerous specimens in this court of pottery work, chiefly in the shape of sculptural terra-cotta, and there are many very excellent examples of the uses to which clay can be put for decorative purposes.

The President of the Institution of Civil Engineers held a *conversazione* at the Exhibition on the evening of Tuesday, on which occasion the picture galleries and the machinery galleries were lighted up. It is understood that any society or body promoting arts, manufactures, and commerce may obtain a similar privilege.

An Official Guide has been published and may now be obtained at any of the catalogue stalls at the Exhibition. It has been prepared under the direction of her Majesty's Commissioners and is published by Messrs. Johnson and Sons. It contains miscellaneous intelligence with alphabetical references to numerous matters of interest, together with notes and articles upon the various classes and divisions. The observations upon British painting, sculpture, and engraving are by Mr. Samuel Redgrave. Mr. H. A. Bowler supplies some notes on foreign pictures; and Mr. ReaderLack some notes upon the principal manufactures. The aim of this "Guide," as stated in the preface, is threefold:—To be useful to the reader who has not visited the Exhibition, by conveying to him, as far as is possible by words and plans, some notion of what he may look to find in it; to serve as a hand-book to be studied on the spot; and, lastly, to be consulted as an *aide-memoire* when the visit is over. The book, therefore, consists of a gathering and arrangement of facts, as accurate as circumstances permit, but of necessity dry. Its official character prevented much freedom in the expression of individual opinion. The work of public criticism on the Exhibition has been left, therefore, to the public to provide for itself. For the purpose of connecting exhibits in the present display, especially those of the industrial classes, with their past history, compilations of facts and statistics, bearing on the more important divisions of the Exhibition, have been prepared by an officer of the Board of Trade, and will be found in their proper position. There will be several issues of this "Guide:" one published as a pamphlet at 6d., and other editions, printed on fine paper and containing illustrations, published at higher prices. The following extract, regarding the *raison d'étre* of exhibitions, is taken from the prefatory remarks:—"In concluding these prefatory remarks, it may be as well to answer a question very generally propounded by those who find the *nil admirari* principle easier to practise than the effort to think for themselves, and that query is, 'What good have the various exhibitions produced?' Now, it is scarcely too much to affirm that their influence is felt at this moment in every household in the kingdom—indirectly in the absence of some discordant object which else would have been perpetuated, directly by recognisable and tangible productions of useful and harmonious design. If we take a retrospective glance down the vista of comparatively only a few years, we cannot fail to be reminded of the sorts of objects which formed the Lares and Penates in the homes of our fathers or forefathers. The willow-pattern dinner service; the china mugs with treacle-coloured rims, in strange contrast, perhaps, to the rare specimen of china from the East, carefully hid away in the old oak buffet; the cruet stand, with its black frame, and mean, pinched-looking bottles, the whole of a form so completely the antithesis of beautiful that during the Exhibition of 1862 a specimen was placed in juxtaposition to one of French manufacture—a bitter satire, but useful in its irony; knives with projecting tips, and often with green bone handles, and two-prong forks to match; stony peaches and chalky parrots on the mantel-shelf, flanking a squat mandarin with nodding head and palsied hands; pictures representing objects in gaudy colours splashed over the outline of the figures on to the plate itself; and though the charming mezzotint (copies perhaps of Sir Joshua Reynolds and his school) was often on the walls of the better classes, engravings of a high order were the exception. And now—magic mutation has been at work, and the fear is that taste may lose its nice discrimination from plethora, not starvation. Though, of course, the natural progress of the power of selection by the aid of such men as Chipoendale, Flaxman, and Wedgwood, achieved much towards public improvements, Exhibitions in modern times have done more, and have, to a considerable extent, exorcised the evil spirits of ugliness and deformity which once existed in our homes. In respect to shops, the keramic displays alone are a marvel of what a short time has accomplished; but it were trite and useless to specify the wonderful advance of decorative art in all branches during the last twenty years, which is undeniably traceable to the seeds sown by the system of International Exhibitions—seeds which have fructified and ripened into the various national displays in this country, where the power to compare object with object has wrought such incalculable value. Messrs. Johnson and Sons are about publishing a penny guide.

EXHIBITIONS.

The Paris Salon.—The exhibition of modern works of art, although not of half the usual extent, and not above the average in point of quality, is more attractive this year than it has ever been. The number of visitors to the present time, as compared with 1870, shows an excess of at least a tenth. This is only to be accounted for in two ways; in the first place, there was no *salon* last year; and, in the second, there are now two free days per week, Sunday and Thursday, in place of the one day of former years. The attractions of the exhibition are just now enhanced by the opening, in what is called the nave of the Palais de l'Industrie—converted into a garden and sculpture exhibition—of the annual floral show of the Central Society of Horticulture of France, which includes not only flowering plants, ornamental shrubs, and coniferous plants, but also gardening and horticultural fittings, tools, and implements.

THE DEEPENING OF THE PAUMBEN CHANNEL.

The opening of the Suez Canal has given an impetus to the construction of similar engineering works, that are only waiting the necessary funds at the disposal of the governments, that can discern in such works the advantages to be derived for commerce and navigation in various parts of the globe. The island of Ceylon, which appears to be attached to the continent of India by a narrow thread, has been the subject of recent inquiries in Parliament. This portion of the world was first made known to Europe by the companions of Alexander the Great, in his far distant Indian campaigns, and subsequently detailed by Aristotle in his treatise, "De Mundo," where the only fragments of the knowledge acquired by those officers survived, to be enlarged and increased in later times.

The object of the correspondence just published is the deepening of one of the channels that connect the Gulf of Manar with the Palk Straits, by which engineering operation the detour at present made on the voyage from Suez to Madras will involve a saving of 360 miles. From Point Tonitory, on the continent, this obstacle extends about 56 miles, the intermediate space being filled up by the small islands of Rameswaram and Manar, the latter of which is divided from the former by a sand-bank, called Adam's-bridge, and from Ceylon by a narrow strait, called the Manar Channel. The first step towards deepening and widening the most likely spot which presented itself at the Paumben Channel seems to have been taken in the year 1822, when a survey was made by Lieut.-Col. Cotton. The project was then laid aside until 1829, when the work was again renewed under Lieut.-Col. Sim. On this occasion a party of sappers was sent, and the bottom of the pass was thoroughly examined throughout. By blasting and removing the fragments, the pass was also considerably improved. It was previously so crooked, that in one part it was necessary, when the current was strong, to have out five warps at once to conduct a vessel round a rock. Such obstacles were removed so as to make the channel nearly straight, and at the same time the shallowest points were deepened so as to allow of vessels passing through drawing about a foot more water than before. A minute survey was also made of the whole pass and of Adam's-bridge, on the other side of the island of Rameswaram. At this time, also, the commanding engineer from Ceylon, with the superintendent of the pearl fishery, met the officers from Madras, and the whole subject was discussed. The conclusion was that it was hopeless to attempt anything on the Ceylon side, and that the Paumben Pass alone offered any prospect of success. The reports of the results of these examinations remained without anything being altered, in consequence, till, in 1837, Colonel Monteith, Chief Engineer, took the matter in hand, and prosecuted it with such energy and perseverance, that a real commencement was at length made upon its improvement. On the 2nd January, 1838, Colonel Monteith reported that a country brig, drawing 8 feet, had passed through at high water, and a dhony, drawing 8 ft. 6 in., had done the same at the highest spring-tides. The depth of the channel was very irregular as well as its width, and it was not then considered safe for a vessel drawing more than 8 feet of water to attempt passing through, even at high tide of neaps.

In a report to the government, made in 1839, Colonel Monteith states that the channel had been deepened 3½ feet during 1837 and 1838, and that it would require 2,000 rupees a month for three years, at nine working months a year, or 54,000 rupees more, to deepen the channel 3½ feet more, which would give it a depth when finished of 10 feet at low water. In 1850, Colonel Lawe and Captain Horseley, of the Engineers, reported that vessels of 150 tons, drawing from 8 to 10 feet, then passed through the channel, but that 6,733 cubic yards of material required to be removed, for which 12,000 rupees were required to perform the work in two and a-half years. The result of these works are shown by the tonnage through the channel, which had increased from 17,000 in 1822, and 65,731 in 1839, to 148,244 in 1852, and nearly 160,000 in 1853. The native merchants did not fail to make improvements in the class of vessels used in the coasting trade. As long as the voyage from the Coromandel to the Malabar Coast, on the west side of Ceylon, was confined to one voyage in the year, the dhony, a very frail description of craft, was in general favour, as being less expensive and as easily sailed with a fair wind as any other; but so soon as the communication rendered the passage practicable at all seasons, this was superseded by the more substantial brig and schooner, able to work down the Gulf of Manar against the south-west monsoons, a feat which, fifty years previous, few English ships would attempt. On the score of humanity alone, the sweeping of the dhony from these coasts was worthy of effort. It not infrequently happened that, in consequence of their being driven out to sea, many crews perished miserably for want of water, who would have been saved in vessels that were capable of working to windward.

On the 24th of August, 1871, his Excellency the Governor, accompanied by Mr. Townshend, C.E., and a party of scientific gentlemen, visited Paumben in the Ceylon steam vessel *Serendib*, from whence various excursions were made to Tonitory Point, on the coast of Madura, to the Paumben Channel, to the island of Rameswaram, to Adam's-bridge, Talaimanáru, and to the Manar Channel, the three first-named places being in Indian territory. The object of the party was to consider the feasibility or otherwise of six various projects, each having the sanction of authority; and Mr. Townsend in his report explains the causes that in his opinion render most of them totally unfit for such a great work, and describes the probable advantages to be gained by adopting the line of the Paumben Channel. It having been thought advisable to obtain a series of levels, borings and soundings in the direction of the proposed new canal, Mr. Stoddart, from the Surveyor-General's office, with an efficient staff of assistants, proceeded to Paumben for the purpose. The information so collected and the drawings correctly laid down are at the present moment invaluable. The position and depths of the old channel are carefully recorded. Considering the precarious modes adopted of clearing, blasting rocks, &c., by native divers in 12 feet water, it seemed a matter of wonder that so much had already been accomplished. Mr. Townshend then records his opinions of what means should be employed hereafter. In determining the proportion of the proposed canal, he has assumed that the width should not be less than 210 feet at high-water level, and the depth of the water in the main channel 26 feet, as in the Suez Canal, deepening to 30 feet at each sea entrance, the width of these embouchures to be 500 yards, gradually contracting to 70 yards; the sides of the cutting must be sloped from top to bottom, to such angle as the nature of the material will permit. When completed the whole line of navigation thus formed should be well buoyed on either hand. Where required, stone obelisks should be built out of the rubble-rock excavated, a lighthouse, exhibiting a revolving light, to distinguish it from Paumben light, should be erected in the island of Rameswaram, near the Godander Rama pagoda, and all the old beacons in the Paumben Channel should be renovated and made conspicuous. A powerful steam tug, provided with boats, hawsers, and towing warps, should be stationed at Paumben, to assist ships through the canal. The progress of the works would be necessarily governed by the monsoon, which render available only 150 working days in the year for deepening the channel at the respective entrances.

To carry on works of this importance in a rapid but safe manner, Mr. Townshend is of opinion that it will be necessary to call in the services of experienced English divers and mechanics, and to employ the best machinery for dredging. Probably twelve trained helmet divers would be found sufficient, each provided with a complete waterproof dress, helmet, air-pump, and all things for performing this submarine work in a satisfactory manner. In addition, at least six diving-bells, with air-pumps and all other fittings necessary for working the same, should be employed in deep water, and where the current runs the strongest. Each bell must be slung from the prow of a large vessel, which is to be provided with efficient overhead traveller-crab winches, for lowering and lifting the bells at all times with facility when moored over their respective sites of operation. At least ten derrick cranes will have to be provided for lifting purposes afloat and on shore, Plymouth breakwater pattern. Workshops for repairing engines, &c., will, of course, be constructed on shore, to the extent required by the engineer conducting the operations. Coolies should be employed as labourers. It will be found necessary and economical to provide the new establishment with three small steam launches, strongly built, covered in from the sun and rain. In a place like Paumben, with harbour works in progress, and spreading over a wide channel of six miles in length, the assistance of these small steamboats would prove invaluable to the officers and men, and their services would prove economical by the work performed and the time saved. At least two powerful steam-dredging machines should be provided, of sufficient power to work long bucket-ladders, constructed to dredge to a depth of upwards of 30 feet below low-water level. The type of dredge should be similar to the screw-dredge *Greenore*, built by Messrs. Simons and Co., of Renfrew. It is reported this dredging vessel in six working days removed 17,650 tons, and in one day no less than 4,660 tons. If, therefore, the proposal for making a deep channel through Paumben Pass is to be realised, this great work must be carried out on a totally different basis to that hitherto followed.

Assuming that the quantities of earth, sand, rock, &c., given by Mr. Stoddart in his report are to be relied upon, the estimates for each design, adding the probable expenditure for plant, machinery, lighthouses, steam-tugs, steam-dredges, supervision, &c., result in a probable cost of £1,386,780. Recent soundings and borings have satisfactorily proved, to a certain extent, that there is no great depth of rock to be blasted and removed. With powerful steam-dredges as described, all the sand, mud, silt, and other material now lying in the direction of the proposed channel can be raised and conveyed away. The south end is completely protected by several islands, and thus deepening the canal at the Horse-shoe bank can be executed even during the south-west monsoon. This is an important fact. Making due allowances for prevailing winds and currents, there are no engineering difficulties in the deepening and widening the Paumben Pass, so as to permit large vessels to pass through it, which cannot be overcome by an experienced engineer and contractor. There only remains to add that this work ought to be completed in about six years after commencement.

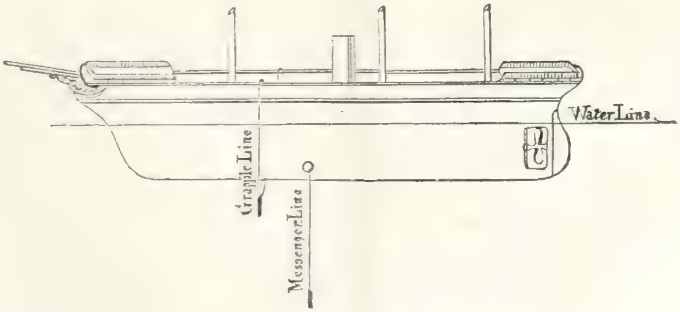
Note.—The tracings that accompany this correspondence can be inspected on application to the Librarian of the Colonial-office.

SAFETY PLATES FOR STOPPING HOLES IN SHIPS' BOTTOMS.

Mr. McCool has patented a method of doing this in two ways. In either, dished plates are employed, with a soft and waterproof packing, and as a rule a plate is applied on both outer and inner side of the aperture. The dishing has the advantage of strengthening the plates, besides insuring a tight joint at the strongest part of the ship's side around the leak. The main point, however, is the application of these plates in any seaway and under all circumstances, when once the opening has been discovered. This is effected by dropping through the hole a long, narrow weight of lead or other metal, attached to one end of a cord or wire, the other end of which is secured within the vessel. The weight is then hauled on deck, by means of a weighted grappling line dropped over the bow, and drawn along underneath the vessel by means of cords, one at each side. The weight is then removed from its cord, and replaced by a threaded bolt or spindle, upon the outer end of which a metal plate with India-rubber or other elastic washer is screwed or otherwise fixed. The cord or wire is dropped overboard, and by means of the opposite end, secured within the vessel, the bolt is drawn into the hole, so as to bring the outer plate in position. Another metal plate and elastic washer is then fixed to the bolt on the inside, and the leak effectually closed. Another plan whereby the same object may be attained, is by employing a bar of any required length, and not too large in diameter to pass through the hole to be stopped. To this bar, at or near its middle, one end of a threaded bolt is jointed. The bolt can turn on its joint so as to lie upon the bar or within a slot in the bar; and when the bolt is in this position the bar and bolt are passed through the hole in the vessel into the water. The bolt is then lifted by means of a wire, and the end drawn through the hole into the vessel, the bar remaining outside across the hole. An india-rubber or other elastic washer and a metal plate are placed on the bolt, and screwed up tightly by means of a nut. There are various kinds of bars, but the principle never varies, and the outer bar acts as a stay or support for the ship's side, and insures a proper hold for the plates and packing.

Fig. 1 of the accompanying sketches shows the line and weight dropped through the hole in the ship's bottom. Also the grapple for hauling the messenger line on deck, for the purpose of attaching the threaded

Fig. 1.



bolt and patch. Fig. 2 shows the patch fastened to the messenger line, and ready to be drawn into its place over the hole, when the inner washer and plate can be readily and firmly fixed. Fig. 3 gives a view of a round and square patch, showing both the inside and outside plate, with the threaded bolt and nut for fixing. Fig. 4 shows a slightly curved bar and jointed bolt, with the plate and nut. Either a square, round, or oval plate can be used, as circumstances may require. Fig. 5 is a double bar, with the screwed bolt working from the centre of the slot, and showing a round plate. Fig. 6 shows the threaded bolt moving from the side of the bar, and drawing of an oval plate.

FIG. 2.

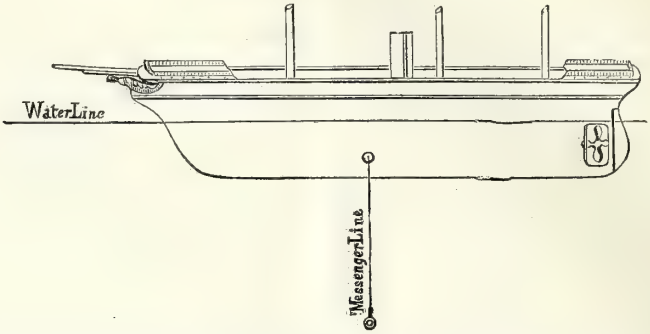


FIG. 3.

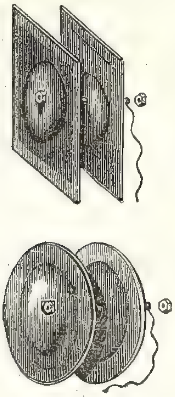


FIG. 4.

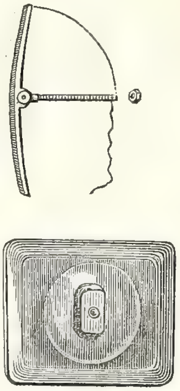


FIG. 5.

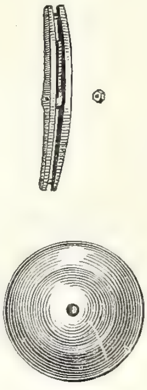
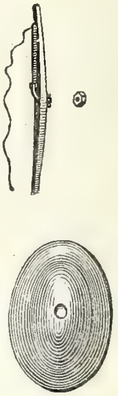


FIG. 6.



The method can be seen at the office, 1, Great Winchester-street-buildings, London, E.C.

CO-OPERATIVE SUGAR-MAKING AT ST. LUCIA.

The increased production of sugar, remarked upon in the report from the governor of her Majesty's West Indian Colony of St. Lucia, is attributed rather to extended area of cultivation than to improvement of culture. That less energy is shown in the latter respect is considered to be owing—in a measure—to the extraordinary fertility of the soil, which, not uncommonly, produces a crop from the same cane-plants for twenty years in succession; whereas, in most other countries, the fields require to be planted every two or three years. The system of agriculture, as in most of the West India Islands, is somewhat rude; but signs at efforts to improve it are not altogether wanting. Virgin soil is being broken for the purpose in all directions; and while no estates have latterly been abandoned, some have been reclaimed, and others, which a few years ago grew little else but weeds and trees, are now yielding abundant crops.

Besides extension of cultivation, the governor is able to record a progress in manufacture which makes further improvement probable, and will certainly render it more easy. Steam power is gradually superseding all other for grinding purposes. Fourteen steam-mills were imported in 1870, of which seven replaced others that had been moved by wind, water, or cattle, and seven were destined for newly opened estates. To meet any reduction in prices, improvement in the quality of the sugar grown upon this island, which is almost exclusively of the low class, is without doubt of the first importance. The estates are, for the most part, too small to support singly expensive works, such as produce the crystallized sugar of Demerara; and on this account the co-operative system, which has achieved extraordinary results in the neighbouring colony of Martinique, would appear to offer by far the best prospect of success. That system, having as yet been introduced into no English West India colony, is probably little known in England. Its chief distinctive feature is the entire separation of agriculture from manufacture. Though co-operation has proved useful for the introduction of the system, and has tended greatly to enhance its profits, it is not essential to it. Before this innovation every sugar planter in the West Indies was also a manufacturer. He not only grew canes, but ground them, and turned their juice into sugar.

Under the Martinique system, the division of labour is complete. The planter is merely a planter, and sugar-making is an entirely separate occupation. A central "usine" manufactures the canes of a number of neighbouring estates, and pays for them by weight, irrespective of the sugar produced; so that the planters, after delivering the raw produce, has no further concern with it, and he is enabled to devote his capital and energy exclusively to the improvement of his cultivation. The first factories were established under agreement as to full supplies of material with the neighbouring planters, who also furnished a considerable portion of the capital. But now others are in operation, which have dispensed with a part of this security, and which partially depend for supplies on the growers' self-interest. It was, in fact, taken for granted by their projectors that the planters would sell their canes rather than make sugar themselves. This calculation was more than justified by the event. Canes are now coming to these factories from most unexpected sources, and from distances of eight and ten miles. Further proof is scarcely needed to show that the planters are deriving benefit from the new system. Though the extent of that benefit cannot of course be known. a notion of it can be formed from the price given for the canes. The lowest price offered by the usines is the market value of 5 lbs. of the best common-process sugar for every 100 lbs. of canes; and this is only 1 per cent. less on the average than is obtained by those planters who incur the risk, anxiety, and expense of manufacture. There is, however, more definite knowledge as to the profits of the manufacturer, who so far deserves them that he produces the best sugar yet exported from the West Indies. "The usine of François," established in 1866, has, in the last four years, declared dividends as follows:—In 1867, 19 per cent.; in 1868. 37 per cent.; in 1869, 48 per cent.; and in 1870, 36 per cent.; the decrease in the latter year being merely the result of the disasters in France, which receives the bulk of the Martinique sugars.

The new system, besides its intrinsic merits, has in its operation developed a collateral advantage of no small importance. It has proved a powerful promoter of social order. The capital required for the factories being too large to be commonly furnished by individual capitalists, and even exclusively by the "monied classes," has in some cases been divided into small shares, which are largely held by negro labourers and peasant proprietors. Moreover, the factories themselves, as supplying regular work at good wages, are held in considerable regard by the people. Consequently, in the disturbances which occurred on the news of the disasters in France, when property was being destroyed in all directions in the south-western part of the island. where alone there are no usines, there was but little disturbance in the other quarters. and the usines and their contributing estates were entirely exempt from injury. This fact suggests a question worthy of the consideration of the proprietors in other colonies, where labour is insufficient, and where the malignity of individual labourers is apt to indulge in incendiarism. viz., whether the admission of the labourers to a certain share of profits would not save expense both in superintendence and insurance, and thus conduce to the benefit of both employers and employed. But apart from its incidental advantages, there can be little doubt that the Martinique system might be profitably adopted in St. Lucia. There are several localities where the cane cultivation is already sufficient to support an usine, and if, as Martinique experience indicates, a coast carriage of eight to ten miles does not prevent profit both to grower and manufacturer, there is no quarter of the island where one might not be established with advantage.

Besides the regular sugar estates. there is, owing to the cheapness of land. a large number of small plots in the occupation of negro peasant-proprietors, who show their preference for cane cultivation when there is the slightest opportunity for indulging it. When sufficiently near to an estate, they deliver their canes to the proprietor, consenting, in consideration of their manufacture, to surrender half the sugar produced and all the molasses —an arrangement which gives rise, as may be supposed, to continual misunderstandings. Many others are content with their own manufacturing, carried on with wooden hand-mills, movable boiling kettles, and other rude contrivances. All these would inevitably seize the opportunity which would be afforded by a usine of selling their canes by weight; and many others, whose poverty now precludes them from cane-growing, would probably abandon for it the raising of provisions. Moreover, the requisite capital could, undoubtedly, be obtained by co-operation. But here is the chief difficulty. Whenever the question has been hitherto mooted, there has been disclosed on the part of some whose assistance was necessary, not only an extreme reluctance to abandon long-established habits, but a notion that the new system would involve a certain loss of their independence and position. Uniting at present the functions of planter and manufacturer, and to a certain extent those of merchant also, they are unwilling to adopt an innovation which involves their necessary confinement to one character. If, however, a single instance of the success of the new system could be brought immediately under their eyes, it is probable that this reluctance would be overcome. There is, the Governor gladly observes, reason to hope that such an instance will not be long forthcoming.

THE PRODUCTION OF HONEYDEW.

The following is an abstract of a paper by M. Boussingault, in the *Comptes Rendus*, a translation of which was read by Professor Dyer to the Royal Horticultural Society, at a recent meeting. On July, 21, 1869, at Liebfrauenberg, the leaves of a lime were coated on their upper surface with an extremely saccharine viscid matter. The tree, in fact, afforded an example of the production of honeydew, a manna-like substance, which is frequently observable upon the lime, the black alder, the maple, and the rose. I have myself noticed it upon a plum-tree and upon a young oak. On the 22nd the honeydew was sufficiently abundant in the morning to fall in large drops upon the ground. It was a shower of manna. At three o'clock the saccharine matter no longer remained fluid upon the leaves which were exposed to the sun. It had sufficient consistency not to adhere to the fingers when touched; it formed, in fact, a sort of transparent and flexible varnish. Out of the sun the honeydew still retained its viscous condition. On the 23rd, at seven in the evening, several leaves at the extremity of a branch were washed and sponged, so as to remove all the saccharine matter. At six o'clock the following morning the leaves which had been washed seemed free from honeydew, but, on examination with a lens, minute glistening dots, due to very small drops, were observable. At seven the same evening the appearance of the leaves remained the same. The day had been warm; the temperature in the shade 84°. On the 25th numerous spots of honeydew were scattered over the leaves, but there was none upon the principal veins; at three o'clock the temperature was 86°.

During the night a violent shower removed a great part of the honeydew formed during the evening. It became, therefore, impossible to follow, as had been proposed, the progress of the secretion upon the leaves washed upon the 22nd. A swarm of bees settled upon the tree. On the 27th, the whole of the honeydew had disappeared, in consequence of the rain which fell during the evening of the 26th. The temperature had stood at between 62° and 75° Fahr. On the morning of the 28th the leaves bore numerous spots of honeydew, which had made their appearance during the night. On the 29th it had increased; on some of the leaves it occupied a third of the surface. At two o'clock the temperature was 84°. On the 30th the honeydew was very abundant.

The lime tree remained covered with it till the commencement of persistent rains, which took place at the beginning of September.

On two occasions—namely, July 22 and August 1, honeydew was collected by washing the leaves. The solution, after treatment with lead-subacetate, to precipitate albuminous and mucilaginous matters, yielded a syrup in which crystals of sugar formed. On examination it contained a sugar analogous to cane-sugar, and also a reducing sugar. By fermentation with yeast the two sugars disappeared completely. In the fermented liquid, however, a substance remained possessed of very strong powers of right-handed rotation. This proved to be dextrine, already announced by Berthelot as existing in the mannas of Sinai and Kurdistan, and subsequently by Buignet in a manna occurring in "tears" (*manne en larmes*). I have endeavoured to find mannite, and with especial care, because Langlois, an experienced observer, has found it in a saccharine matter collected from the leaves of a lime. Mannite is so easy to detect that I have not the slightest doubt as to its presence in the product studied by Langlois.

Optical observations have shown that the reducing sugar detected in lime-tree manna is not glucose (grape sugar), of which the rotatory power is 56° in the right-handed direction, but levulose (inverted or fruit sugar) which has a left-handed rotatory power of 26°.

Taking into consideration those substances only which rotate the polarised ray, the composition of honeydew will be:—

	July 22.	August 1.
Cane sugar	48·86	55·44
Inverted sugar	28·59	24·75
Dextrine	22·55	19·18
	100·00	100·00

These analyses show that the composition of honeydew collected with several days' interval has not remained the same. No doubt, one has no right to expect that the composition should remain precisely identical; what however, is remarkable is the analogy which exists in composition between the honeydew of the lime and the manna of Mount Sinai analysed by Berthelot. Its composition is, in fact, identical with that of the honeydew collected on August 1.

Cane sugar	55
Inverted sugar	25
Dextrine	20
	100

It is a discovery not without interest to have found the manna of Mount Sinai in the Vosges.

In attempting to compare by analysis the quantity of honeydew existing upon the leaves of the lime which was affected with the saccharine matter contained in the leaves in their normal state, we arrived at the following result:—

	Cane sugar.	Inverted sugar.	Dextrine.	Weight in grammes.
In one square metre of healthy leaves—	3·57	·86	0·00	4·43
In honeydew collected from ditto—	13·92	7·23	5·62	26·77
Difference—	10·35	6·37	5·62	22·34

The amount of manna, therefore, which exudes from the affected leaves is considerable, especially when one takes into consideration the amount of dextrine, a substance which does not exist in the healthy leaves at all From calculations made upon a tree of the same age and size, the leaves of the affected lime-tree would have a surface of 240 square metres (equal to 145 square yards), since the manna only covers one side of their surface. It would result from this, that on July 22, 1869, the lime bore two to three kilogrammes (equal to 4lb. to 7lb.) of honeydew, reckoned in a dry state.

In the normal conditions of vegetation the saccharine matters elaborated by the leaves, under the influence of light and heat, are distributed through the organism of the plant with the descending sap. In the abnormal state, which determines the production of the honeydew, saccharine matters are accumulated at the upper surface of the leaves, either because the movement of the sap is interrupted, or because it is retarded by the viscosity resulting from the formation of dextrine.

The production of honeydew cannot be due merely to meteorological influences—to the effect of warm and dry summers. No doubt the lime of Liebfrauenberg secreted it during a summer when there were periods of high temperature, accompanied by great dryness; we must not, however, lose sight of the fact that it was a single tree that was attacked by the malady, and that at a little distance there were limes which were perfectly healthy.

It has been supposed that aphides, after having drawn the honeydew from the parenchyma, discharge it again scarcely altered; but it is contrary to the results of analysis to assign it a composition similar to that of leaf sap. It is, however, admitted that certain insects possess the faculty of determining the production of manna. Thus it is to the punctures of a coccus that Ehrenberg and Heimprich attribute the formation of the manna which is still found on the mountains of Sinai.

The manna falls to the ground from the air (that is to say, from the summit of a tree, not from the sky). The Arabs call it man, and they, as well as the Greek monks, collect it to eat upon bread, in the same way as honey. I have myself seen it fall, collected it, and brought it to Berlin with the plant and the remains of the insect. This species of manna is produced by *Tamarix mannifera*, Ehr. As with many other mannas, it is the result of the punctures of an insect, which, in the present case, is *Coccus manniparus*, H. and Ehr.

The manna, consequently, collected in 1869 at Liebfrauenberg, had not the same origin as the Sinai manna, though it had the same composition. At the time of its appearance upon the lime no insects were observable. It was later that a few aphides were seen glued upon a certain number of the leaves.

I have already stated that, after having washed the extremity of a branch, glutinous points were seen gradually to rise; at first scarcely perceptible, they increased each day, so as finally to cover the whole of the upper surface of the leaf. This slow and progressive development of the honeydew was clearly effected without the intervention of aphides, which did not make their appearance till subsequently, like the flies and bees, either to feed upon the secretion or to pilfer it.

In a subsequent number Harting states that honeydew is produced by *Aphis tiliæ*, which, living on the under surface of the leaves of the lime, drops its excrement on the upper surface of the leaves beneath. Analysed by Gunning at Amsterdam, it proved to consist of cane sugar. Boussingault remarked, in reply, that the manna of Liebfrauenberg, like the Sinaitic manna analysed by Berthelot, contained, in addition to cane sugar, fruit sugar and dextrine. He added also, that the leaves of the lime contain considerable amounts of cane sugar almost pure, the original of which could not be attributed to insects.

Professor Dyer then quoted Goethe, as saying, "I have seen limes, of which the leaves seemed varnished, but where not a single insect was visible. The juice is secreted by the plant itself." Mr. Hanbury informed him that he noticed the exudation of a saccharine matter from a canella, and that after repeated cleansings it still made its appearance. He had seen also the occurrence of minute crystals of sugar upon the corolla of the azalea. De Candolle mentions the same thing in *Rhododendron ponticum.* This is, however, different to the secretion which takes place on leaves, because it is probably merely due to the loss of water from the flower preparatory to fading.

De Candolle remarks that granular secretions are found on the young shoots of the larch, and are collected locally under the name of manna of Briançon; they also occur on *Salix alba*, and upon some other trees. "We cannot affirm," he says, "either that they are a natural excretion, or that they are produced by insects." Dr. Masters states that a manna-like substance is produced from species of Alhagi, and that it is an exudation from the leaves and branches of the plant only appearing in hot weather. Saline secretions from leaves have been more frequently observed. De Saussure states that an accumulation of saline matters at their surface often occurs in garden vegetables, transpiration being impeded, the leaves are ultimately destroyed. De Candolle found a saline secretion from the leaves of a Reaumuria to consist of carbonates of soda and potash.

NOTES ON MANUFACTURES.

The production of pig-iron in the United States in 1871 is estimated at 1,850,000 tons. The amount of fuel consumed in the manufacture of this quantity was about 863,000 tons of anthracite, 387,000 tons of charcoal, and 600,000 tons of ordinary coal and coke. The value of pig and wrought iron, including iron work of all kinds, amounted during that year to 900 millions of dollars, and the number of persons engaged in the manufacture, 940,000.

According to the latest official returns, the number of manufacturing establishments in the canton of Zurich was 665, utilising 7,934 horse of water-power, and 2,326 horse of steam-power. The number of workpeople employed was 11,980 male, and 9,861 female. The number of cotton-spinning factories is 87, driven by a motive power of 3,561 horse water, and 468 steam, employing 3,275 workmen, and 3,239 workwomen. The total number of spindles in these factories is 660,136, and 1,227 power-looms. There are 40 cotton-weaving establishments, with a total of 5,750 power-looms, employing 3,100 persons. The establishments for spinning floss-silk are 38 in number, driven by 318 horse water and 87 horse steam-power, and employing 3,128 persons. The silk-weaving establishments are 9, employing 330 workpeople; the number of power-looms 744, driven by 225 horse water and 53 steam power. For the spinning and weaving of woollen goods there are 8 factories, with 4,152 spindles, and giving employment to 448 people.

The rose-oil, or attar of roses, which Europe consumes at present comes almost exclusively from the southern slopes of the Balkan, where, in some 150 places, the ingathering of the rose blossoms, and the manufacturing of the rose oil takes place. The quantity of oil which is produced in the South of France is very unimportant as compared with the quantity of the Turkish produce. The most important Turkish districts where this dear article is produced are Tchirpan, Philippopolis, Carlova, Zeni-zaghra, and Kizamlik; this last is the most important of all. Professor Dr. Hochsteller, from the Vienna University, in his reports to the Geographical Society of Vienna of his travels through Roumelia, has given very important data of the produce of oil at Kizanlit. These data, which have been reproduced by Mr. Blunt, the Vice-Consul at Adrianople, with the addition of drawings of the apparatus used in the process of manufacture, may serve to remove many incorrect statements published upon the subject. The roses planted in the basin of Kizanlik have light-red blossoms. They are planted in rows like the vine. Sometimes roses and vines are planted intermingled on the same plot. The most important species of roses planted there are *Rosa damascena*, *sempervirens*, and *moschata*. The first of these is also planted in the south of France, the last mentioned having a slight musk flavour, gives the chief material of the produce of the Indian rose-oil. The roses are gathered in their blossom state during the month of May, and are subjected to distillation, together with their green calix leaves. The distiller consists of a tinned copper boiler, from which runs a pipe into the cooling tub. In every boiler are placed 50 okes of water and 20 okes of roses, and the heating takes place over an open fire. The mass is boiled for two hours; the first part of the distilled fluid is put again into the boiler, the then condensing fluid is gathered into bottles of broad bottoms and straight necks. Water and oil are distilling over at the same time, the latter of course swimming on the surface. When there is a layer of oil of the thickness of a finger it is removed. This is done by a funnel-shaped spoon with a very thin opening at the top, which permits a passage to the water but not to the oil. 5,000 lbs. (German weight) of roses give, by careful distilling, 1 lb. of oil. The so-called freezing degree, that is, the degree of temperature when the separation of the solid parts takes place, varies, with the oils of Kizanlik, between 8 to 16 degrees Réaumur, equal to 50 to 68 degrees Fahrenheit. The best oils get solid or stiff at these degrees. They come from the colder mountain districts, whereas the oils from the warmer localities get solid at 12 to 16 degrees Réaumur, equal to 59 to 68 degrees Fahrenheit. These oils, marked strong oils, have a less delicate flavour, and are by the ignorance of the traders preferred. Such a valuable substance as the rose-oil is very often exposed to adulterations. These take place most extensively at the home of the oil, where also the substance for adulteration is produced on a large scale. This article, also an ethereal substance, is called in India "rosia oil," in Egypt "idris-oil," and in England "ginger oil." It is distilled from grass species of *Andropogon* and *Cymbopopon*. The idris oil is sometimes called "geranium oil." The distillers often adulterate the rose oil with geranium oil, which is imported from Alexandria. This is but idris oil exported from Bombay. The rose-oil is exported in round tinned copper bottles, called "kunkoumas," which, when filled, are closed by soldering.

The largest armour-plate bending machine ever manufactured has just been completed by Messrs. Westwood, Baillie, and Co., and erected by them at her Majesty's Dockyard, Pembroke. The machine has been tested to the enormous pressure of 4,000 tons. The large cylinder and ram are capable of being moved on the bed, so as to apply the pressure at any part between the columns to suit the difference in shape of the plates required to be bent. This movement is effected by means of a small hydraulic cylinder fixed on one end of the main bed casting. By an arrangement of screw valves the water can be applied at either end of the small hydraulic cylinder, or it can be connected with the large cylinder, and the ram made to lift instantaneously. The machine consists of a massive cast-iron block, top and bottom, each weighing upwards of 24 tons. These blocks are connected by four large columns forged from the best scrap iron. The large ram is 40⅝ inches in diameter, and is worked by a set of four pumps contained in one cistern, two being of large and two of small diameter; all four work in concert to lift the ram up to the plate to be bent, and when about 600 tons pressure has been attained, the large pumps, by their own self-action, throw out of gear, and the small pumps continue to work and produce the power necessary for bending the armour-plate. The whole weight of the machine complete is about 83 tons.

There is now every prospect that the getting of coal by machinery will be more generally adopted than has hitherto been the case. At present it has only been adopted at a few places, but a new machine, patented by Messrs. Gillott and Copley, has just been tested at the

Wharncliffe Silkstone Colliery, near Barnsley, in the presence of a number of mining engineers from various parts of the kingdom, and with most satisfactory results. In 136 minutes a bank of coal, 58 yards long and 4ft. 8in. thick, was cut to a depth of 3ft. 1in. The quantity of coal so cut would be about 80 tons in the time stated. In connection with coal machinery, a hydraulic coal breaker, patented by Mr. Clubb, of London, has just been very successfully tested at the Oaks Colliery, Barnsley. It brings down the coal in vast blocks, effecting a great saving by making little or no slack, as wedges and gunpowder make from 25 to 40 per cent. The owners of the Oaks Colliery are so satisfied with the machine that they have given orders for four of them.

In consequence of the scarcity of skilled labour, and the high rates of wages resulting therefrom, manufacturers are introducing machinery into almost every branch of industry, for the manufacture of articles never before thought suitable for machinery. The making of "whip sockets" for carriages, for instance, has always been executed by hand labour; but, by a machine made by Messrs. James Moore, Clement, and Co., of Birmingham, this labour will henceforth be saved. The machine is what is termed an "armed machine," with strong working parts, and with a revolving brass arm, inside which the shuttle works. The whip-socket, which is a cylinder of patent leather upon a foundation of tin, is placed on the arm, and on the machine being set in motion, a double row of stitches is sown through the whole substance with great ease and rapidity.

The wool manufacturing industries of England includes 1,550 factories; 10,462 carding, and 458 combing machines. Nearly 2,000,000 spindles, and 33,792 power-looms are used. 100,640 persons are employed—53,811 males, and 46,829 females. There are 599 worsted mills, with 991 carding, and 848 combing machines, which work 1,900,000 spindles, and 34,739 power-looms, and employ 103,514 hands—40,459 males, and 63,055 females. More than one million of persons are employed by the wool industry.

Professor Charles A. Goessman, Ph.D., has written a report on sugar-beets raised upon the farm of the Massachusetts Agricultural College, which is published in the ninth general report of the the trustees of that institution to the Governor and Council of Massachusetts, in January of the present year. An experiment was made on the college farm with forty-seven acres of land, prepared in the best manner possible for the reception of beet seeds. Owing to the want of a suitable drill for sowing the seeds, the rows were made two feet and a half apart, instead of from 18 to 20 inches apart, as should have been the case, thus leaving considerable waste land. The seed drill also worked imperfectly, leaving blank spaces in some of the rows. Still, under these unfavourable circumstances, the root crop averaged 22 200 pounds to the acre. Seeds of the following varieties of beets were planted, namely:—Vilmorin of 1869, Imperial of 1869, ditto of 1870, Electoral of 1870, Vienna Globe of 1869, varieties of mangold of 1870. The Imperial sugar-beet crop—seed of 1870—gave 12·59 per cent. of sugar; Vilmorin, 12·95 per cent.; Electoral, 12·30 per cent.; Vienna, red, white, and yellow globe beets, 8·004 per cent.; ordinary mangolds, 5·035.

Regarding the profitable manufacture of sugar from beet in the United States, Professor Goessman says:—"Although duly recognising the great weight of this point—for with the farmer rests the success of the enterprise in the end—I believe that its influence, as an obstacle, is frequently overrated and based on somewhat obsolete assumptions. The government tax of from 40 to 50 dollars per acre of sugar-beets, in Germany and France, as well as our higher prices of sugar, will go far towards covering our most expensive labour. The interests of the Louisiana sugar planters and the sugar-beet cultivators of more northern sections of the country are the same, as far as a proper protection of their industry is concerned; and the public opinion, in view of the requirements of the government, is apparently prepared to accord to them, for some time at least, this advantage. Great improvements in agricultural implements and in modes of securing the juice have reduced labour by hand to a considerable extent. A short enumeration of the most conspicuous instances may place this statement in its proper light. Various seeding machines, improvements more or less on Garrett's famous seed drill, are used in planting the seed, in four or more rows at once, and at any desired distances from twelve to twenty inches apart. According to the size of the machine, one or two men, with one or two horses or oxen, may seed from eight to sixteen acres per day; the same implement can also be modified by replacing the seed boxes with suitable knives to be used as cultivators, to clean the space between the rows of plants, and to cover the roots. Ploughs with two knives are used to break up the soil on both sides of the rows of beets, to loosen the latter in such a manner, without lacerating them, that children may do the harvesting of the roots. In fact, the whole work in the field, after the soil is once properly broken up, calls for no extraordinary labour. A good deal of the work can be done by boys. Machines do the washing, the grinding or cutting, and general handling of the roots to the centrifugal apparatus. The task of handling the pulp of beet roots for the press requires, comparatively speaking, a large supply of hands to do the business connected with that process, but Roberts's diffusion method dispenses with a large number of hands formerly required in the press room—nearly one-half."

GENERAL NOTES.

Musical Examinations.—At a meeting of the Council and Honorary Members of the Tonic Sol-fa College, as well as those who have obtained Honourable Mention in the course of Elementary Composition, held at 165, Aldersgate-street, on March 16th, Mr. Vernon Lushington, Q.C., in the chair, resolutions were passed establishing a scheme of examinations similar to those that have been held by the Society of Arts, and particulars of which will be found in an advertisment in this *Journal*. In consequence of these resolutions the Council of the Tonic Sol-fa College have decided to hold four examinations in April next. Further particulars in reference to the preliminary examination and Local Boards of Examiners may be had by applying to the secretary, Mr. Robert Griffiths, North-street, Plaistow, London, E. Subscriptions for the support of these examinations and prizes may be sent to the Secretary, or to Godfrey Lushington, Esq., 16, Great Queen-street, Westminster. In these examinations school-teachers will not be excluded from the prizes. Those who have previously obtained a first-class certificate can compete again for prizes. If two or more competitors are very nearly equal, the College reserves the right to divide the prize, or, if the funds allow, to give two or more equal prizes.

Society of Engineers.—Mr. G. W. Harris having resigned the secretaryship of the Society of Engineers, Mr. Perry F. Nursey, C.E., has been appointed to the vacant post.

East India Association.—The meeting announced for Tuesday next, the 4th of June, will not be held, owing to the severe illness of Mr. Tait, the reader of the paper.

Roofing Tiles of Cement.—Tiles made of cement are coming into general use for roofing purposes in Prussia. They are made in steel moulds; their thickness is only 3 millimetres, and for this reason are extremely light, a square metre weighing only 37·50 kils., and costing 11·50 francs.

Bethnal Green Branch Museum of the South Kensington Museum.—The Hertford collection of pictures, sculpture, bronzes, Sèvres porcelain, buhl, &c., have all been brought together from Paris and Manchester-house, and are in course of arrangement in this Museum, by the liberality of Sir Richard Wallace. It is intended that the Museum shall be opened to the public in the course of next month.

University of London.—The following is a list of the candidates who have passed the recent general examination for women:—Honours Division.—Bennett, Mary Amelia, North London Collegiate School for Ladies; Ewart, Elizabeth, private study; Lord, Henrietta Frances, private tuition. First Division.—Edwardes, Frances Millicent, private study; Raisin, Catherine Alice, North London Collegiate School for Ladies; Wallis, Mary Anne, Queen's College and private study. Second Division.—Woods, Evangeline Alice, Ladies' College, Cheltenham.

Workmen's Prizes.—The Company of Coachmakers and Coach Harness Makers offer for the year 1872 the following prizes, for competition among persons engaged in the trade of coachmaking, being masters, foremen, workmen or apprentices, viz.:—For freehand drawing—1st prize, the company's silver medal, and 2nd prize, the company's bronze medal; for practical mechanics—1st prize, the company's silver medal, and 2nd prize, the company's bronze medal. The awards will be made by the Science and Art Department, South Kensington, at the examinations held (in connection with the Department) throughout the country. Information on this point may be obtained at any of the schools of art. The company, in addition, offers two silver and two bronze medals for drawings of carriages or parts of carriages, to any scale, for competition among foremen, workmen, and apprentices engaged in the trade of coachmaking. The following are entitled to compete:—Coach body makers, coach carriage makers, coach carvers, coach joiners, coach spring makers, coach smiths, coach vice-men, coach herald painters, coach painters, coach wheelers, coach trimmers, coach budget-trimmers, coach lace makers, coach lamp makers, coach platers, coach chasers, coach sawyers, and coach labourers. The competition is open to natives of England, Scotland, Ireland, and Wales, or any British colony. The drawings to be sent to the hall of the Coach Makers' Company (Noble-street, Cheapside, London,) on or before June 10th, 1872. The drawings are to have a mark put upon them before being sent in, and are to be accompanied by a note containing the name, age, occupation, and address of the producer, which note is to be enclosed in an envelope bearing the same mark as that placed upon the drawings. These notes will not be opened until the medals have been finally awarded. The judges nominated by the court are John F. Woodall, (Master), Joseph Peters (a Past Master), Herbert M. Holmes (Upper Warden), and George N. Hooper (member of the Court of Assistants).

Gold in Old Crowns and Half-Crowns.—The Deputy Master of the Mint, in his report for the year 1871, supplies the following curious information:—As is well known, silver, when extracted from its ores, usually contains a small quantity of gold, and the process of refining, as practised when the coins in question were struck, was too expensive to admit of the extraction at a profit of the small quantity contained in them. At the present day, however, improvements in refining render it possible to extract with profit any quantity of gold exceeding two grains in the pound troy of silver. Samples examined in the Mint prove that the half-crowns now in process of withdrawal from circulation contain an average of 4·07 grains in the pound, and when, therefore, any considerable quantity of these coins has accumulated in the Mint, it will probably be advisable to recommend that the gold should be extracted from them before they are re-coined.

Krupp's Steel Works at Essen.—The famous steel works of Krupp at Essen produced, in 1871, 65,000 tons of steel, employing 7,100 persons, steam-power of 5,377 horses, furnished by 256 steam-engines and 150 boilers. The most powerful steam-engine used at these works is upwards of 1,000-horse power, and thirteen are more than 100-horse power each.

Street Railways in Vienna.—The Street Railway Company at Vienna have 340 cars, of which 80 to 150 are in daily use. In 1870, the greatest number of persons carried in one day (24th May) was 138,978, the number of cars running on that day being 206, and horses 937. The number of persons carried during the year is estimated at 15 millions.

Consumption of Petroleum in Italy.—From the most recent returns published by the Custom-house, it appears that the quantity of petroleum imported into and consumed in Italy yearly was as follows:—In 1869, 295,265 quintals; 1870, 383,540, and during the first three months of 1871, 241,800, so that it may be presumed that the entire consumption during that year amounted to at least 450,000 quintals.

The Dominion of Canada.—Among the annual departmental reports recently laid before the Parliament of the Dominion is one from the Minister of Marine and Fisheries. He states that the value of the produce of the fisheries for the purpose of trade in the past year was 7.573,200 dollars, being a large excess over the preceding year. It is estimated that the quantity used for domestic supply amounts to about 600,000 dollars worth. The value of the annual catch by Canadians for export and home consumption, therefore, exceeds 8,000,000 dollars. The amount of capital engaged is estimated at 15,000,000 dollars, and the number of persons employed at about 87,000. About 150,000 healthy salmon fry, bred at Newcastle, were distributed in the most favourable streams, and it is estimated that within two years they will become available food, worth 130,000 dols. Referring to the investigation of the Natural History Society of Montreal in the Gulf of St. Lawrence, on the subject of food for fishes, Mr. Mitchell recommends that a small appropriation be granted for continuing the investigation. The total amount expended by this department for services for the year ending the 30th June, 1871, was 575,916 dollars. With respect to the abduction of the schooner E. A. Horton, the report states that an official investigation leaves an impression that there was culpable negligence, if not connivance, on the part of those persons who, having captured the vessel, had it in charge. The report of the Postmaster-General for 1871 has also been issued, and shows evidence of the prosperity of the country. On the 1st of January, 1872, there were in the four old provinces of the dominion 3,943 post-offices. In the year 1871 there were 3,039 miles of post route, and 11.992.898 miles were travelled over in the course of that year for postal purposes. The number of letters and cards sent through the post-office during the year was 27,050,000; of newspapers 22 250,000; of registered letters, 1,100.000; of free letters, 1.218.400; and of parcels, 64,160. The revenue for the year was 1,079.767 dollars, and the expenditure 1.271,006 dollars, leaving a deficit of 191.239 dollars, a large portion of which would have been made up had the franking system been abolished. A regular rate of postage has been established over the whole dominion, so that letters can go from Halifax to Victoria for three cents. Of the registered letters 115 miscarried. Of these 57 were destroyed by fire. Deducting these, the loss is about one in 18,000. The mail steamers have run during the year with exemplary regularity and expedition; the average length of voyage westward during the winter months being, according to this report, 11 days 7 hours; eastward, 10 days 15 hours. For the summer months, the average passage westward was 10 days 5 hours; and eastward, 9 days 20½ hours.

Importation of Iron Ore into France.—The imports of iron ore into France amounted, in 1871, to 378,577 tons, against 483,093 tons in 1870, and were from the following countries :—Belgium, 92,228 tons; Germany, 6,000; Spain, 91,427; Italy, 31,649; Algeria, 155,608; and other countries, 1,665. Total, 378,577 tons.

The St. Gothard Railway.—It is reported in engineering circles in Milan that a contract has just been signed between Signor Grattoni and the St. Gothard Railway Company, for the construction of the tunnel, the particulars of which was published in the *Journal* 17th May. It is said that the prices and conditions of the contract are extremely favourable for the company, and this seems probable, as Signor Grattoni, having carried out the Mont Cenis Tunnel, and having all the plant and boring machinery that was used there, would naturally be in a better position than any other contractor to undertake the work at a low price, and to insure its success.

Tramways in Paris.—After several months' discussion the question of the establishment of tramways in and around Paris has been decided in principal, and a commission of the Council-General, in concert with the Prefect of the Seine, has made a report on the subject. After examining the many propositions sent in to the authorities, the Commission recommended ten different lines as urgent, and as supplying the nucleus of a more extended system. The following are the routes recommended by the Commission:—1. A circular line along the outer boulevards, where the last octroi wall stood. 2. A line from the Place de la Concorde to Vincennes, with a branch to Montreuil from the Barrière du Trône. As a line exists already from the Place to St. Cloud and Versailles, the projected line will complete the communication between the latter town and Vincennes. 3. From the Bastille to Charenton, with branches touching the circular line. 4. From the Place du Château d'Eau to Pantin and Aubervilliers. 5. From La Chapelle to St. Denis. 6. From the Place Clichy to Clichy, and thence to Gennevilliers on the opposite bank of the Seine, with a branch to St. Denis. 7. From the Place St. Augustin, Boulevard Malesherbes, to Neuilly, Courbevoie, Suresne, and perhaps St. Cloud, with branch to Levallois-Perret. 8. From the Church of St. Germain-de-Pres, Rue Bonaparte, to Issy, Vanves, Clamart, on the one hand, and to Châtillon and Fontenay-aux-Roses on the other, with a branch to the railway station at Mont-Parnasse. 9. From the Barrière d'Enfer to Sceaux, by Bourg-la-Reine. 10. From the Collège de France to Choisy-le-Roi, by way of Vitry. The above is a formidable list, and yet it excludes some very important proposed lines, such, for instance, as one along the quays of the Seine, and a subterranean line to complete the project of the great central market and bring it in direct communication with the Chemin-de-fer Circulaire, and consequently with all the main lines of France. The terminus was formed when the market was built, and for business purposes this is regarded by many persons as the most important of all the proposed lines. Probably it may be reserved for special consideration, as not forming part of the general plan for public accommodation. The commission has also decided that the lines to be constructed within and without the limits of Paris may be conceded to two different companies, but that in such case there shall be established a system of correspondence, so that the entire distance shall be traversed without change of carriage. As regards the vehicles to be employed, the general opinion is that the carriages of the line in operation between Paris, St. Cloud, and Versailles are much too cumbrous, and a model carriage which has been exhibited at the Luxembourg, much resembling those in use in London, seems to be approved. The report of the Commissioner is now under the consideration of the General Council of the Seine, but it is assumed for certain that the principle points are accepted in advance, and that before long the environs of Paris, so ill-supplied with means of communication, will be endowed with a good system of tramways. One grand difficulty in the way is the existing monopoly of the omnibus company, which does not expire till the year 1910. This company has applied for a concession of the proposed tramways for fifty years, together with an extension of its existing contract to the same date, that is to say till 1922, but the feeling is now so strong in Paris against monopolies of all kinds, that it seems impossible that such a project should even be taken into consideration, except in competition with other parties. The question will probably be decided very shortly.

CALENDAR OF MEETINGS.

INDIA CONFERENCE.

On June 7th a Conference will be held, at half-past four, on "Engineering Education in India," to be opened by Mr. Hyde Clarke.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....Society of Engineers, 7½. Mr. E. G. Bartholomew, "Electric Telegraph Instruments."
Royal Institution, 2. General Monthly Meeting.
London Institution, 4. Prof. Bentley, "On Elementary Botany."
Royal United Service Institution, 8½. Capt. E. M. Jones, "The latest Changes made by the Prussians in their Infantry Drill-book."
Entomological, 7.
Asiatic, 3. Annual Meeting.
Victoria Institute, 8.
Anthropological, 8.

Tues....Royal Institution, 3. Mr. E. B. Tylor, "Development of Belief and Custom."
Biblical Archæology, 8½. 1. Dr. August Eisenlohr, "On the Political Condition of Egypt before the reign of Rameses III., probably in connection with the establishment of the Jewish Religion, from the Harris Papyrus.' 2. Mr. Solomon M. Drach, "Some Mathematical Observations of the Base of the Great Pyramid, and the Royal Coffer.' 3. Dr. Daniel H. Haigh, "The XXXVII. Aamu in the Tomb of Chnum-Hotep, at Beni Hassan, identified with the family of Israel."
Zoological, 9.

Wed.....Geological, 8. 1. Mr. George Henderson, "Notes on Sand-pits, Mud-volcanoes, and Brine-pits, met with during the Yarkand Expedition of 1870" Communicated by Mr. R. Etheridge. 2. Mr. W. Boyd Dawkins, "On the Cervidæ of the Forest-bed of Norfolk and Suffolk." 3. Mr. W. Boyd Dawkins, "The Classification of the Pleistocene Strata of Britain and the Continent by means of the Mammalia."
Microscopical, 8. 1. Mr. Charles Cubitt, "Remarks on the Homological Position of the members constituting the Thecated Section of the Rotatoria." 2. Mr. Isaac Roberts, "On a Micro-pantograph."
British Medical Association, 8. (At the House of the Society of Arts.)
Obstetrical, 8.

Thurs...Royal Institution, 3. Prof. Tyndall, "On Light and Heat."
Antiquaries, 8½.
Linnæan, 8.
Chemical, 8.
Royal Society Club, 6.

Fri.......**SOCIETY OF ARTS, 8.** India Conference. Mr. Hyde Clarke, "On Engineering Education in India."
Royal Institution, 9. Dr. Odling, "History of Ozone."
Geologists' Association, 8.
Philological, 8¼
Archæological Institute, 4.

Sat.......Royal Botanic, 3¾.
Royal Institution, 3. Prof. Roscoe, "Chemical Action of Light and Heat."

Journal of the Society of Arts.

No. 1,020. Vol. XX.

FRIDAY, JUNE 7, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ALBERT MEDAL.

The medal has been awarded by the Council this year to Mr. Henry Bessemer, "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

This medal was instituted in 1863, after the death of H.R.H. the Prince Consort, the President of the Society, to reward "distinguished merit in promoting Arts, Manufactures, or Commerce," and has been awarded as follows:—

In 1864, to Sir Rowland Hill, K.C.B., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty the Emperor of the French, "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Professor Faraday, D.C.L., F.R.S., for "discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (now Sir) W. Fothergill Cooke and Professor (now Sir) Charles Wheatstone, F.R.S., in "recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (now Sir) Joseph Whitworth, F.R.S., LL.D., "for the invention and manufacture of instruments of measurement and uniform standards, by which the production of machinery has been brought to a degree of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, Foreign Member of the Royal Society, Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food-economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to M. Ferdinand de Lesseps, "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. Henry Cole, C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

CONVERSAZIONE.

The Society's Conversazione is fixed to take place at the South Kensington Museum, on Wednesday, the 19th June. Tickets have been issued to the Members.

SHIPS' LIFE BOATS.

The actual trials of the boats built after the models selected by the Committee will take place on Wednesday, July 31st, and NOT on July 30th, as previously announced.

REVIEW OF SCHOOL DRILL.

The Committee met on Wednesday, the 5th June. Present—Major-General F. Eardley-Wilmot, R.A., F.R.S. (in the chair), Captain E. F. Du Cane, R.E., E. Chadwick, C.B., Mr. W. S. Fitzwilliam, Vice-Admiral Ommanney, C.B., F.R.S., Captain Phipps, R.N., Mr. Seymour Teulon, and Mr. E. Carleton Tufnell, with Captain O'Hea, who has been appointed to inspect and report on the drill of the schools for the prizes.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Blenheim Literary Institute, Marlborough, New Zealand.

Dundee Young Men's Christian Association.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first subscription list amounted to £351 3s. A further list will shortly be published.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

FINAL EXAMINATION, 1872.

PRIZES AND CERTIFICATES AWARDED TO CANDIDATES.

PRIZES.

His Royal Highness the Prince Consort's Prize of Twenty-Five Guineas to

No. 1233—William Pollitt, aged 20, Salford Working Men's College, clerk, who has obtained the following First-class Certificates :—

1869—German—First-class Certificate, with Second Prize.
,, English History—First-class Certificate, with First Prize.

1870—Book-keeping—First-class Certificate.
,, Logic—First-class Certificate, with Second Prize.

1871—Latin—First-class Certificate, with First Prize.
,, English Language—First-class Certificate, with Second Prize.

1872—Domestic Economy—First-class Certificate with First Prize.
,, Metric System—First-class Certificate, with Second Prize.
,, Mensuration—First-class Certificate.

The Council Prize (for Female Candidates) of Ten Guineas

Has not been awarded this year, as no candidate qualified to receive prizes has fulfilled the required conditions.

Arithmetic	1st Prize	£5	To No. 1045—Henry Wood, 17, Manchester Mech. Inst., assistant book-keeper
	2nd Prize ..	3	,, 1131—Frederick J. Barnes, 21, Pembroke Dock Mech. Inst., shipwright
	Female Prize	2	,, 200—Mary E. Rudd, 16, Carlisle Mech. Inst. (no occupation stated)
Metric System	1st Prize	5	,, 1035—Alexander Gibson, 18, Manchester Mech. Inst., draughtsman
	2nd Prize ..	3	,, 1233—William Pollitt, 20, Salford Working Men's College, clerk *No Prize for Females awarded.**
Book-keeping	1st Prize	5	,, 1199—Thomas R. Clarke, 20, Salford Working Men's College, clerk
	2nd Prize ..	3	,, 808—George W. Brangwin, 24, City of London College, clerk *No Prize for Females awarded.**
Mensuration	1st Prize	5	,, 1092—William H. Stanier, 23, New Swindon Mech. Inst., railway clerk
	2nd Prize ..	3	,, 1029—William Dodgson, 26, Manchester Mech. Inst., civil and mechanical engineer
Floriculture	1st Prize	5	,, 1182—John Jones, 21, Richmond Parochial Library, gardener *No Second Prize awarded.*†
Fruit and Vegetable Culture	1st Prize	5	,, 1182—John Jones, 21, Richmond Parochial Library, gardener
	2nd Prize ..	3	,, 521—Charles Huggins, 23, Hull Young People's Christian and Literary Inst., gardener
Domestic Economy..	1st Prize	5	,, 1233—William Pollitt, 20, Salford Working Men's College, clerk
	2nd Prize ..	3	,, 665—Fletcher T. Turton, 19, Liverpool Inst., surveyor *No Prize for Females awarded.**
Political Economy..	1st Prize	5	,, 1092—William H. Stanier, 23, New Swindon Mech. Inst., railway clerk
	2nd Prize ..	3	,, 566—Chas. J. Palmer, 19, Ipswich Working Men's College, clerk
Geography	1st Prize	5	,, 1128—George M. Thomas, 19, Pembroke Dock Mech. Inst., shipwright apprentice
	2nd Prize ..	3	,, 1035—Alexander Gibson, 18, Manchester Mech. Inst., draughtsman *No Prize for Females awarded.**
English History ..	1st Prize	5	,, 141—Alfred T. Gregory, 19, Birmingham and Midland Inst., stationer
	2nd Prize ..	3	,, 171—Thomas Ward, 18, Birmingham and Midland Inst., clerk *No Prize for Females awarded.**

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* No Female Candidate qualified to receive Prizes obtained a First-class Certificate in this subject.

† No other First-class Certificates were given in this subject.

English Language..	1st Prize	£5	To No. 141—Alfred T. Gregory, 19, Birmingham and Midland Inst., stationer
	2nd Prize ..	3	„ 860—William R. Kerr, 19, City of London College, clerk
	Female Prize	2	„ 175—Bertha M. Wootton, 18, Birmingham and Midland Inst. (no occupation stated)
Logic	1st Prize	5	„ 349—John McAlpine, 21, Glasgow Athenæum, warehouseman
			No Second Prize awarded.†
Latin	..	..	*No Prizes awarded.*‡
French	1st Prize	5	„ 138—Edward Edmonds, 21, Birmingham and Midland Inst., electro depositor
	2nd Prize ..	3	„ 760—Ronald G. Madden, 24, Birkbeck Literary and Scientific Inst., clerk
			*No Prize for Females awarded.**
German	1st Prize	5	„ 789—Mary E. Martin, 23, Birkbeck Literary and Scientific Inst. (no occupation stated)
	2nd Prize ..	3	„ 305—William Young, 21, Glasgow Athenæum, clerk
	Female Prize	2	„ 789—Mary E. Martin, 23, Birkbeck Literary and Scientific Inst. (no occupation stated)
Italian............	1st Prize	5	„ 138—Edward Edmonds, 21, Birmingham and Midland Inst., electro depositor
			No Second Prize awarded.†
			*No Prize for Females awarded.**
Spanish	1st Prize	5	„ 826—Edward K. Courthorpe, 22, City of London College (no occupation stated)
	2nd Prize ..	3	„ 864—Charles E. Lloyd, 24, City of London College, clerk
			*No Prize for Females awarded.**
Theory of Music ..	1st Prize	5	„ 292—Daniel Riddell, 24, Glasgow Andersonian University Popular Evening Classes, clerk
	2nd Prize ..	3	„ 747—Charles H. Hewitt, 25, Birkbeck Literary and Scientific Inst., clerk
	Female Prize	2	„ 230—Mary Bissell, 24, Dudley Mech. Inst. (no occupation stated)
Elementary Musical Composition	1st Prize	5	„ 263—Timothy L. Campbell, 29, Glasgow Andersonian University Popular Evening Classes, japanner
	2nd Prize ..	3	„ 1161—Samuel Dash, 25, Beauvoir College Evening Classes, Plaistow, warehouseman
			*No Prize for Females awarded.**

The Third Prize of £2, in Domestic Economy, offered by Mr. T. Twining, a Vice-President of the Society, has been awarded as follows :—

No. 987—James Hogg, 26, Manchester Mechanics' Institute, mechanic.

The Three Prizes of Books, also offered by Mr. T. Twining, have not been awarded, as only three First Class Certificates were given in this subject.

The Third Prize of £2, in Political Economy, offered by Mrs. Harry Chester, has been awarded as follows :—

No. 654—Thomas Adcock, 24, Leicester Working Men's College, baker.

The Three Prizes of Books, also offered by Mrs. Harry Chester, have not been awarded, as the remaining First Class Certificate holders in this subject were disqualified for receiving prizes.

The Royal Horticultural Society's Prizes have been awarded as follows :—

Floriculture	1st Prize	£5	To No. 1182—John Jones, 21, Richmond Parochial Library, gardener
	2nd Prize ..	3	„ 521—Charles Huggins, 23, Hull Young People's Christian and Literary Inst., gardener
Fruit and Vegetable Culture	1st Prize	5	„ 1182—John Jones, 21, Richmond Parochial Library, gardener
	2nd Prize ..	3	„ 521—Charles Huggins, 23, Hull Young People's Christian and Literary Inst., gardener

The Prize of £5, offered by the Royal Geographical Society, has been awarded to—

No. 1128—George M. Thomas, 19, Pembroke Dock Mech. Inst., shipwright apprentice

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* No Female Candidate qualified to receive Prizes obtained a First-class Certificate in this subject.

† No other First-class Certificates were given in this subject.

‡ No First-class Certificates were awarded in this subject.

The Prizes offered by the Proprietors of the *Gardeners' Chronicle* have not been awarded, no Candidate having fulfilled the required conditions.

The Prizes offered by the Council for Writing from Dictation have been awarded as follows :—

1st Prize of £3 to No. 627—John W. Palliser, 23, Leeds Young Men's Christian Association, art student
2nd ,, 2 ,, 169—William H. Taylor, 25, Birmingham and Midland Inst., clerk
3rd ,, 1 ,, 860—William R. Kerr, 19, City of London College, clerk

The Prizes offered by the Council for Writing and Manuscript Printing have been awarded as follows :—

1st Prize of £3 to No. 1261—Henry Williams, 23, Southampton Athenæum, clerk on ordnance survey
2nd ,, 2 ,, 1263—George Bean, 16, St. Martin's School of Art, Stamford, solicitor's clerk
3rd ,, 1 ,, 1023—John Ingham, 21, Manchester Mech. Inst., clerk

The Prizes offered by the Council for the four best specimens of Handwriting, as shown in any of the papers worked in any subject, have been awarded as follows :—

1st Prize of £5 to No. 860—Kerr, William R. 19, City of London College, clerk
2nd ,, 3 ,, 788—Bray, William H., 17, Birkbeck Literary and Scientific Institution, clerk
3rd ,, 2 ,, 774—Edrupt, Richard W., 17, Birkbeck Literary and Scientific Institution, clerk
4th ,, 1 ,, 831—Davis, Edward J., 22, City of London College, clerk

VIVA-VOCE EXAMINATION IN MODERN LANGUAGES.

The vivâ-voce examination in Modern Languages, as proposed in the memorandum furnished by Mr. Hyde Clarke, Member of the Council, has been held by only one Local Board, viz., that of the Birkbeck Literary and Scientific Institute, the Examiners reporting the result as follows :—

German—Annie Chapman, aged 35, governess, "very good."
,, —Arthur A Higgins, aged 19, clerk, "very good."
French —Ronald G. Madden, aged 24, clerk, "good."

CERTIFICATES.

The following is an Alphabetical List of the Candidates who have obtained Certificates.

The number following the name gives the age of the Candidate.

(1st) after a subject signifies a First-class Certificate.
(2d) ,, ,, Second-class ,,
(3d) ,, ,, Third-class ,,

The occupations stated are either present or proposed.

649—Abbott, William, 20, Leicester W.M. Coll., clicker—Eng. Lang. (3d)

799—Abrahams, Moses, 20, City of London Coll., clerk—French (2d)

461—Ackroyd, Herbert, 20, Halifax W.M. Coll., clerk—Arith. (3d); Bkpg. (3d)

800—Adamson, Robert H., 23, City of London Coll., clerk—Bkpg. (1st); French (2d)

801—Adcock, John H., 24, City of London Coll., teacher—Logic (3d); Met. Syst. (3d)

654—Adcock, Thomas, 24, Leicester W.M. Coll., baker—Eng. Hist. (2d); Pol. Econ. (1st), with third prize of £2

614—Ainley, Richard, 20, Leeds Y.M. Chr. Assoc., warehouseman—Eng. Lang. (3d)

370—Aird, John A., 19, Glasgow M.I., warehouseman—Spanish (1st)

419—Anderson, George, 16, Glasgow M.I., clerk—Eng. Lang. (2d)

374—Anderson, James, 34, Glasgow M.I., clerk—Met. Syst. (2d)

360—Anderson, Matthew, 18, Glasgow M.I., clerk—Bkpg. (3d)

435—Anderson, William, 23, Glasgow M.I., clerk—Mus. Comp. (1st); Theory of Mus. (1st)

1059—Anderton, Sarah, 17, Manchester M.I., shopwoman—Dom. Econ. (3d)

1028—Anderton, Thomas, 19, Manchester M.I., tin-plate worker—Arith. (1st); Eng. Hist. (1st)

257—Andrew, Archibald, 20, Glasgow And. Univ. Pop. Evg. Classes, assistant teacher—Mens. (2d)

386—Alexander, James, 22, Glasgow M.I., clerk—Eng. Lang. (3d)

802—Alexander, William M., 32, City of London Coll., architect and surveyor's assistant—Arith. (2d); Bkpg. (2d); Mens. (3d)

256—Allan, David S., 32, Glasgow And. Univ. Pop. Evg. Classes, tailor—Mus. Comp. (2d)

1147—Allen, Mary, 36, Penzance, confectioner, French (2d)

734—Allingham, William, 21, Birkbeck Lit. and Sci. Inst., writer in Admiralty—Arith. (1st); Pol. Econ. (3d)

247—Allison, Charles, 16, Edinburgh Watt Inst., engineer's apprentice—Arith. (2d)

990—Almgill, R., 21, Manchester M.I., salesman—Bkpg. (2d)

1190—Almgill, Samuel D., 17, Salford W.M. Coll., warehouseman—Bkpg. (3d)

203—Armstrong, John, 22, Carlisle M.I., engineer's clerk—Logic (2d); Met. Syst. (1st)

236—Ashton, John, 27, Edinburgh Watt Inst., goldsmith—Theory of Mus. (2d)

1191—Ashworth, George, 16, Salford W.M. Coll., clerk—Arith. (2d)

50—Aslett, Henry, 28, Aldershot and Farnham District Board, soldier—Arith. (3d); Eng. Hist. (3d)

1192—Astley, James, 19, Salford W.M. Coll., warehouseman—Arith. (3d)

213—Atkinson, Roger, 20, Crewe M.I., fitter—Arith. (1st)

551—Aylward, Walter C., 16, Ipswich W.M. Coll., shoemaker—Bkpg. (3d)

216—Ayre, John T., 18, Crewe M.I., fitter's apprentice—Arith (3d)

1193—Babington, Arthur R., 18, Salford W.M. Coll., warehouseman—Bkpg. (3d)

576—Baguley, William, 16, Irwell Inst., weaver—Arith. (3d)

930—Bailey, Frederick G., 17, Royal Polytechnic Inst., clerk—Bkpg. (3d)

775—Baird, James, 22, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

330—Baird, James S., 21, Glasgow Ath., clerk—Pol. Econ. (2d)

1194—Baker, Benjamin, 21, Salford W.M. Coll., tailor—Arith. (3d)

562—Baker, Findley, 19, Ipswich W.M. Coll., pupil teacher—Eng. Hist. (3d); Eng. Lang. (2d); Geog. (3d)

1096—Baker, Orlando, 38, New Swindon M.I., clerk—Mus. Comp. (2d)

258—Bald, Claud, 18, Glasgow And. Univ. Pop. Evg. Classes, engine fitter's apprentice—Mus. Comp. (3d); Theory of Mus. (2d)

130—Ball, George E., 17, Birmingham and Mid. Inst., pupil teacher—Geog. (1st)

803—Ball, Henry W., 19, City of London Coll., artist on glass—Pol. Econ. (3d)

245—Ballantyne, James, 30, Edinburgh Watt Inst., factory worker—Mus. Comp. (3d)

1027—Bamforth, William, 20, Manchester M. I., clerk—Bkpg. (2d)

504—Bancroft, John, 18, Huddersfield M. I., apprentice—French (3d)

804—Barnes, Benjamin, 21, City of London Coll., clerk—French (3d)

1131—Barnes, Frederick J., 21, Pembroke Dock M. I., shipwright—Arith. (1st), with second prize of £3.

74—Barnett, James S., 18, Ashford M. I., pupil-teacher—Eng. Lang. (2d); Geog. (1st)

805—Barnett, Leopold, 18, City of London Coll., clerk—Arith. (2d)

1291—Barratt, Samuel, 20, Stockport Sunday Sch. Imp. Soc., teacher—Eng. Lang. (2d)

1099—Barrett, Joseph, 18, Oldham Lyceum, warehouseman—Bkpg. (3d)

259—Barrie, Peter, 39, Glasgow And. Univ. Pop. Evg. Classes, railway clerk—Theory of Mus. (1st)

666—Barrow, James H. M., 24, Liverpool Inst., teacher—Eng. Hist. (1st); French (3d)

671—Barrow, William M., 20, Liverpool Inst., clerk—Bkpg. (3d)

1000—Barry, John, 16, Manchester M.I., in solicitor's office—Bkpg. (2d)

317—Barry, John C., 22, Glasgow Ath., mechanical draughtsman—Eng. Lang. (3d)

1297—Bartle, Harry, 16, Wakefield M.I., messenger—Arith. (3d)

939—Baurne, Frederick, 20, Royal Polytechnic Inst., clerk—Bkpg. (3d)

1063—Baxter, John, 16, Mossley M.I., tailor—Arith. (3); Bkpg. (3d); Eng. Lang. (3d)

229*-Bayley, John, 35, Devonport M.I., writer (in H.M. Dockyard)—Met. Syst. (2d)

1263—Bean, George, 16, Stamford (St. Martin's School of Art), solicitor's clerk—the second prize of £2 for writing and manuscript printing.

806—Beard, Frederick, 28, City of London Coll., clerk—Bkpg. (2d)

554—Beaumont, Arthur W., 18, Ipswich W.M. Coll., clerk—Bkpg. (1st)

505.—Beaumont, Thomas S., 17, Huddersfield M.I., wool sorter—German (3d)

1024—Beckett, George E., 20, Manchester M.I., clerk—Arith. (2d)

807—Beer, Henry, 21, City of London Coll., clerk—Logic (2d); Eng. Lang. (2d)

518—Bell, John C., 20, Hull Young People's Chr. and Lit. Inst., clerk—Com. German (1st)

1104—Bell, Robert K, 21, Paisley Artisans' Inst., dyer—Theory of Mus. (1st)

611—Bell, Thomas W., 19, Leeds Young Men's Chr. Assoc., warehouseman—Eng. Hist. (1st); Geog. (2d)

261—Bell, William, 22, Glasgow And. Univ. Pop. Evg. Classes, warehouseman—Theory of Mus. (2d)

953—Bennett, Frederick J., 18, Royal Polytechnic Inst., dentist's pupil—Geog. (3d); Eng. Hist. (3d)

730—Bennett, Richard W., 19, Birkbeck Lit. and Sci. Inst., clerk—French (3d)

989—Bennett, Robert, 20, Manchester M.I., grocer's assistant—Bkpg (1st)

954—Bennett, William C., 20, Royal Polytechnic Inst., dentist's pupil—Geog. (3d); Eng. Lang. (3d); Eng. Hist. (3d)

1180—Bennett, William R., 19, Avenham M.I. (Preston), schoolmaster—Arith. (3d); Eng. Lang. (3d); Geog. (3d)

131—Benton, Anne, 31, Birmingham and Mid. Inst., teacher—French (3d)

1048—Berra, James W., 17, Manchester M.I., clerk—Bkpg. (2d)

610—Berry, William, 19, Leed's Young Men's Chr. Assoc., architect's pupil—Eng. Lang. (2d)

943—Bettger, Alfred, 24, Royal Polytechnic Inst., clerk—Bkpg. (3d); French (2d)

982—Birchby, William N., 19, Manchester M.I., warehouseman—Bkpg. (2d)

230—Bissell, Mary, 24, Dudley M.I. (no occupation stated)—Theory of Mus. (1st), with the prize of £2 for females

981—Blackstock, William, 32, Manchester M.I., clerk—Theory of Mus. (2d)

705—Blackwell, John W., 22, Birkbeck Lit. and Sci. Inst., clerk—Eng Lang. (1st)

786—Blaikley, Alexander F., 19, Birkbeck Lit. and Sci. Inst, clerk—German (2d)

402—Blair, James, 17, Glasgow M.I., pupil-teacher—Arith. (3d)

38—Blakemore, George, 25, Aldershot and Farnham District Board, drawing-master—Mens. (2d)

1020—Bland, Thomas, 20, Manchester M.I., clerk—Bkp. (1st)

431—Blyth, James A., 16, Glasgow M.I., law-clerk—Latin (3d)

1172—Bonner, William H., 19, Beauvoir Coll. Evg. Classes, clerk—Theory of Mus. (1st)

1033—Booth, James, 18, Manchester M.I., clerk—Arith. (2d); Eng. Hist. (1st)

1032—Booth, John O, 21, Manchester M.I., clerk—Bkpg. (1st)

1052—Booth, Samuel, 22, Manchester M.I., warehouseman—Arith. (1st)

1098—Boothby, William, 18, Oldham Lyceum, surveyor's apprentice—Eng. Lang. (3d)

183—Boothroyd, William H., 19, Bradford M.I., merchant's clerk—German (3d)

1196—Bostock, Edmund I., 17, Salford W.M. Coll., clerk—Bkpg. (3d)

531—Botham, William, 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg (1st)

590—Bower, John W., 19, Leeds Ch. Inst., clerk—Bkpg. (2d)

366—Bowie, James M., 16, Glasgow M.I., clerk—Bkpg. (3d)

1322—Bowker, Joseph, 19, York Inst. of Pop. Sci., gardener—Arith. (2d)

1197—Brabin, C., 20, Salford W.M. Coll., warehouseman—Arith. (2d)

1039—Bradley, John, 22, Manchester M.I., warehouseman—Eng. Hist. (2d); Eng. Lang. (3d); Geog. (2d)

101—Bradley, Thomas, 23, Bollington Useful Knowledge Soc, cotton-piecer—Eng. Lang. (3d)

951—Bradshaw, Frederick J., 16, Royal Polytechnic Inst., clerk—Arith. (2d); Bkpg. (3d)

1120—Brady, Edward G., 16, Parsonstown Young Men's Mut. Imp. Soc., clerk—Arith. (1st)

1157—Brain, Edwin B., 19, Beauvoir Coll. Evg. Classes, builder's apprentice—Mus. Comp. (2d); Theory of Mus. (3rd)

1183—Brameld, Thomas, 23, Rotherham Lit. and M.I., clerk—Theory of Mus. (1st)

1160—Branch, George, 21, Beauvoir Coll. Evg. Classes, clerk—Theory of Mus. (2d)

808—Brangwin, George W., 24, City of London Coll., clerk—Bkpg. (1st), with the second prize of £3.

988—Brantingham, William, 18, Manchester M.I., clerk—Bkpg. (3d)

788—Bray, William H., 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); and the second prize of £3 for hand-writing.

593—Brayshay, William A., 19, Leeds Ch. Inst., clerk—Arith. (3d)

1146—Brewer, Elizabeth J., 18, Penzance, pupil teacher—Arith. (3d); Eng. Lang. (2d)

1003—Briggs, Thouston, 18, Manchester M.I., bookkeeper—Arith. (3d)

463—Broadbent, Sykes, 20, Halifax W.M. Coll., warehouseman—Arith. (3d)

537—Broadhead, Charles K., 19, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)

464—Broadley, Arthur, 21, Halifax W.M. Coll., clerk—Eng. Hist. (2d); Met. Syst. (2d)

47—Brock, Joseph O., 21, Aldershot and Farnham District Board, soldier—Arith. (3d)

331—Brodie, Thomas, 28, Glasgow Ath., teacher—French (2d)

1250—Brodrick, Thomas, 16, Scarborough M.I., bookkeeper—Arith. (2d)

757—Brook, Edwin, 17, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

238—Brook, James, 26, Edinburgh Watt Inst. (no occupation stated)—Mus. Comp. (3d); Theory of Mus. (1st)

227—Brook, John W. T., 17, Devonport M.I., apprentice—French (3d)

741—Brook, Sydney R., 21, Birkbeck Lit. and Sci. Inst. (no occupation stated)—Mens. (3d)

1067—Brooks, John H., 17, Mossley M.I., clerk—Arith. (2d); Eng. Lang. (3d)

1011—Brooks, Samuel, 24, Manchester M.I., warehouseman—Arith. (2d); Eng. Lang. (2d)

986—Brooks, Thomas B., 19, Manchester M.I., clerk—Bkpg. (2d)

1008—Broster, George A. B., 21, Manchester M.I., clerk—Arith. (1st); Eng. Lang. (1st)

809—Brown, Patrick, 19, City of London Coll., clerk—French (3d)

489—Brown, Samuel B., 19, Haslingden M.I., ironmonger's apprentice—Eng. Hist. (3d)

1101—Brown, William A., 19, Oldham Lyceum, bookkeeper—Arith. (1st)

1289—Brownsword, John, 20, Stockport Sunday Sch. Imp. Soc., clerk—Arith. (3d)

193—Broxup, James, 30, Burnley M.I., mechanic—German (3d)

724—Bruce, Frank, 20, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

1198—Brydon, William, 25, Salford W.M. Coll., salesman—Bkpg. (3d)

2—Buchanan, Dalziel R., 16, Aberdeen M.I., clerk—Eng. Lang. (3d)

207—Buckley, Michael P., 26, Cork Catholic Young Men's Soc., clerk—Bkpg. (2d)

1174—Burgess, Henry T., 19, Beauvoir Coll. Evg. Classes, clerk—Theory of Mus. (3d)

1175—Burgess, John W., 23, Beauvoir Coll. Evg. Classes, clerk—Theory of Mus (3d)

1185—Burgin, Benjamin, 25, Rotherham Lit. and M.I., metal stamper—Theory of Mus. (1st)

811—Burnett, David, 21, City of London Coll., clerk—Pol. Econ. (2d)

727—Burnett, Harriett S., 22, Birkbeck Lit. and Sci. Inst., schoolmistress—Arith. (2d); French (3d)

812—Burton, George J. W., 21, City of London Coll., clerk—Arith. (2d); Bkgp. (2d); French (3d)

1138—Butler, George, 20, Pembroke Dock M.I., shipwright apprentice—Met. Syst. (2d)

571—Butler, Joseph R., 31, Ipswich W.M. Coll., clerk Arith. (2d)

328—Byers, Alexander, 23, Glasgow Ath., colourist—French (3d)

1—Calder, David, 18, Aberdeen M.I. clerk—Arith. (2d); Eng. Lang. (2d)

355—Calder, James, 21, Glasgow M.I., clerk—Bkpg. (2d)

526—Calvard, Frederick, 16, Hull Young People's Chr. and Lit. Inst., engine fitter—Arith. (3d)

262—Campbell, John, 17, Glasgow And. Univ. Pop. Evg. Classes, clerk in measurer's office—Mus. Comp. (2d); Theory of Mus. (1st)

263—Campbell, Timothy L., 29, Glasgow And. Univ. Pop. Evg. Classes, japanner—Mus. Comp. (1st), with 1st prize of £5

134—Carfield, Luke, 26, Birmingham and Mid. Inst., musician—Theory of Mus. (1st)

508—Carney, John, 29, Hulme W.M. Inst., maker-up—Bkpg. (3d)

908*—Carpenter, George, 27, City of London Coll., clerk—Bkpg. (2d)

533—Carter, Fred, 23, Hull Young People's Chr. and Lit. Inst., grocer's assistant—Bkpg. (2d)

813—Carter, William D. C., 26, City of London Coll., clerk—Pol. Econ. (3d)

928—Cattermole, Agnes E., 23, Royal Polytechnic Inst., governess—German (3d)

751—Chaloner, Arthur B., 19, Birkbeck Lit. and Sci. Inst., glass salesman—Arith. (3d)

780—Chapman, Annie, 35, Birkbeck Lit. and Sci. Inst., governess—German (1st); French (2d)

1176—Chapple, George J., 27, Beauvoir Coll. Evg. Classes, builder—Theory of Mus. (1st)

264—Chisholm, James, 36, Glasgow And. Univ. Pop. Evg. Classes, bookseller's assistant—Mus. Comp. (2d)

379—Chisholm, James, 21, Glasgow M.I., clerk—German (2d)

324—Chisholm, James W., 21, Glasgow Ath., clerk—French (3d)

1264—Christian, Gilbert A. 17, Stamford (St. Martin's Sch. of Art), pupil teacher—Eng. Hist. (1st); Eng. Lang. (1st); Geog. (2d)

511—Clapham, Robert, 23, Hulme W.M. Inst., gardener, Bkpg. (3d)

1202—Clare, George, 16, Salford W.M. Coll., clerk—Arith. (1st); Bkpg. (1st); Met. Syst. (2d)

535—Clark, Alfred H., 22, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st.)

1201—Clark, Ernest C., 16, Salford W.M. Coll., clerk—Arith. (3d)

815—Clark, Frederic, 30, City of London Coll., in Civil Service—Bkpg. (2d)

816—Clark, William H., 23, City of London Coll., clerk—Eng. Lang. (3d); Com. French (1st)

1200—Clarke, Albert, 19, Salford W.M. Coll., house-decorator—Arith. (1st); Bkpg. (1st); Met. Syst. (3d).

60—Clarke, David J., 16, Aldershot and Farnham District Board (no occupation stated)—Arith. (2d); Geog. (3d)

818—Clarke, Ebenezer, 21, City of London Coll., clerk—Arith. (1st); Pol. Econ. (1st)

107—Clarke, James McF., 16, Bolton Ch. Inst., farmer—Arith. (2d)

1199—Clarke, Thomas R., 20, Salford W.M. Coll., clerk—Bkpg. (1st), with the first prize of £5; Eng. Lang. (1st)

546—Clarke, William M., 19, Ipswich W.M. Coll., clerk—Bkpg. (2d)

819—Clatworthy, Abraham, 25, City of London Coll., in Civil Service—Arith. (1st); French (3rd); Geog. (2d)

490—Clay, John, 18, Hebden Bridge M.I., warehouseman—Latin (2d)

1004—Clift, Charles E., 21, Manchester M.I., clerk—French (3d)

1320—Clough, John, 17, York Inst. of Pop. Sci., clerk—Eng. Hist. (1st); Eng. Lang. (2d); Mens. (3d)

265—Cochran, John, 35, Glasgow And. Univ. Pop. Evg. Classes, warehouseman—Mus. Comp. (3d)

822—Colegrave, Philip B., 22, City of London Coll., clerk—Bkpg. (3d)

1204—Collinge, Harriet, 17, Salford W.M. Coll., pupil teacher—Arith. (2d)

586—Columbine, Bennett F., 16, Leeds Ch. Inst., pupil teacher—Eng. Lang. (3d)

376—Conner, James, 18, Glasgow M.I., engineer—Arith. (3d)

1144—Cook, Albert A., 18, Penzance, clerk—Bkpg. (3d)

824—Cook, Charles C., 22, City of London Coll., clerk—French (2d); Com. French (1st)

588—Cooper, Alfred, 25, Leeds Ch. Inst., clerk—Bkpg. (3d)

1247—Cooper, Charles E., 18, Salford W.M. Coll., mill overlooker—Arith. (2nd)

570—Cooper, Charles H., 18, Ipswich W.M. Coll., clerk—Bkpg. (3d)

1336—Cooper, Samuel, 16, New Mills M.I., pupil teacher—Arith. (2d); Eng. Hist. (3d)

556—Cooper, William G., 16, Ipswich W.M. Coll., clerk—Bkpg. (3d)

779—Corcoran, John, 20, Birkbeck Lit. and Sci. Inst., engineer—Eng. Lang. (1st)

825—Cornell, John J., 19, City of London Coll., clerk—Bkpg. (2d)

1300—Corscadden, John, 24, Wakefield M.I., mat-maker—Arith. (2d)

941—Cosier, Elizabeth, 29, Royal Polytechnic Inst. (no occupation stated—German (3d)

923—Cosier, Jane, Royal Polytechnic Inst. (no occupation stated)—French (3d)

568—Cotton, John A., 19, Ipswich W.M. Coll., clerk—French (3d)

826—Courthorpe, Edward K., 22, City of London Coll. (no occupation stated)—Arith. (1st); Bkpg. (1st); French (3d); Spanish (1st), with the first prize of £5

1184—Coward, Henry, 22, Rotherham Lit. and M.I., spring knife cutter—Theory of Mus. (2d)

1074—Cowell, Charles, 23, Newcastle-on-Tyne Ch. Inst., clerk—Arith. (3d); Bkpg. (3d)

135—Cowell, John S. 20, Birmingham and Mid. Inst., draper's assistant—Arith. (3d)

745—Cownden, Charles, 23, Birkbeck Lit. and Sci. Inst., collector—German (2d)

827—[illegible]nley, Francis L., 19, City of London Coll., clerk—German (3d)

450—Coyle, Edward, 20, Glasgow Young Men's Soc. for Religious Improvement, bootmaker—Logic (3d)

1123—Cozens, James, 18, Pembroke Dock M.I., shipwright apprentice—Arith. (1st)

456—Crabtree, Frank, 20, Halifax M.I., clerk—Arith. (3d)

362—Craig, Thomas, 16, Glasgow M.I., draper—Bkpg. (3d)

692—Craine, George, 17, Liverpool Inst., clerk—Eng. Hist. (2d)

382—Crawford, Thomas, 21, Glasgow M.I., clerk—German (2d)

744—Crawte, George F., 30, Birkbeck Lit. and Sci. Inst., clerk—Theory of Mus. (2d)

702—Creak, George, 25, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)

926—Crocker, Charles J., 18, Royal Polytechnic Inst., pupil teacher—Arith. (1st); Eng. Hist. (2d); Eng. Lang. (2d); Geog. (2d)

934—Crocker, William H., 16, Royal Polytechnic Inst., clerk—Bkpg. (3d)

1057—Crockford, William, 40, Manchester M.I., teacher—French (3d)

828—Crompton, William P., 23, City of London Coll., clerk—Bkpg. (1st)

503—Crook, Benjamin, 21, Huddersfield M.I., articled clerk—French (2d)

136—Cross, William J., 19, Birmingham and Mid. Inst., cabinet, gun and pistol case maker—Latin (2d)

54—Crossley, Arthur, 19, Aldershot and Farnham District Board, soldier—Eng. Lang. (3d)

781—Crowest, Albert H., 23, Birkbeck Lit. and Sci. Inst., clerk—Theory of Mus. (2d)

763—Crump, Charles, H., 24, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (3d)

465—Cundall, Robert T., 18, Halifax W.M. Coll., weaver—Arith. (3d)

314—Cunningham, John R., 23, Glasgow Ath., clerk—Logic (3d); Eng. Hist. (1st); Eng. Lang. (2d)

67—Cunningham, John W., 16, Aldershot and Farnham District Board, soldier—Arith. (2d)

365—Currie, Duncan, 20, Glasgow M.I., clerk—Bkpg. (2d)

1080—Cuthbertson, John, 19, Newcastle-on-Tyne Excelsior Temperance Class, clerk—Eng. Lang. (3d)

69*—Dadswell, George T. 20, Aldershot and Farnham District Board, clerk—Eng. Hist. (1st); French (3d)

346—Dale, Marian, 21, Glasgow Ath. (no occupation stated)—French (1st)

830—Dalton, Alfred, 25, City of London Coll., clerk—Bkpg. (1st)

1205—Daly, John, 18, Salford W.M. Coll., clerk—Arith. (2nd)

1301—Darley, George S., 17, Wakefield M.I., clerk—Arith. (3d)

1161—Dash, Samuel, 25, Beauvoir Coll. Evg. Classes, warehouseman—Mus. Comp. (1st) with second prize of £3; Theory of Mus. (1st)

1001—Davenport, Frank, 19, Manchester M.I., draughtsman's apprentice—Logic (3d); Dom. Econ. (2d); Met. Syst. (2d)

31—Davidson, William, 26, Aberdeen M.I., clerk—Eng. Lang. (3d)

1026—Davies, Joe, 16, Manchester M.I., office boy—Eng. Hist. (1st)

1137—Davies, Joseph, 17, Pembroke Dock M.I., shipwright apprentice—Arith. (1st)

1016—Davies, Thomas A., 18, Manchester M.I., clerk—Bkpg. (2d)

1043—Davies, Thomas W., 18, Manchester M.I., clerk—Logic (3d); Dom. Econ. (2d); Eng. Lang. (1st); Geog. (2d)

831—Davis, Edward J., 22, City of London Coll., clerk—Arith. (1st); French (3d); and the fourth prize of £1 for Handwriting.

407—Dawson, James, 16, Glasgow M.I., pupil teacher—Arith. (1st)

501—Dean, Henry, 24, Huddersfield M.I., draper—French (3d)

979—Derbyshire, Lea, 20, Macclesfield Soc. for the Acquirement of Useful Knowledge, silk warehouseman—Arith. (3d)

389—Dick, Frank W., 18, Glasgow M.I., engineer—Arith. (3d)

307—Dickie, Andrew B., 20, Glasgow Ath., teacher—Logic (3d)

267—Dickson, Donald W., 20, Glasgow And. Univ. Pop. Evg. Classes, clerk—Arith. (3d); Bkpg. (3d)

693—Dickson, Humphrey C., 18, Liverpool Inst., clerk—Eng. Lang. (2d); Mens. (3d)

1186—Dix, William P., 18, Rotherham Lit. and M.I., clerk—Bkpg. (2d)

1082—Dixon, Joseph, 26, Newcastle-on-Tyne Excelsior Temperance Class, clerk—Arith. (1st); Eng. Hist. (1st); Eng. Lang. (1st); Geog. (2d)

1304—Dixon, Joseph, 21, Walsall Ch. Inst., clerk—Met. Syst. (1st)

204—Dobson, Thomas H., 20, Carlisle M.I., railway clerk—Arith. (1st)

1029—Dodgson, William, 26, Manchester M.I., civil and mechanical engineer—Mens. (1st), with second prize of £3

342—Donald, George, 23, Glasgow Ath., teacher—French (3d)

361—Donald, John, 17, Glasgow M.I., clerk—Bkpg. (3d)

268—Donaldson, James, 25, Glasgow And. Univ. Pop. Evg. Classes, warehouseman—Theory of Mus. (2d)

1335—Donkersley, Joe, 17, Lockwood M.I., clerk—Arith. (3d); Eng. Hist. (3d)

580—Doughty, Thomas J., 17, Leeds Ch. Inst., pupil teacher—Arith. (2d); Eng. Hist. (3d); Eng. Lang. (3d)

445—Dove, Ebenezer, 21, Glasgow Young Men's Soc. for Religious Improvement, clerk—Logic (3d)

466—Downsborough, Julian, 16, Halifax W.M. Coll., clerk—Arith. (2d)

956—Draeger, Arthur, 20, Royal Polytechnic Inst., clerk—German (3d); Eng. Lang. (3d)

573*-Drummond, Frank C., 17, Ipswich W.M. Coll., clerk—Eng. Hist. (2d)

387—Drummond, Robert, 19, Glasgow M.I., clerk—Eng. Lang. (3d)

231—Dudley, Joseph H., 20, Dudley M.I., clerk—Bkpg. (3d)

717—Duncan, Malcolm W., 16, Birkbeck Lit. and Sci. Inst., clerk—Eng. Hist. (2d)

995—Dunch, George, 18, Manchester M.I., clerk—Eng. Hist. (2d); Eng. Lang. (3d)

381—Dunlop, James, 20, Glasgow M.I., engineer—Arith. (1st); Met. Syst. (2d); Mens. (1st)

356—Dunlop, Peter, 21, Glasgow M.I., mechanical draughtsman—Bkpg. (3d)

15—Durie, James, 19, Aberdeen M.I., engine fitter—Eng. Hist. (2d); Eng. Lang. (2d)

46—Dyer, Thomas, 19, Aldershot and Farnham District Board, soldier—Arith. (3d); Bkpg. (3d)

1207—Earl, Arthur, 17, Salford W.M. Coll., clerk—Bkpg. (1st)

467—Eastwood, Edward, 19, Halifax W.M. Coll, wool sorter—Bkpg. (2d)

1208—Edmeston, Alfred, 20, Salford W.M. Coll., draughtsman—Arith. (2d)

138—Edmonds, Edward, 21, Birmingham and Mid. Inst., electro depositor—Italian (1st), with first prize of £5; French (1st), with first prize of £5

774—Edrupt, Richard W., 17, Birkbeck Lit. and Sci. Inst., clerk—Geog. (3d), and the third prize of £2 for handwriting

956*-Edrupt, Richard W., 17, Royal Polytechnic Inst., clerk—Arith. (3d)

3—Edwards, David, 16, Aberdeen M.I., clerk—Eng. Lang. (2d)

82—Edwards, John W., 21, Bacup M.I., carder—Arith. (3d)

673—Egan, William M., 19, Liverpool Inst., clerk—Bkpg. (3d)

796—Eldridge, William, 22, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

1091—Elliott, Philip A., 21, New Swindon M.I., engine fitter—Arith. (2d)

392—Elliott, William, 25, Glasgow M.I., warehouseman—Eng. Lang. (3d)

965—Ellis, George W., 18, St. Stephen's Evg. Sch., Westminster, clerk—Arith. (3d)

197—Ellwood, Joseph, 18, Carlisle M.I., student—Arith. (2d)

523—Embley, Matthew H., 16, Hull Young People's Chr. and Lit. Inst., pupil teacher—Eng. Lang. (3d)

971—Evans, Alice, 26, Walworth Lit. and Sci. Inst., schoolmistress—French (3d)

436—Fairley, William G., 21, Glasgow M.I., salesman—Eng. Lang. (3d)

124—Farnworth, Eli, 19, Bolton M.I., packer—Arith. (3d)

1209—Farnworth, Joshua H., 18, Salford W.M. Coll., warehouseman—Arith. (1st); Met. Syst. (2d)

606—Fawcett, Alfred, 23, Leeds Young Men's Chr. Assoc., mechanic—Arith. (3d); Met. Syst. (3d); Mens. (3d)

1319—Fawcett, John, 23, York Inst. of Pop. Sci., clerk—Arith. (2d)

567—Fawkes, Frank A., 23, Ipswich W.M. Coll., clerk—Theory of Mus. (1st); Pol. Econ. (2d)

202—Fazackerley, William, 17, Carlisle M.I., railway clerk—Arith. (1st); Eng. Hist. (1st)

793—Fenn, Henry E., 21, Birkbeck Lit. and Sci. Inst., reporter—Eng. Lang. (3d)

32—Fenton, Henry, 38, Accrington M.I., warehouseman—Eng. Lang. (3d)

177—Fielding, John, 24, Bradford M.I., book-keeper—Bkpg. (2d)

248—Finlay, David G., 18, Edinburgh Watt Inst., pupil teacher—Arith. (2d); Eng. Lang. (3d)

700—Fish, William D., 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st); Eng. Lang. (2d); Geog. (1st)

1179—Fisher, Henry, 26, Avenham M.I. (Preston), teacher of music—Mus. Comp. (2)

1169—Fisk. Francis C., 24, Beauvoir Coll. Evg. Classes, printer—Theory of Mus. (2d)

961—Fitzgerald, John, 16, St. Stephen's Evg. Sch., Westminster, in Inland revenue—Arith. (1st)

833—Fleck, Henry, 16, City of London Coll., clerk—French (3d)

759—Flegg, Robert, 21, Birkbeck Lit. and Sci. Inst., clerk—Arith. (2d); Eng. Hist. (2d); Met. Syst. (3d); Geog. (2d)

794—Flegg, Thomas, 16, Birkbeck Lit. and Sci. Inst., law-clerk—Arith. (2d)

1254—Fletcher, George H., 16, Scarborough M.I., stationer—Arith. (3d)

834—Fletcher, Joseph, 18, City of London Coll., clerk—French (1st)

1308—Fletcher, Mary S., 22, Walsall Ch. Inst. (no occupation stated)—German (1st); Eng. Hist. (1st); Eng. Lang. (1st)

835—Fletcher, William W., 16, City of London Coll., clerk—French (3d)

337—Forgie, James T., 16, Glasgow Ath., engineer—Arith. (1st); Mens. (3d)

933—Fossey, Mary, 24, Royal Polytechnic Inst., governess—German (1st)

1252—Fox, Charles J., 16, Scarborough M.I., engineer—Arith. (3d)

78—Fox, John, 20, Ashford M.I., turner—Arith. (3d)

313—Fraser, Harry, 18, Glasgow Ath., clerk—French (2d)
935—Freeman, David, 22, Royal Polytechnic Inst., clerk—Arith. (1st); Bkpg. (2d)
948—Frisby, George, 18. Royal Polytechnic Inst., clerk—Arith. (2d); Bkpg. (2d); Eng. Lang. (3d)
959—Fulkes, George J., 17, St. Stephen's Evg. Sch., Westminster, pupil teacher—Eng. Hist. (2d); Met. Syst. (3d); Geog. (2d)
836—Fulton, Gabriel, 21, City of London Coll., clerk—French (3d)
322—Fyfe, Leander M., 17. Glasgow Ath., student—Arith. (2d); Eng. Hist. (1st); Pol. Econ. (3d)

623—Garnett, Robert, 27, Leeds Young Men's Chr. Assoc., clerk—Bkpg. (1st)
558—Garnham, James, 17, Ipswich W. M. Coll., clerk—Bkpg. (3d)
707—Garrett, George W., 29, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (3d)
837—Garrett, George W., 29, City of London Coll., clerk—Bkpg. (1st)
553—Garrod, Philander N., 16, Ipswich W.M. Coll., clerk—Bkpg. (3d)
116—Gass, John B., 17, Bolton M.I., architect's pupil—Dom. Econ. (2d); Eng. Lang. (3d)
1140—George, John, 17, Pembroke Dock M.I., shipwright apprentice—Met. Syst. (2d)
756—George, Rowland T., 16, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d)
1292—Gething, James M., 20, Stourbridge Ch. of Eng. Inst., clerk—Arith. (3d)
1035—Gibson, Alexander, 18, Manchester M.I., draughtsman—Met. Syst. (1st), with first prize of £5; Geog. (1st), with second prize of £3.
538—Gibson, Edward, 23, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
975—Gibson, William J., 18, King's Lynn Ath., pupil teacher—Arith. (3d)
226—Gill, Edward J., 22, Devonport M.I., clerk—Arith. (1st)
513—Gleadow, Robert, 18, Hull Ch. Inst., railway clerk—Bkpg. (3d)
998—Gledhill, James, 18, Manchester M.I., assistant book-keeper—Arith. (3d)
421—Glen, Alexander, 17, Glasgow M.I., clerk—Eng. Lang. (3d)
840—Glenn, Walter W., 21, City of London Coll., clerk—Arith (3d); Bkpg. (2d)
718—Godard, John G., 19, Birkbeck Lit. and Sci. Inst., shorthand clerk—French (2d)
716—Godwin, John, 18. Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d)
697—Gooch, Frederick W., 23, Birkbeck Lit. and Sci. Inst., clerk—Eng. Hist. (1st); Eng. Lang. (1st); Geog. (2d)
140—Goode, Frank B., 19, Birmingham and Mid. Inst., pupil teacher—Arith. (1st); Geog. (1st)
583—Gordon, John, 17. Leeds Ch. Inst., clerk—Arith. (1st); French (3d)
128—Goulding, Samuel. 26, Bolton M.I., cloth-finisher—Arith. (3d); Bkpg. (3d)
243—Graham, George S., 18, Edinburgh Watt Inst., railway clerk—Arith. (2d)
347—Granger, John, 22. Glasgow Ath., railway clerk—Eng. Lang. (2d)
684—Grant, James, 17, Liverpool Inst., clerk—Arith. (2d)
390—Gray. Andrew, 24, Glasgow M.I., stonemason—Mens. (2d)
393—Gray. Henry M., 22, Glasgow M.I., clerk—French (3d)
520—Gray. John, 25, Hull Young People's Chr. and Lit. Inst., gardener—Floriculture (2d); Fruit and Vegetable Culture (1st)
499—Green, John T., 16, Huddersfield M.I., clerk—Eng. Lang. (3d)
1041—Green, William E., 22, Manchester M.I., watchmaker—Eng. Lang. (3d); Geog. (3d)
1106—Greenlees, Robert, 25, Paisley Artisan's Inst., salesman—Mus. Comp. (1st); Theory of Mus. (1st)
492—Greenwood, Stansfield, 17, Hebden Bridge M.I., shopman—Geog. (3d)
99—Greenwood, Wilson, 21, Bacup M.I., mule-spinner—Arith. (2d); Mens. (3d)
141—Gregory, Alfred T., 19, Birmingham and Mid. Inst., stationer—Eng. Hist. (1st), with first prize of £5; Eng. Lang. (1st), with first prize of £5.
53—Griffith, Arthur, 22, Aldershot and Farnham District Board, soldier—Arith. (1st); Eng. Hist. (2d); Eng. Lang. (3d); Geog. (3d)
1010—Griffith, William E., 16, Manchester M.I., clerk—Arith. (3d)
1139—Griffiths, David, 16, Pembroke Dock M.I., pupil teacher—Arith. (1st); Geog. (3d)
1163—Griffiths, Laura M., 20, Beauvoir Coll. Evg Classes, clerk—Theory of Mus. (2d)
1058—Grimes, John, 22, Manchester M.I., in local rates office—Bkpg. (2d)
596—Grimshaw, Henry, 22, Leeds M.I., clothmaker—Theory of Mus. (2d)
841—Groocock, Edwin, 18, City of London Coll., surveyor—Arith. (2d); Mens. (3d)
142—Grundy, Harriette, 25, Birmingham and Mid. Inst., teacher—Eng. Lang. (1st)
1042—Grundy, James E., 18, Manchester M.I., warehouseman—Bkpg. (3d)

345—Haddow, George, 19, Glasgow Ath., clerk—French (3d)
791—Haddow, James T., 17, Birkbeck Lit. and Sci. Inst., clerk—German (2d); French (2d)
626—Haigh, John W., 19, Leeds Young Men's Chr. Assoc., dispenser—Arith. (3d); Eng. Lang. (3d)
755—Hailes, Walter T., 19, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Geog. (2nd)
720—Hale, John W., 17, Birkbeck Lit. and Sci. Inst., clerk—French (2d)
433—Hall, Charles S., 18, Glasgow M.I., clerk—Latin (2d)
43—Halloran, Thomas, 25, Aldershot and Farnham District Board, soldier—Eng. Hist. (1st); Eng. Lang. (3d); Mens. (2d)
194—Halstead, Alfred, 19, Burnley M.I., cloth-looker—Eng. Hist. (2d); Eng. Lang. (2d)
185—Halstead, William, 20, Bradford M.I., clerk—Arith. (3d)
98—Hamer, Ralph T., 20, Bacup M.I., weaver—Arith. (2d)
1296—Hammond, Charles, 18, Stourbridge Ch. of Eng. Inst., pupil teacher—Arith. (3d)
1211—Hampson, Thomas, 19, Salford W.M. Coll., clerk—Bkpg. (3d)
550—Hancock, Arthur E., 18, Ipswich W.M. Coll., railway clerk—Bkpg. (3d)
325—Hardie, F. W., 19, Glasgow Ath., clerk—Com. French (1st); French (1st)
344—Hardie, Henry D., 19, Glasgow Ath., clerk—Com. French (1st)
540—Harding, John S. M., 19, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)
913—Harding, Rose, 20, Royal Polytechnic Inst., teacher—German (3d)
469—Harding, William H., 21, Halifax W.M. Coll., assistant manager—Bkpg. (3d)
315—Harley, Joan H., 22. Glasgow Ath. (no occupation stated)—French (2d)
210—Harris, Frank W., 19, Crewe M.I., engine-fitter—Arith. (3d)
761—Harris, Isidore, 18, Birkbeck Lit. and Sci. Inst., assistant traveller—Arith. (3d); Eng. Hist. (1st); Met. Syst. (3d); Latin (2d)

143—Harris, Sydney, 19, Birmingham and Mid Inst., factor's apprentice—German (3d)

721—Harrison, William C., 21, Birkbeck Lit. and Sci. Inst., clerk—French (3d)

528—Hartley, George, 17, Hull Young People's Chr. and Lit. Inst., pupil teacher—Arith. (3d); Eng. Lang. (3d)

787—Harvey, William A., 18, Birkbeck Lit. and Sci. Inst., writer C.S.C.—Eng. Hist. (1st); Eng. Lang. (2d); Geog. (3d)

1310—Harvey, William B., 41, Western Super-mare Albert Night Sch. and Industrial Inst., chemist—Mus. Comp. (3d)

144—Hathaway, Frederick, 26, Birmingham and Mid. Inst., clerk—Bkpg. (3d)

1107—Hattrick, Alexander, 27, Paisley Artisan's Inst., smith—Theory of Mus. (1st)

952—Hayward, Joseph, 20, Royal Polytechnic Inst., engineer—Eng. Hist. (2d); French (3d); Arith. (2d)

115—Heap, John R., 31, Bolton Ch. Inst., schoolmaster—Met. Syst. (3d)

111—Heaton, William H., 16, Bolton Ch. Inst. (no occupation stated)—Arith. (1st); Eng. Hist. (3d); French (3d)

714—Heelis, John L., 35, Birkbeck Lit. and Sci. Inst., publisher's assistant—Com. German (1st)

843—Hember, Robert G., 20, City of London Coll., clerk—Logic (2d)

1084—Hemiston, Mark, 24, Newcastle-on-Tyne Excelsior Temperance Class, clerk—Bkpg. (3d)

944—Henderson, David G., 26, Royal Polytechnic Inst., clerk—French (3d)

16—Henderson, John, 21, Aberdeen M.I., letter carrier—Eng. Lang. (3d)

316—Henderson, John, 20, Glasgow Ath., clerk—French (3d)

844—Henderson, John D., 16, City of London Coll. (no occupation stated)—Arith. (2d)

380—Henderson, Peter, 18, Glasgow M.I., clerk—Arith. (3d); Eng. Hist. (3d); Eng. Lang. (3d); Geog. (3d)

1265—Henshaw, Frederick, 17, Stamford (St. Martin's Sch. of Art), pupil teacher—Arith. (2d); Eng. Hist. (2d); Geog. (3d)

271—Hendry, Jeanie G., 19, Glasgow And. Univ. Pop. Evg. Classes (no occupation stated)—Theory of Mus. (2d)

622—Heward, Robert, 20, Leeds Young Men's Chr. Assoc., book-keeper—Bkpg. (3d)

747—Hewitt, Charles H., 25, Birkbeck Lit. and Sci. Inst., clerk—Mus. Comp. (3d); Theory of Mus. (1st), with second prize of £3

1071—Hewitt, James, 18, Newcastle-on-Tyne Ch. Inst., gardener—Arith. (3d)

587—Hewson, Thomas R., 17, Leeds Ch. Inst., pupil teacher—Arith. (3d); Eng. Lang. (2d)

455—Heyhurst, Phineas, 22, Halifax M.I., cabinet-maker—Mens. (2d)

1177—Heywood, John J., 21, Avenham M.I. (Preston), clerk—Met. Syst. (3d); Mens. (2d)

1178—Heywood, Thomas M., 17, Avenham M.I. (Preston), warehouseman—Arith. (2d)

617—Higgins, Alfred, 17, Leeds Young Men's Chr. Assoc., clerk—Arith. (3d)

619—Higgins, George H., 19, Leeds Young Men's Chr. Assoc., book-keeper—Arith. (1st); Eng. Hist. (3d); Eng. Lang. (3d)

710—Higson, John, 21, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

845—Hill, Arthur, 18, City of London Coll., clerk—Arith. (1st); Bkpg. (1st)

146—Hill, Elizabeth, 30, Birmingham and Mid. Inst., teacher—Eng. Lang. (3d)

770—Hill, Gilbert J., 17, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (3d)

687—Hill, Henry A., 19, Liverpool Inst., engineer—Arith. (2d); Geog. (3d)

974—Hillam, Arthur A., 18, King's Lynn Ath., pupil teacher—Arith. (1st)

147—Hirons, Charles A., 23, Birmingham and Mid. Inst., accountant's clerk—Bkpg. (3d)

846—Hislop, Edward, 19, City of London Coll., watchmaker and jeweller—Arith. (1st)

1331—Hobson, James, 23, Lockwood M.I., weaver—Arith. (2d)

912—Hodges, Matilda, 19, Royal Polytechnic Inst., teacher—German (3d)

1088—Hofield, John T., 23, New Swindon M.I., clerk—Bkpg. (1st)

987—Hogg, James, 26, Manchester M.I., mechanic—Arith. (2d); Dom. Econ. (1st), with the third prize of £2. Eng. Lang. (2d); Mens. (3d)

272—Hogg, Thomas, 28, Glasgow And. Univ. Pop. Evg. Classes, gardener—Floriculture (2d); Fruit and Veg. Culture (2d)

507—Hollingworth, Robert H., 16, Hulme W.M. Inst., accountant's clerk—Bkpg. (3d)

1108—Holmes, Matthew, 24, Paisley Artizan's Inst., pattern maker—Theory of Mus. (2d)

509—Holt, Charles W., 28, Hulme W.M. Inst., clerk—Bkpg. (1st)

848—Hopkins, James, 23, City of London Coll., teacher—Arith. (2d)

849—Hopwood, Edwin E., 19, City of London Coll., clerk—Bkpg. (2d)

541—Hornby, Henry, 26, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (3d)

273—Horne, Alexander, 22, Glasgow And. Univ. Pop. Evg. Classes, lithographic printer—Theory of Mus. (2d)

1215—Homer, Eliza M., 18, Salford W.M. Coll., pupil teacher—Arith. (3d)

1173—Hotine, Henry, 49, Beauvoir Coll. Evg. Classes, warehouseman—Theory of Mus. (1st); Mus. Comp. (3d)

676—Houghton, Rowland, 16, Liverpool Inst., apprentice—Bkpg. (3d)

686—Howarth, Mark, 18, Liverpool Inst., clerk—Arith. (3d); Bkpg. (3d)

274—Howat, David, 28, Glasgow And. Univ. Pop. Evg. Classes, compositor—Theory of Mus. (3d)

1187—Howe, John, 20, Rotherham Lit. and M.I., clerk—Bkpg. (1st)

1133—Howell, Edmund, 17, Pembroke Dock M.I., shipwright apprentice—Arith. (1st)

667—Howorth, Benjamin, 18, Liverpool Inst., accountant's apprentice—Eng. Lang. (1st)

460—Hoyle, Hadden, 16, Halifax M.I., clerk—German (3d)

521—Huggins, Charles, 23, Hull Young People's Chr. and Lit. Inst., gardener—Floriculture (2d), and Royal Horticultural Society's second prize of £3; Fruit and Vegetable Culture (1st), with second prize of £3, and the Royal Horticultural Society's second prize of £3.

1059*—Hughes, Joseph S., 23, Manchester M.I., clerk—Bkpg. (2d)

129—Hulton, Samuel, 29, Bolton M.I., cloth finisher—Bkpg. (3d)

190—Humphreys, Eugene H., 17, Bromsgrove Lit. and M.I., clerk—Eng. Hist. (1st)

850—Huntley, Frederick A., 16, City of London Coll., clerk—Arith. (3d)

647—Hutchins, Alfred, 19, Leicester W.M. College., printer—Eng. Lang. (3d)

239—Hutchinson, George, 21, Edinburgh Watt Inst., map engraver—Mus. Comp. (3d); Theory of Mus. (1st)

339—Hutchinson, Joseph H., 20, Glasgow Ath., clerk—Bkpg. (3d)

1126—Huzzey, William A., 17, Pembroke Dock M.I., pupil teacher—Arith. (1st); Eng. Lang. (1st)

1023—Ingham, John, 21, Manchester M.I., clerk—Arith. (2d), and the third prize of £1 for Writing and Manuscript Printing.

471—Ingham, William H., 20, Halifax W.M. Coll., overlooker—Bkpg. (3d)

457—Illingworth, Thomas, 22, Halifax M.I., mechanic—Eng. Hist. (3d)

1268—Isgrove, Edmund, 18, Stockport Sunday Sch. Imp Soc., clerk—Arith. (3d)

487—Isherwood, Robert, 18, Haslingden M.I., warehouseman—Arith. (3d)

1217—Jackson, John, 19, Salford W.M. Coll., clerk—Arith. (3d); Met. Syst. (2d)

1216—Jackson, Joseph R., 25, Salford W.M. Coll., clerk—Arith (1st)

428—Jacobs, William, 16, Glasgow M.I., clerk—French (2d)

768—Jakeman, Emily S. E., 27, Birkbeck Lit. and Sci. Inst., teacher—Met. Syst. (2d)

1309—James, Job, 21, Walsall Ch. Inst., clerk—Arith. (2d); Bkpg. (2d)

1122—James, John R., 19, Pembroke Dock M.I., shipwright apprentice—Arith. (1st); Met. Syst. (2d); Mens. (2d)

767—Jarrett, Edward, 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

683—Jarvis, Christopher, 18 Liverpool Inst., messenger at Dock office—Arith. (3d)

1129—Jenkins, Philip, 18, Pembroke Dock M.I., shipwright apprentice—Mens. (1st)

1164—Jesseman, Emanuel, 23, Beauvoir Coll. Evg. Classes, teacher—Theory of Mus. (3d)

762—Jewell, Thomas O., 30, Birkbeck Lit. and Sci. Inst., warehouseman—Bkpg. (3d)

854—Johnson, Cornelius, 29, City of London Coll., clerk—Bkpg. (2d)

855—Johnson, Edwin E., 19, City of London Coll., clerk—Logic (3d); Bkpg. (3d); Met. Syst. (3d)

1287—Johnson, James H., 16, Stockport Sunday School Imp. Soc., mechanics' apprentice—Met. Syst. (3d)

148—Johnson, Marion, 22, Birmingham and Mid. Inst., teacher—French (3d)

659—Johnson, William, 21, Leicester W.M. Coll., warehouseman—French (3d)

120—Johnston, James, 18, Bolton M.I., warehouseman—Geog. (3d)

1007—Johnston, William, 21, Manchester M.I., book-keeper—Arith. (1st); Eng. Lang. (2d)

353—Johnstone, David, 19, Glasgow M.I., designer—Mus. Comp. (2d)

1166—Jones, Daniel B., 31, Beauvoir Coll. Evg. Classes, music teacher—Theory of Mus. (1st)

1219—Jones, Edwin, 17, Salford W.M. Coll., clerk—Arith. (2d); Bkpg. (2d); Met. Syst. (3d)

149—Jones, Henry F., 28, Birmingham and Mid. Inst., die-sinker—Arith. (3d)

1124—Jones, John, 18, Pembroke Dock M.I., shipwright apprentice—Arith. (3d)

1182—Jones, John, 21, Richmond Parochial Library, gardener—Floriculture (1st); Fruit and Veg. Culture (1st), with the first prize of £5, and the Royal Horticultural Society's first prize of £5 in each subject.

925—Jones, Robert, 17, Royal Polytechnic Inst., pupil teacher—Arith. (2d); Geog. (3d)

1044—Jones, Robert, 22, Manchester M.I., warehouseman—Arith. (2d); Bkpg. (2d)

1218—Jones, Thomas, 28, Salford W.M., Coll., photo-instrument maker—Arith. (1st); Bkpg. (1st); Met. Syst. (1st); Mens. (2d)

102—Jones, William, 23, Bollington Useful Knowledge Soc., cotton-spinner—Arith. (3d)

663—Jones, William, 24, Liverpool Inst., gardener—Dom. Econ. (3d); Fruit and Veg. Culture (1st)

1220—Kay, Herbert, 19, Salford W.M., Coll., clerk—Bkpg (1st)

857—Kebbell, Edward, 18, City of London Coll., clerk—Arith. (2d)

1019—Kean, Thomas, 20, Manchester M.I., clerk—Arith. (2d); Bkpg. (1st)

75—Keene, James G., 17, Ashford M.I., railway accountant's clerk—Arith. (3d)

1253—Keld, James, 16, Scarborough M.I., book-keeper—Arith. (2d)

604—Kemp, James V., 21, Leeds Young Men's Chr. Assoc., cloth finisher—Eng. Lang. (1st)

1079—Kenmir, George, 21, Newcastle-on Tyne Excelsior Temperance Class, compositor—Eng. Lang. (3d)

858—Kenchington, Mark, 22, City of London Coll., clerk—French (3d)

275—Kerr, James H., 29, Glasgow And. Univ. Pop. Evg. Classes, goldsmith—Theory of Mus. (2d)

860—Kerr, William R., 19, City of London Coll., clerk—Arith. (1st); Eng. Lang. (1st) with the second prize of £3; Mens. (3d) and the third prize of £1 for Writing from Dictation, and the first prize of £5 for Handwriting.

1181—King, Benjamin G., 24, Richmond Parochial Library, book-keeper—Bkpg. (1st)

405—Knox, Robert, 21, Glasgow M.I., clerk—Bkpg. (3d)

1326—Lake, Edward, 18, York Inst. of Pop. Sci., clerk—Arith. (1st)

33—Lang, Benjamin, 19, Accrington M.I., railway goods clerk—Arith. (2d)

955—Larke, Arthur, 22, Royal Polytechnic Inst., clerk—Met. Syst. (3d); Mens. (2d)

957—Larkman, Emily T., 26, Royal Polytechnic Inst., governess—German (3d)

250—Laudale, Isabella, 25, Edinbugh Watt Inst. (no occupation stated)—French (3d)

711—Laurence, Julia, 18, Birkbeck Lit. and Sci. Inst. (no occupation stated)—Bkpg. (3d)

968—Laurie, James A., 17, St. Stephen's Evg. Sch., Westminster, pianoforte case maker—Eng. Hist. (3d); Geog. (3d)

1246—Law, Edwin, 26, Salford W.M. Coll., clerk—Eng. Hist. (1st)

485—Law, John, 20, Haslingden M.I., warehouseman Arith. (3d)

472—Lawrence, Frank, 17, Halifax W.M. Coll., broker's assistant – Arith. (3d)

1135—Lawrence, John, 16, Pembroke Dock M.I., clerk—Arith. (2d)

352—Lawrie, Thomas, 17, Glasgow Ath., clerk—French (3d)

1061—Lawton, Fred, 21, Mossley M.I., spinner—Arith. (2d); Bkpg. (3d)

1109—Lee, Charles H., 20, Paisley Artisans' Inst., clerk—Arith. (2d); Mens. (3d)

1334—Lee, Fred, 16, Lockwood M.I., clerk—Arith. (3d); Eng. Hist. (3d)

1303—Lees, Ebenezer A., 18, Walsall Ch. Inst., clerk—French (2d)

1224—Lever, William F., 23, Salford W.M. Coll., umbrella maker—Arith. (2d)

62—Libby, Henry, 23, Aldershot and Farnham District Board, musician—Arith. (1st)

276—Lillie, John, 24, Glasgow And. Univ. Pop. Evg. Classes, clerk—Mus. Comp. (2d); Theory of Mus. (2d)

19—Lindsay, John, 17, Aberdeen M.I., clerk—Arith. (2d); Geog. (2d)

151—Livesey, Marion, 21, Birmingham and Mid. Inst., pupil teacher—Eng. Lang. (3d)

864—Lloyd, Charles E., 24, City of London Coll., clerk—Spanish (1st), with the second prize of £3.

670—Lloyd, David H., 17, Liverpool Inst., clerk—Bkpg. (3d)

678—Lloyd, Edward, 17, Liverpool Inst., clerk—Bkpg. (3d)

25—Lobban, Margaret, 17, Aberdeen M.I., governess—French (3d)

86—Lomax, Zeno, 16, Bacup M.I., pupil teacher—Arith. (2d); Geog. (3d)
92—Lord, Edward S., 16, Bacup M.I., letter press printer—Arith. (3d)
1222—Lowe, James, 19, Salford W.M. Coll., clerk—Bkpg. (3d)
561—Lowe, Marshall H., 16, Ipswich W.M. Coll., reporter—Eng. Lang. (2d)
703—Lowrie, Augustus F., 26, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)
1223—Lucas, John E., 18, Salford W.M. Coll., clerk—Latin (2d)
358—Lyle, David M., 30, Glasgow M.I., clerk—German (2d)
674—Lynas, Joseph, 18, Liverpool Inst., clerk—Bkpg. (2d)
473—Lynch, William, 23, Halifax W.M. Coll., warehouseman—Eng. Lang. (3d)

320—Macarthur, John, 30, Glasgow Ath., teacher—French (3d)
451—Macarthur, John, 30, Glasgow Young Men's Soc. for Religious Improvement, teacher—Logic (3d)
349—McAlpine, John, 21, Glasgow Ath., warehouseman—Logic (1st), with first prize of £5; Bkpg. (2d); Met. Sys. (2d); Mens. (2d)
432—McCance, John, 17, Glasgow M.I., clerk—Latin (3d)
208—McCarthy, Edward V., 17, Cork Catholic Young Men's Soc., clerk—Logic (3d)
695—McCay, Thomas C., 18, Liverpool Inst., clerk—Arith. (1st); Mens. (3d)
255—McCloyd, Robert, 20, Gilford (Co. Down, Ireland) Young Men's Mut. Imp. Soc., book-keeper—Bkpg. (3d)
278—McCormack, John, 23, Glasgow And. Univ. Pop. Evg. Classes, clerk—Mus. Comp. (2d); Theory of Mus. (1st)
795—McCormack, John, 18, Birkbeck Lit. and Sci. Inst., camera maker—Arith. (3d)
440—McCowan, Daniel, 17, Glasgow M.I., clerk—Bkpg. (3d)
424—McCoy, James A., 19, Glasgow M.I., engineer—Eng. Lang. (3d)
403—McCrindle, James, 16, Glasgow M.I., clerk—Arith. (2d)
363—McCutchion, Andrew, 16, Glasgow M.I., clerk—Bkpg. (2d)
413—McDermid, William, 20, Glasgow M.I., tailor—Eng. Lang. (3d)
404—MacDonald, John, 16, Glasgow M.I., clerk—Arith. (3d)
742—McDonnell, Denis, 20, Birkbeck Lit. and Sci. Inst., clerk—Theory of Mus. (1st)
279—McDougall, William H., 21, Glasgow And. Univ. Pop. Evg. Classes, book-keeper—Bkpg. (3d)
308—McFadyean, George, 17, Glasgow Ath., warehouseman—French (3d)
1110—Macfarlane, Peter, 26, Paisley Artisans' Inst., water inspector—Theory of Mus. (1st)
338—McFarlane, William, 19, Glasgow Ath., clerk—Bkpg. (3d)
378—McGilchrist, Peter C., 17, Glasgow M.I., clerk—Bkpg. (3d)
280—McInnes, John, 17, Glasgow And. Univ. Pop. Evg. Classes, pupil teacher—Arith. (1st); Eng. Lang. (3d)
281—McKay, Alexander, 37, Glasgow And. Univ. Pop. Evg. Classes, cloth lapper—Theory of Mus. (2d)
10—McKay, George M., 17, Aberdeen M.I., pupil teacher—Eng. Lang. (2d)
545*—McKay, George P., 18, Hull Young People's Chr. and Lit. Inst., civil service writer—Arith. (1st)
1327—McKecknie, Alexander, 21, York Inst. of Pop. Sci., clerk—Arith. (1st)
1134—Macken, Arthur, 16, Pembroke Dock M.I., pupil teacher—Arith. (1st); Geog. (2d)
1081—McKendrick, William, 24, Newcastle-on-Tyne Excelsior Temperance Class, clerk—Mus. Comp. (2d)
1148—MacKenzie, Alexander, 41, Beauvoir Coll. Evg. Classes, clerk—Theory of Mus. (1st)
282—McKinlay, James, 24, Glasgow And. Univ. Pop. Evg. Classes, hand-mill warper—Theory of Mus. (3d)
283—McKinnon, William K., 24, Glasgow And. Univ. Pop. Evg. Classes, cork-cutter—Mus. Comp. (2d); Theory of Mus. (2)
251—McLaren, Beatrice C., 19, Edinburgh Watt Inst. (no occupation stated)—Arith. (3d)
21—McLean, George, 29, Aberdeen M.I., clerk—Bkpg. (2d)
1006—McMillan, John, 17, Manchester M.I., clerk—Bkpg. (2d)
327—Macnair, Andrew, 17, Glasgow Ath., clerk—French (3d)
318—MacPhee, D. S., 24, Glasgow Ath., clerk—Eng. Lang. (3d)
284—McVie, William, 25, Glasgow And. Univ. Pop. Evg. Classes, miner—Eng. Hist. (3d); Eng. Lang. (3d); Geog. (3d)
760—Madden, Ronald G., 24, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (3d); French (1st), with second prize of £3
497—Mainwairing, Thomas C., 20, Hitchin M.I., gunmaker—Arith. (1st)
1332—Mallinson, James, 16, Lockwood M.I., joiner—Eng. Hist. (2d)
474—Mallinson, James E., 20, Halifax W.M. Coll., clerk—Bkpg. (2d)
359—Maltman, Peter, 16, Glasgow M.I., clerk—Bkpg. (2d)
39—Marchant, Edward T., 25, Aldershot and Farnham District Board, soldier—Geog. (3d)
1064—Marland, James E., 17, Mossley M.I., cotton-weaver—Bkpg. (3d)
155—Marle, Henry, 30, Birmingham and Mid. Inst., schoolmaster—Theory of Mus. (1st)
154—Marle, William, 23, Birmingham and Mid. Inst., clerk—Mus. Comp. (3d); Theory of Mus. (1st)
1142—Marrack, Philip, 22, Penzance, clerk—Theory of Mus. (1st)
426—Marshall, Hugh, 21, Glasgow M.I., clerk—Arith. (3d)
340—Marshall, James, 17, Glasgow Ath., warehouseman—French (1st)
304—Marshall, James N., 23, Glasgow And. Univ. Pop. Evg. Classes, commercial traveller—Theory of Mus. (2d)
1013—Massey, William T., 19, Manchester M.I., maker-up—Arith. (3d); Bkpg. (3d)
866—Masters, John, 18, City of London Coll., artificial limb maker—Pol. Econ. (2d)
865—Martin, Arthur J., 18, City of London Coll., clerk—Arith. (1st); Com. German (1st)
543—Martin, John, 24, Hull Young People's Ch. and Lit. Inst., clerk—Bkpg. (1st)
789—Martin, Mary E., 23, Birkbeck Lit. and Sci. Inst. (no occupation stated)—German (1st), with the first prize of £5, and the £2 prize for females.
548—Mayhew, Frank G., 17, Ipswich W. M. Coll., pupil teacher—Eng. Hist. (1st); Geog. (2d)
512—Mellor, William, 27, Hulme W. M. Inst., warehouseman—Bkpg. (1st)
215—Mercer W. J., 21, Crewe M.I., clerk—Arith. (2d); Bkpg. (3d)
1227—Merrill, Richard, 17, Salford W. M. Coll., clerk—Arith. (3d); Met. Syst. (3d)
1150—Merritt, George, 23, Beauvoir Coll. Evg. Classes, clerk—Mus. Comp. (2d); Theory of Mus. (2d)
22—Meston, William, 22, Aberdeen M.I., clerk—Theory of Mus. (1st)

27—Millar, Eliza S., 18, Aberdeen M.I., governess—French (1st)

434—Millar, Thomas, 18, Glasgow M.I., chemist—Latin (3d)

286—Millar, William, 18, Glasgow And. Univ. Pop. Evg. Classes, architect's apprentice—Theory of Mus (1st)

221*-Miller, Joseph, 19, Dean Mills M.I., warehouseman—Bkpg. (3d)

156—Mills, Marian, 30, Birmingham and Mid. Inst., stationer—Arith. (2d)

1049—Mills, Thomas G., 21, Manchester M.I., draughtsman—French (3d); Mens. (2d)

31*-Milne, Alexander, 16, Aberdeen M.I., mason—Eng. Lang. (3d)

401—Milne, Alexander, 22, Glasgow M.I., clerk—Arith. (2d)

18—Milne, James, 18, Aberdeen M.I., clerk—Arith. (2d); Bkpg. (2d)

685—Milne, John H., 20, Liverpool Inst., law clerk—Eng. Lang. (2d); Latin (2d)

534—Mobbs, Richard, 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)

582—Molyneux, Henry P., 17, Leeds Ch. Inst., pupil teacher—Arith (1st); Eng. Hist. (1st); Geog. (3d)

869—Moncrieff, Henry A., 22, City of London Coll., publisher—French (3d)

870—Monday, Alfred, 22, City of London Coll., clerk—French (2d); Com. French (1st)

1159—Moody, Richard A., 28, Beauvoir Coll. Evg. Classes, paper stainer—Theory of Mus. (3d)

253—Moon, Henry, 18, Gilford (Co. Down, Ireland) Young Men's Mut. Imp. Soc., clerk—Arith. (2d); Bkpg. (3d)

502—Moore, Frederic, 17, Huddersfield M.I., book-keeper—Arith. (2d); French (3d)

1100—Moore, Octavius, 21, Oldham Lyceum, mechanic—Eng. Hist. (3d)

544—Morris, Christopher, 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)

218—Morris, Morris T., 16, Dean Mills M.I., pupil teacher—Arith. (1st); Eng. Lang. (2d)

28—Morrison, James, 26, Aberdeen M.I., clerk—Bkpg. (1st)

929—Morse, Rosa E. S., 26, Royal Polytechnic Inst., governess—German (3d)

77—Mortleman, George, 19, Ashford M.I., fitter's apprentice—Arith. (2d)

621—Morton, Robert, 18, Leeds Young Men's Chr. Assoc., clothier's apprentice—Eng. Hist. (2d); Eng. Lang. (3d)

475—Morton, Sydney, 20, Halifax W.M. Coll., warehouseman—Bkpg (2d)

999—Morton William, 17, Manchester M.I., warehouseman—Bkpg. (3d)

422—Moses, David, 16, Glasgow M.I., clerk—Arith. (2d)

871—Mosey, Philip S., 23, City of London Coll., clerk—Arith. (3d); Bkpg. (1st)

383—Muir, George W., 17, Glasgow M.I., engineer's apprentice—Eng. Lang. (3d)

736—Mullins, William, 22, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (3d)

732—Mungeam, Mary S., 29, Birkbeck Lit. and Sci. Inst. (no occupation stated)—German (2d); French (3d); Geog. (3d)

410—Murdoch, Alexander, 16, Glasgow M.I., engineer—Arith. (2d)

9—Murison, George, 20, Aberdeen M.I., clerk—Eng. Lang. (3d)

26—Murray, Janet J., 22, Aberdeen M.I. (no occupation stated)—French (3d)

54—Murray, Roderick, 19, Glasgow M.I., clerk—Bkpg (1st)

1111—Murray, William H., 22, Paisley Artisans' Inst., clerk—Mus. Comp. (2d)

1087—Myers, James, 30, Newcastle-on-Tyne Excelsior Temperance Class, potter—Eng. Hist. (3d); Eng. Lang. (3d)

35—Myers, John B., 19, Accrington M.I., postman—Arith. (3d)

1305—Myring, Kate, 24, Walsall Ch. Inst., governess—Theory of Music (2d)

158—Naish, George W., 24, Birmingham Mid. Inst., paper-dealer—French (3d)

936—Narraway, Clara M., 24, Royal Polytechnic Inst., tile painter—German (1st)

872—Neems, Edwin W., 16, City of London Coll., clerk—Arith. (1st); Bkpg. (1st); French (3d)

287—Neil, James W., 22, Glasgow And. Univ. Pop. Evg. Classes, warper—Theory of Mus. (2d)

288—Neilson, David, 26, Glasgow And. Univ. Pop. Evg. Classes, clerk—Bkpg. (3d)

1058*-Nelson, George, 23, Manchester M.I., assistant buyer—French (3d)

772—Newall, Katherine J., 20, Birkbeck Lit. and Sci. Inst., student—French (2d)

873—Newton, Richard B., 18, City of London Coll., in Geological Museum—Arith. (2d); Eng. Lang. (2d)

59—Nicholls, Arthur, 22, Aldershot and Farnham District Board, soldier—Arith. (3d); Eng. Hist. (3d)

335—Nicholson, John, 20, Glasgow Ath., book-keeper—French (2d)

195—Nicholson, Robert, 19, Carlisle M.I. (no occupation stated)—Arith. (2d)

1112—Niven, Robert, 21, Paisley Artisans' Inst., clerk—Arith. (3d)

395—Niven, William A., 16, Glasgow M.I., engineer's draughtsman—Arith. (3d)

1228—Noar, Herbert, 19, Salford W.M. Coll., clerk—Bkpg. (1st); Met. Syst. (2d)

73—Nobbs, Alfred W, 19, Ashford M.I., railway accountant's clerk—Arith. (2d)

875—Norman, Alfred, 32, City of London Coll., clerk—Bkpg. (1st)

161—Norman, Frank E. B., 18, Birmingham and Mid. Inst., pupil-teacher—Geog. (2d)

160—Norman, John G., 26, Birmingham and Mid. Inst., jeweller—Geog. (1st)

914—Norris, James, 23, Royal Polytechnic Inst., clerk—Arith. (1st); French (3d)

1229—Nuttall, Edward B., 22, Salford W.M. Coll., clerk—Bkpg. (2d); Met. Syst. (3d); Geog. (2d)

94—Nuttall, Samuel, 17, Bacup M.I., warehouse boy—Arith. (3d)

967—Nutting, George, 16, St. Stephen's Evg. Sch., Westminster, carpenter—Arith. (3d)

1162—O'Brien, Edward, 29, Beauvoir Coll. Evg. Classes, law stationer—Mus. Comp. (2d)

217—O'Grady, Thomas, 24, Crewe M.I., labourer—Arith. (3d)

179—Ollerenshaw, James S., 18, Bradford M.I., clerk—German (3d)

1113—O'May, Robert, 23, Paisley Artisans' Inst., warehouseman—Arith. (2d)

743—Overall, Edwin H., 19, Birkbeck Lit. and Sci. Inst., clerk—Theory of Mus. (2d)

1056—Owen, William A., 18, Manchester M.I., clerk—French (3d)

877—Page, Edmund, 18, City of London Coll., architect's assistant—Met. Syst. (3d); Mens. (3d)

627—Palliser, John W., 23, Leeds Young Men's Chr. Assoc., art student—Eng. Lang. (2d); and first prize of £3 for Writing from Dictation

191—Palmer, Alfred L., 16, Bromsgrove Lit. and M.I., assistant bookseller—Eng. Hist. (3d)

566—Palmer, Charles J., 19, Ipswich W.M. Coll., clerk—Bkpg. (1st); Pol. Econ. (1st), with second prize of £3

439—Park, Douglas, 17, Glasgow M.I., pupil-teacher—Arith. (3d)
100—Parker, John H., 20, Bacup M.I., weaver—Arith. (2d)
878—Parker, John J., 23, City of London Coll., clerk—Eng. Lang. (1st)
311—Paterson, Alexander, 20, Glasgow Ath., grocer—Com. French (1st)
399—Paterson, George B., 17, Glasgow M.I., ironmonger—Arith. (3d)
348—Paterson, John, 16, Glasgow Ath., university student—Arith. (2d); French (3d)
1114—Paterson, Robert M., 19, Paisley Artisans' Inst., warehouseman—Theory of Mus. (1st)
287—Paterson, William, 25, Glasgow And. Univ. Pop. Evg. Classes, blacksmith—Theory of Mus. (3d)
371—Paton, James, 36, Glasgow M.I., letter carrier—Bkpg. (3d)
196—Pattinson, Robert, 17, Carlisle M.I., student—Arith. (2d)
254—Paul, Thomas, 18, Gilford (Co. Down, Ireland) Young Men's Mutual Imp. Soc., clerk—Arith. (2d); Bkpg. (3d)
1017—Parkins, Sydney, 19, Manchester M.I., photographic artist—Geog. (3d)
126—Peacock, Jacob, 18, Bolton M.I., piecer—Arith. (3d)
58—Pearson, John O., 25, Aldershot and Farnham District Board, soldier—Arith. (2d)
1121—Peart, Thomas, 17, Parsonstown Young Men's Mut. Imp. Soc., farmer—Arith. (2d)
290—Penman, James, 17, Glasgow And. Univ. Pop. Evg. Classes, fireman—Arith. (3d)
634—Penniston, Joseph, 35, Leeds Young Men's Chr. Assoc., book-keeper—Bkpg. (2d)
76—Pentecost, Horace, 18, Ashford M.I., smith's apprentice—Arith. (2d)
792—Pentony, Rebecca, 31, Birkbeck Lit. and Sci. Inst., governess—French (1st)
1231—Percival, Thomas, 22, Salford W.M. Coll., clerk—Arith. (2d)
1149—Perl, Augustus, 17, Beauvoir Coll. Evg. Classes, pupil teacher—Theory of Mus. (3d)
1005—Pettitt, Frederick M., 20, Manchester M.I., salesman—French (3d)
1262—Petty, John, 26, Southampton Ath., customs' officer—Arith. (1st)
184—Petty, Lister, 22, Bradford M.I., wool sorter—Arith (2d)
162—Phillips, Arthur, 18, Birmingham and Mid. Inst., clerk—German (2d)
1127—Phillips, Eugene G. H., 16, Pembroke Dock M.I., pupil teacher—Eng. Lang. (3d)
519—Philip, Robert H., 20, Hull Young People's Chr. and Lit. Inst., clerk—French (3d)
575—Pickup, Henry, 19, Irwell Inst., timekeeper—Arith. (1st)
946—Pike, Thomas, 23, Royal Polytechnic Inst., jeweller—Bkpg. (3d)
97—Pilling, William, 20, Bacup M.I., clerk—Arith. (2d); Eng. Lang. (3d)
599—Pillow, Edward, 19, Leeds M.I., mechanic—Arith. (3d); Eng. Hist. (3d)
581—Pitts, James, 16, Leeds Ch. Inst., pupil teacher—Arith. (3d); Eng. Lang. (3d); Geog. (2d)
726—Pohse, Sophie C., 23, Birkbeck Lit. and Sci. Inst., schoolmistress—French (3d)
880—Pollard, Henry T., 24, City of London Coll., clerk—Bkpg. (3d)
1014—Pollard, William, 18, Manchester M.I., clerk—Bkpg. (1st)
1233—Pollitt, William, 20, Salford W.M. Coll., clerk—Dom. Econ. (1st), with first prize of £5; Met. Syst. (1st), with second prize of £3; Mens. (1st), and the Prince Consort's Prize of Twenty-five Guineas
616—Preston, John, 16, Leeds Young Men's Chr. Assoc., clothworker—Eng. Hist. (3d); Eng. Lang. (3d)
1269—Prestwich, David, 19, Stockport Sunday Sch. Imp. Soc., clerk—Arith. (2nd); Eng. Hist. (1st); Met. Syst. (2d); Geog. (2d)
709—Prior, Samuel J. B., 24, Birkbeck Lit. and Sci. Inst., coal merchant—French (2d)
163—Pritchard, George, 32, Birmingham and Mid. Inst. book-keeper—Arith. (1st); Mens. (3d)
881—Prout, Frederic A., 19, City of London Coll., clerk—German (1st); Com. German (1st)
228—Pudner, William H., 22, Devonport M.I., clerk—Bkpg. (1st)
725—Pugh, Eliza, 20, Birkbeck Lit. and Sci. Inst., governess—French (3d)

947—Quick, John H., 22, Royal Polytechnic Inst., solicitor's clerk—Arith. (3d); French (3d)

618—Raby, John, 17, Leeds Young Men's Chr. Assoc., pupil teacher—Arith. (2d); Eng. Lang. (2d)
414—Ramsay, Daniel, 19, Glasgow M.I., clerk—Eng. Lang. (3d)
536—Ramsey, George, 26, Hull Young People's Chr. and Lit. Inst., warehouse foreman—Bkpg. (1st)
563—Rand, Charles W., 17, Ipswich W.M. Coll., clerk—Bkpg. (3d)
712—Randle, Samuel B., 29, Birkbeck Lit. and Sci. Inst., warehouseman—Logic (3d)
883—Read, Charles H., 25, City of London Coll., clerk—French (2d)
1018—Redfearn, Abraham, 18, Manchester M.I., clerk—Bkpg. (1st); Eng. Lang. (3d)
1047—Redfern, John R., 19, Manchester M.I., clerk—French (3rd); Spanish (2d)
1266—Reedman, Benjamin, 19, Stamford (St. Martin's Sch. of Art), carpenter and joiner—Arith. (3d)
706—Reid, Gerard J., 20, Birkbeck Lit. and Sci. Inst., assistant in British Museum—German (1st)
296—Reid, Robert, 34, Glasgow And. Univ. Pop. Evg. Classes, boot and shoe maker—Mus. Comp. (3d); Theory of Mus. (2d)
885—Reynolds, James, 18, City of London Coll., clerk—French (3d)
648—Richardson, Frederick, 23, Leicester W.M. Coll., elastic-braid weaver—French (3d)
292—Riddell, Daniel, 24, Glasgow And. Univ. Pop. Evg. Classes, clerk—Mus. Comp. (3d); Theory of Mus. (1st), with first prize of £5
1115—Rigg, James, 28, Paisley Artizan's Inst., clerk—Theory of Mus. (2d)
945—Riorden, George J., 21, Royal Polytechnic Inst., engraver—French (1st)
983—Ritchie, Joshua, 19, Manchester M.I., clerk—Bkpg. (1st)
114—Ritson, James T., 16, Bolton Ch. Inst., pupil-teacher—Arith. (2d)
680—Roberts, John, 22, Liverpool Inst., clerk—Mus. Comp. (1st); Theory of Mus. (1st)
746—Roberts, Robert A., 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)
886—Roberts, William W., 17, City of London Coll., clerk—Bkpg. (2d)
984—Robertshaw, Francis L., 30, Manchester M.I., decorator—Mus. Comp. (1st)
441—Robertson, Archibald, 17, Glasgow M.I., joiner—Eng. Lang. (3d); Arith. (2d)
30—Robertson, James, 17, Aberdeen M.I., clerk—Eng. Lang. (3d)
425—Robertson, John, 17, Glasgow M.I., draughtsman—Arith. (3d)
719—Robertson, John G., 20, Birkbeck Lit. and Sci. Inst., clerk—French (2d)
293—Robertson, Robert, 26, Glasgow And. Univ. Pop. Evg. Classes, warehouseman—Theory of Mus. (3d)

412—Robertson, Robert, 17, Glasgow M.I., clerk—Arith. (3d)

1025—Robinson, Thomas F., 16, Manchester M.I., clerk—Arith. (1st)

1034—Rogers, Stephen, 18, Manchester M.I., clerk—Arith. (2d); Bkpg. (2d); Eng. Lang. (3d)

887—Rookwood, Joseph, 17, City of London Coll., surveyor—Bkpg. (2d);

888—Rose, John H., 24, City of London Coll., clerk—Bkpg. (3d); Eng. Lang. (2d)

294—Ross, James, 22, Glasgow And. Univ. Pop. Evg., Classes, teacher—Eng. Lang. (3d)

1073—Ross, James J., 18, Newcastle on Tyne Ch. Inst., clerk—Arith. (3d)

295—Ross, Zachary M. H., 19, Glasgow And. Univ. Pop. Evg. Classes, teacher—Eng. Lang. (1st)

1237—Rothwell, Ephraim T., 35, Salford W.M. Coll. clerk—Arith. (3d)

1145—Robbins, Catherine, 18, Penzance, pupil teacher—Arith. (2d); Eng. Hist. (3d); Eng. Lang. (2d)

776—Rowbotham, S. A., 19, Birkbeck Lit. and Sci. Inst., clerk—German (1st); Com. German (1st)

200—Rudd, Mary E., 16, Carlisle M.I., (no occupation stated)—Arith. (1st), with the prize of £2 for females; Eng. Hist. (3d)

1282—Rushton, Cephas M., 22, Stockport Sunday Sch. Imp. Soc., clerk—Arith. (3d)

409—Russell, Thomas, 18, Glasgow M.I., clerk—Eng. Lang. (3d)

1072—Rutherford, George, 21, Newcastle on Tyne Ch. Inst., clerk—Arith. (3d)

696—Rutherford, William W., 19, Liverpool Inst., solicitor—Arith. (1st); Eng. Hist. (1st); French (3d); Latin (3d)

890—Ryde, William, 18, City of London Coll., clerk—Bkpg. (2d)

777—Rymer, Edward D. F., 20, Birkbeck Lit. and Sci. Inst., clerk—Eng. Lang. (2d)

542—Rymer, Walter, 29, Hull Young People's Ch. and Lit. Inst., clerk—Bkpg. (2d)

437—Sandilands, George, 18, Glasgow M.I., grocer—Eng. Lang. (3d)

369—Sands, David, 45, Glasgow M.I., stationer—Theory of Mus. (2d)

229—Saunders, Henry, 18, Devonport M.I., clerk—French (3d)

164—Saville, Sarah A., 18, Birmingham and Mid. Inst., pupil teacher—Eng. Lang. (3d)

797—Saxby, George L., 32, Birkbeck Lit. and Sci. Inst., potato salesman—Arith. (2d): Bkpg. (3d)

613—Scholes, Thomas, 25, Leeds Young Men's Chr. Assoc., clerk—Eng. Hist. (3d)

343—Scott, George, 23, Glasgow Ath., teacher—French (3d)

1155—Scott, Julian B., 23, Beauvoir Coll., Evg. Classes, leather warehouseman—Mus. Comp. (3d)

498—Senior, Fred H., 16, Huddersfield M.I., foreign commercial correspondent—German (3d)

40—Seymour, Robert W., 16, Aldershot and Farnham District Board (no occupation stated)—Arith. (1st); Eng. His. (1st)

653—Sharp, George H., 20, Leicester W.M. Coll., joiner—French (3d)

500—Sharp, Samuel, 16, Huddersfield M.I., office-boy—Arith. (1st); Eng. Lang. (3d)

222—Sharpe, Ann, 16, Derby (no occupation stated)—Arith. (3d); Eng. Hist. (3d); French (3d)

225—Sharpe, Margaret M., 18, Derby (no occupation stated)—Arith. (1st); Eng. Hist. (1st); French (2d)

477—Shaw, Enos, 23, Halifax W.M. Coll., warehouseman—Arith. (2d); Eng. Lang. (3d)

891—Shearer, John R., 23, City of London Coll., warehouseman's assistant—Logic (3d); Bkpg. (1st)

630—Shires, Robert, 16, Leeds Young Men's Chr. Assoc., clerk—Eng. Lang. (3d)

698—Shirley, Joseph H., 18, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Met. Syst. (3d); Mens. (3d)

297—Shirra, James, 21, Glasgow And. Univ. Pop. Evg. Classes, engine-fitter—Arith. (1st); Met. Syst. (2d); Geog. (1st)

591—Shoesmith, George, 27, Leeds Ch. Inst., currier—Bkpg. (3d)

198—Sibson, John, 17, Carlisle M.I., student—Arith. (2d)

996—Sidebotham, George H., 20, Manchester M.I., clerk—Spanish (2d)

1171—Silsby, James T., 36, Beauvoir Coll. Evg. Classes, tailor—Mus. Comp. (1st)

166—Silvester, Henry, 23, Birmingham and Mid. Inst., assistant relieving officer—Eng. Lang. (1st)

1337—Simister, James W., 17, New Mills M.I., pupil teacher—Arith. (3d)

892—Simmons, John D., 37, City of London Coll., oilman—Theory of Mus. (1st)

740—Simmons, Joseph A., 18, Birkbeck Lit. and Sci. Inst., thermometer maker—Eng. Lang. (1st)

478—Simpson, Edward, 18, Halifax W M. Coll., pupil teacher—Arith. (3d); Eng. Hist. (3d)

298—Simpson, James, 22, Glasgow And. Univ. Pop. Evg. Classes, engineer—Arith. (2d)

52—Sinclair, Arthur, 20, Aldershot and Farnham District Board, soldier—Arith. (3d)

241—Sinton, John W., 16, Edinburgh Watt Inst., pupil teacher—Arith. (3d)

539—Slack, Henry, 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)

893—Slade, George F., 20, City of London Coll., clerk—Arith. (1st)

201—Slater, Joseph, 18, Carlisle M.I., student—Eng. Hist. (2d); French (3d); Mens. (2d)

963—Slingo, William, 16, St. Stephen's Evg. Sch., Westminster, telegraphist—Arith. (3d); Eng. Lang. (3d); Geog. (2d)

486—Smethurst, Alfred, 20, Haslingden M.I., bookkeeper—Arith. (2d)

1271—Smith, Frederick, 18, Stockport Sunday Sch. Imp. Soc., mechanic—Arith. (3d)

691—Smith, C. Graham, 21, Liverpool Inst., civil engineer—Arith. (2d); Mens. (3d)

569—Smith, Harry, 21, Ipswich W.M. Coll, clerk—Eng. Hist. (2d)

656—Smith, James W, 19, Leicester W.M. Coll., compositor—Eng. Lang. (3d)

41—Smith, John, 29, Aldershot and Farnham District Board, soldier—Arith. (2d); Eng. Hist. (2d)

244—Smith, John A., 20, Edinburgh Watt Inst., clerk—Arith. (1st)

758—Smith, John H. A., 21, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (1st)

189—Smith, Joseph, 19, Bromsgrove Lit. and M.I., warehouseman—Bkpg. (3d)

798—Smith, Robert G., 17, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

178—Smith, Wheater, 19, Bradford M.I., surveyor—Arith (1st)

894—Smith, Walter J., 29, City of London Coll., clerk—Bkpg. (1st)

299—Smith, William, 20, Glasgow And. Univ. Pop. Evg. Classes, pawnbroker's assistant—Theory of Mus. (3d)

609—Smithson, James N., 17, Leeds Young Men's Chr. Assoc., warehouseman—Geog. (3d)

752—Smyth, James, 28, Birkbeck Lit. and Sci. Inst., clerk—French (3d)

565—Smyth, Robert W., 17, Ipswich W.M. Coll., accountant's clerk—Bkpg. (3d)

557—Snell, Robert, 17, Ipswich W.M. Coll., baker—Bkpg., (3d)

949—Snoxell, John J., 17, Royal Polytechnic Inst., clerk—Arith. (3d); Bkpg. (3d)

1281—Southworth, John, 17, Stockport Sunday Sch. Imp. Soc., clerk—Arith. (3d); Eng. Hist. (3d)

1086—Spain, William A., 25, Newcastle-on-Tyne Excelsior Temperance Class, clerk—Bkpg. (2d)

1153—Spencer, Harry, 23, Beauvoir Coll. Evg. Classes, carver and gilder—Theory of Mus. (3d)

1092—Stanier, William H., 23, New Swindon M.I., railway clerk—Pol. Econ. (1st), with first prize of £5; Mens. (1st), with first prize of £5.

1075—Stanners, Thomas, 16, Newcastle-on-Tyne Ch. Inst., clerk—Arith. (1st); Bkpg. (2d)

895—Stebbing, Henry P., 25, City of London Coll., clerk—Pol. Econ. (1st)

17—Steele, Andrew, 17, Aberdeen M.I., pupil teacher—Eng. Lang. (1st)

408—Stevenson, Peter M., 17, Glasgow M.I., clerk—Eng. Lang. (3d)

350—Stewart, Gilbert, 18, Glasgow Ath., engineer's apprentice—Arith. (2d); Mens. (2d)

896—Stirton, Charles M., 24, City of London Coll., clerk—Bkpg. (2d); French (3d)

246—Stirton, James, 18, Edinburgh Watt Inst., joiner's apprentice—Arith. (2d)

922—Stone, Mary, 26, Royal Polytechnic Inst., housekeeper—French (3d)

782—Stone, Walter H., 28, Birkbeck Lit. and Sci. Inst., schoolmaster—Eng. Hist. (1st); Eng. Lang. (1st); Geog. (3d)

242—Stormonth, James, 19, Edinburgh Watt Inst., working engineer—Arith. (2d)

1313—Stout, Robert, 16, York Inst. of Pop. Sci., joiner—Arith. (1st)

527—Strachan, Walter J., 20, Hull Young People's Chr. and Lit. Inst., engine fitter—Arith. (3d)

333—Strang, John H., 19, Glasgow Ath., clerk—French (3d)

592—Strickland, Edwin, 17, Leeds Ch. Inst., clerk—Bkpg. (2d)

300—Struthers, Anna S., 18, Glasgow And. Univ. Pop. Evg. Classes (no occupation stated)—Theory of Mus. (2d)

301—Struthers, Margaret T. R., 20, Glasgow And. Univ. Pop. Evg. Classes (no occupation stated)—Theory of Mus. (3d)

45—Summerland, John, 29, Aldershot and Farnham District Board, soldier—Eng. Hist. (3d)

957*—Summers, James, 21, Royal Polytechnic Inst., clerk—Bkpg. (3d)

1238—Sutcliffe, Lister T., 18, Salford W.M. Coll., clerk—Arith. (3d); Geog. (2d)

480—Sutcliffe, Shaw S., 17, Halifax W.M. Coll., pupil teacher—Arith. (2d); Eng. Lang. (2d)

898—Swain, John, 18, City of London Coll., clerk—Bkpg. (1st)

482—Sykes, John H., 16, Halifax W.M. Coll., warehouseman—Arith. (3d)

1031—Sykes, William E., 20, Manchester M.I., apprentice—German (1st)

899—Symonds, Arthur C., 19, City of London Coll., clerk—Com. German (1st)

1083—Tait, James H., 19, Newcastle-on-Tyne Excelsior Temperance Class, clerk—Bkpg. (3d)

958—Tapp, George W. H., 23, St. Stephen's Evg. Sch., Westminster, clerk—Bkpg. (2d)

966—Tapp, William E., 16, St. Stephen's Evg. Sch. Westminster, writer—Arith. (3d); Eng. Lang. (3d)

901—Tayler, William H., 17, City of London Coll., clerk—Arith. (2d); Eng. Hist. (3d)

357—Taylor, Charles, 22, Glasgow M.I., leather-cutter—Theory of Mus. (2d)

168—Taylor, Helen M., 16, Birmingham and Mid. Inst. (no occupation stated)—French (3d)

1152—Taylor, Henry, 35, Beauvoir Coll. Evg. Classes, schoolmaster—Mus. Comp. (1st)

85—Taylor, James H., 23, Bacup M.I., roller-coverer—Arith. (3d)

701—Taylor, John, 28, Birkbeck Lit. and Sci. Inst., teacher—Eng. Lang. (2d)

545—Taylor, Robert, 21, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (1st)

1070—Taylor Sydney, 21, Mossley M.I., cotton-minder—Bkpg. (3d)

1036—Taylor, Thomas, 20, Manchester M.I., warehouseman—Arith. (1st)

169—Taylor, William H., 25, Birmingham and Mid. Inst., clerk—Eng. Hist. (2d); and second prize of £2 for Writing from Dictation.

1324—Temperton, Frederick N., 18, York Inst. of Pop. Sci., joiner—Arith. (3d)

186—Terry, Sam, 21, Bradford M.I., wool sorter—Mus. Comp. (2d); Theory of Mus. (2d)

1125—Thomas, Alfred, 19, Pembroke Dock M.I., shipwright apprentice—Arith. (1st); Met. Syst. (2d)

1130—Thomas, Charles E., 17, Pembroke Dock M.I., pupil teacher—Arith. (1st); Eng. Lang. (1st)

1128—Thomas, George M., 19, Pembroke Dock M.I., shipwright apprentice—Arith. (1st); Geog. (1st), with first prize of £5, and the Royal Geographical Society's prize of £5.

1093—Thomas, Philip H., 17, New Swindon M.I., pupil teacher—Arith. (1st); Eng. Lang. (3d)

605—Thomson, Alfred, 19, Leeds Young Men's Chr. Assoc., pawnbroker—Bkpg. (3d)

13—Thomson, Alexander, 22, Aberdeen M.I., stonecutter—Arith. (2d)

14—Thomson, Alexander, 17, Aberdeen M.I., clerk—Arith. (3d)

20—Thomson, William, 19, Aberdeen M.I., clerk—Eng. Lang. (3d)

708—Thorn, Arthur G., 17, Birkbeck Lit. and Sci. Inst., clerk—Pol. Econ. (2d)

973—Tilson, Edward, 28, King's Lynn Ath., clerk—Arith. (3d)

483—Timewell, Fred, 22, Halifax W.M. Coll., carpet-weaver—Bkpg. (2d)

1102—Toft, John J., 18, Oldham Lyceum, book-keeper—Arith. (1st)

122—Tonge, Joseph, 26, Bolton M.I., clerk—Arith. (3d); Eng. Lang. (3d)

950—Trathan, Edward E., 16, Royal Polytechnic Inst., clerk—Arith. (1st); Bkpg. (3d); Eng. Lang. (3d)

1151—Treverton, Mrs. G. F., 27, Beauvoir Coll. Evg. Classes—Mus. Comp. (2d); Theory of Mus. (2d)

937—Troake, Edwin, 25, Royal Polytechnic Inst. (in Civil Service)—Eng. Hist. (1st); Eng. Lang. (1st); Geog. (2d)

1132—Turl, Charles P., 16, Pembroke Dock M.I., pupil teacher—Arith. (1st); Geog. (3d)

1116—Turnbull, George, 20, Paisley Artizans' Inst., clerk—Bkpg. (2d)

658—Turner, Joseph, 16, Leicester W.M. Coll., warehouseman—Eng. Lang. (2d)

665—Turton, Fletcher T., 19, Liverpool Inst., surveyor—Dom. Econ. (1st), with second prize of £3; Mens. (2d)

510—Urie, Thomas, 21, Hulme W.M. Inst., clerk—Bkpg. (2d)

1054—Urquhart, Alexander H., 19, Manchester M.I., clerk—Eng. Hist. (1st); Eng. Lang. (3d)

1295—Vaughan, Edward, 20, Stourbridge Ch. of Eng. Inst., clerk—Arith. (2d)

1136—Vaughan, James R., 20, Pembroke Dock M.I., shipwright apprentice—Geog. (2d)

1165—Venables, Leonard C., 24, Beauvoir Coll. Evg. Classes, clerk—Theory of Mus. (1st)

584—Vickers, John, 16, Leeds Ch. Inst., pupil-teacher—Arith. (2d); Eng. Lang. (3d)

1012—Vickers, Nathaniel, 18, Manchester M.I., warehouseman—Eng. Lang. (3d)

1241—Vickers, Thomas R., 19, Salford W.M. Coll., clerk—French (3d)

72—Vie, Edward J., 17, Ashford M.I., organist—Theory of Mus. (1st)

221—Vose, James, 19, Dean Mills M.I., pupil teacher—Eng. Lang. (3d)

1051—Vosper, Henry, 21, Manchester M.I., buyer (foreign shipping trade)—Logic (3d); Pol. Econ. (2d); Geog. (1st)

416—Waddell, Robert D., 17, Glasgow M.I., warehouseman—Eng. Lang. (3d)

180—Waddington, Joseph, 19, Bradford M.I., clerk—Eng. Lang. (3d)

211—Wade, William, 17, Crewe M.I., joiner—Arith. (3d)

108—Wain, James G., 19, Bolton Ch. Inst., warehouseman—Arith. (3d)

70—Waite, William T., 18, Ashford M.I., pupil teacher—Arith. (3d)

119—Walkden, Young, 21, Bolton M.I., machine clerk (colliery)—Arith. (3d)

394—Walker, John A., 17, Glasgow M.I., draughtsman apprentice—Arith. (3d)

940—Walker, Phillip G., 20, Royal Polytechnic Inst., clerk—Bkpg. (3d)

664—Walmsley, Roberts M., 18, Liverpool Inst., timber merchant's apprentice—Arith. (1st); Eng. Hist. (1st); Eng. Lang. (2d); Mens. (1st)

110—Wallace, James W., 18, Bolton Ch. Inst., clerk—French (3d)

960—Wallack, Harry J. A., 17, St. Stephen's Evg. Sch., Westminster, civil service—Arith. (3d)

699—Wans, David, 33, Birkbeck Lit. and Sci. Inst., clerk—German (1st); French (3d)

105—Warburton, James, 20, Bollington Useful Knowledge Soc., mechanic—Arith. (3d)

170—Ward, John W., 17, Birmingham and Mid. Inst., pupil teacher—French (3d)

992—Ward, Joseph, 22, Manchester M.I., clerk—Bkpg. (2d)

171—Ward, Thomas, 18, Birmingham and Mid. Inst., clerk—Eng. Hist. (1st), with second prize of £3

598—Wardle, James W., 22, Leeds M.I., engineer—Mens. (2d)

1021—Wardle, John, 20, Manchester M.I., clerk—Arith. (1st); Eng. Hist. (2d); French (1st)

910—Warton, Agnes, 16, Royal Polytechnic Inst. (no occupation stated)—German (3d)

909—Warton, Alfred, 18, Royal Polytechnic Inst., wine merchant—German (3d)

109—Waters, Thomas F., 16, Bolton Ch. Inst., civil engineer—Arith. (2d); Mens. (3d)

1117—Waterston, John, 23, Paisley Artisans' Inst., clerk—German (2d)

406—Watson, Adams, 25, Glasgow M.I., clerk—Arith. (3d)

23—Watson, Alexander G., 20, Aberdeen M.I., cloth-finisher—Theory of Mus. (2d)

1315—Watson, George, 21, York Inst. of Pop. Sci., clerk—Arith. (2d)

1251—Watson James L., 18, Scarborough M.I., pupil teacher—Arith. (2d)

765—Weatherly, Alexander, 16, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d)

764—Weatherly, George, 18, Birkbeck Lit. and Sci. Inst., clerk—Met. Syst. (1st); Geog. (3d)

625—Weaver, Henry, 34, Leeds Young Men's Chr. Assoc., Inland revenue officer—Arith. (3d); Bkpg. (2d)

220—Webb, William, 18, Dean Mills M.I., pupil-teacher—Arith. (3d); Eng. Lang. (2d)

564—Webber, William J., 17, Ipswich W.M. Coll., bookseller—Eng. Lang. (3d)

1321—Webster, John L., 18, York Inst. of Pop. Sci., joiner—Arith. (3d); Eng Hist. (3d)

977—Webster, William, 19, Macclesfield Soc. for the Acquirement of Useful Knowledge, silk warehouseman—Arith. (3d)

1077—Weddle, John, 23, Newcastle-on-Tyne Ch. Inst., clerk—Arith. (3d); Bkpg. (3d)

34—Welch, Edwin, 17, Accrington M.I., tailor and woollen draper's assistant—Arith. (3d)

517—Wenn, William P., 24, Hull Young People's Chr and Lit. Inst., gardener—Floriculture (3d); Fruit and Veg. Culture (2d)

766—Wharhirst, John, 26, Birkbeck Lit. and Sci. Inst., chaser—Arith. (1st); Bkpg. (2d)

496—Wheeler, Frank, 18, Hitchin M.I., clerk—Mus. Comp. (3d)

1168—Wheeler, George, 22, Beauvoir Coll. Evg. Classes, carver—Theory of Mus. (3d)

689—Whinerey, Robert, 24, Liverpool Inst., clerk—Bkpg. (3d)

96—Whitaker, John, 20, Bacup M.I., clerk—Bkpg. (1st); Met. Syst. (3d); Mens. (2d)

639—Whitaker, Thomas, 18, Leeds Young Men's Chr. Assoc., compositor—Eng. Hist. (2d)

668—White, Henry T., 30, Liverpool Inst., clerk—teacher—Theory of Mus. (1st)

172—White, William, 16, Birmingham and Mid. Inst., pupil teacher—French (3d)

321—Whitelaw, Lena, 18, Glasgow Ath. (no occupation stated)—French (3d)

1015—Whitelow, Edward T., 17, Manchester M.I., engineer's assistant—German (1st); Met. Syst. (1st); Mens. (2d)

459—Whitley, Phineas, 20, Halifax M.I., teacher of music—Theory of Mus. (1st); Eng. Lang. (2d)

1089—Whitton, Charles, 16, New Swindon M.I., clerk—Arith. (2d)

302—Whyte, Charles, 21, Glasgow And. Univ. Pop. Evg. Classes, clerk—Theory of Mus. (2d)

303—Whyte, John, 29, Glasgow And. Univ. Pop. Evg. Classes, clerk—Theory of Mus. (3d)

446—Whytock, John A., 28, Glasgow Young Men's Soc. for Religious Improvement, clerk—Logic (3d)

1242—Wigley, Jeremiah, 30, Salford W.M. Coll., iron-turner—Arith. (3d)

532—Wilburn, Charles, 18, Hull Young People's Chr. and Lit. Inst., clerk—Bkpg. (2d)

942—Wilkins, Robert W., 27, Royal Polytechnic Inst., clerk—Italian (2d)

769—Wilkinson, George, 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (1st); Met. Syst. (2d.)

778—Wilkinson, Jeannette G., 28, Birkbeck Lit. and Sci. Inst., upholstress—Eng. Hist. (2d); Pol. Econ. (2d)

88—Wilkinson, John, 16, Bacup M.I., weaver—Arith. (3d.)

964—Wilkinson, Thomas E., 22, St. Stephen's Evg. Sch., Westminster, carpenter—Arith. (3d)

1244—Willcock, Samuel, 21, Salford W.M. Coll., clerk—Arith. (3d)

1243—Willcock, Thomas, 17, Salford W.M. Coll., clerk—Arith. (1st)

906—Williams, Alfred S., 28, City of London Coll., clerk—French (3d)

911—Williams, Edith, 20, Royal Polytechnic Inst., (no occupation stated)—German (3d)

1261—Williams, Henry, 23, Southampton Ath., clerk in ordnance survey—Bkpg. (1st), and the first prize of £3 for Writing and Manuscript Printing

1276—Williamson, Fred, 17, Stockport Sunday Sch. Imp. Soc., tinplate-worker—Arith. (3d)

798*-Willshire, Thomas, 25, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (3d)

495—Wilson, Alfred, 18, Hertford Lit. and Sci. Inst., pupil teacher—Eng. Lang. (2d)

484—Wilson, Arthur, 16, Halifax W.M. Coll., apprentice (wool trade)—Bkpg. (3d)

595—Wilson, Edward F., 32, Leeds M.I., cloth weaver—Theory of Mus. (2d)
24—Wilson, George, 21, Aberdeen M.I., clerk—French (1st)
985—Wilson, John, 21, Manchester M.I., warehouseman—French (3d)
1078—Wilson, John, 36, Newcastle-on-Tyne Excelsior Temperance Class, joiner.—Eng. Lang. (2d.)
174—Wilson, Joseph A., 23, Birmingham and Mid. Inst., clerk—Eng. Hist. (1st)
223—Wilson, Kate M., 19, Derby (no occupation stated)—Eng. Hist. (2d); Geog. (3d)
594—Wilson, Samuel, 28, Leeds M.I., cloth-weaver—Theory of Mus. (1st)
1076—Wilson, Thomas, 20, Newcastle-on-Tyne Ch. Inst., clerk--Arith. (2d); Bkpg. (3d)
1188—Wing, William, 18, Rotherham Lit. and M.I., clerk—Bkpg. (3d)
790—Winser, George F., 25, Birkbeck Lit. and Sci. Inst., clerk—German (1st)
920—Womack, Alice, 18, Royal Polytechnic Inst. (at school)—German (2d)
1045—Wood, Henry, 17, Manchester M.I., assistant book-keeper—Arith. (1st), with first prize of £5; Bkpg. (1st)
1294—Woodward, Joseph W., 20, Stourbridge Ch. of Eng. Inst., clerk—Arith. (3d)
175—Wootton, Bertha M., 18, Birmingham and Mid. Inst. (no occupation stated)—Eng. Lang. (1st), with the prize of £2 for females ;. Geog (3d)
1245—Worsley, Alfred, 17, Salford W.M. Coll., in warehouse—Arith. (1st)
1283—Worthington, John, 30, Stockport Sunday Sch. Imp. Soc., cotton spinner—Arith. (2d); Met. Syst. (3d)
494—Wrenn, Alice L., 17, Hertford Lit. and Sci. Inst., pupil teacher—Eng. Lang. (2d); Geog. (3d)
1141—Wright, John E., 21, Penzance, teacher—Mus. Comp. (3d); Theory of Mus. (1st)
602—Wright, Richard, 26, Leeds Young Men's Ch. Assoc., joiner—French (3d)
735—Wright, William H., 17, Birkbeck Lit. and Sci. Inst., clerk—Arith. (3d); Bkpg. (2d), Geog. (3d)
306—Wright, William R., 17, Glasgow Ath., clerk—Arith. (3d); Met. Syst. (3d)
1062—Wrigley, Andrew, 21, Mossley M.I., book-keeper—Bkpg. (3d)
453—Wrigley, Frederick G., 19, Halifax M.I., joiner—Arith. (3d)
418—Wright, James, 17, Glasgow M.I., clerk—Eng. Lang. (3d)
704—Wylson, George, 19, Birkbeck Lit. and Sci. Inst., clerk—Bkpg. (2d)

415—Young, John, 16, Glasgow M.I., clerk—Eng. Lang. (3d)
1118—Young, John, 25, Paisley Artisans' Inst., compositor—Theory of Mus. (2d)
753—Young, John W., 17, Birkbeck Lit. and Sci. Inst., builders' clerk—Met. Syst. (2d)
237—Young, Thomas, 34, Edinburgh Watt Inst., gas company's collector—Mus. Comp. (3d); Theory of Mus. (1st)
305—Young, William, 21, Glasgow Ath., clerk—German (1st), with second prize of £3; Com. German (1st)

GENERAL NOTES.

◆

Bethnal-green Branch Museum.—His Royal Highness the Prince of Wales has communicated to the Lord President and the Vice-President of the Committee of Council on Education his intention of opening this national museum on Monday, 24th June. The Prince will be accompanied by her Royal Highness the Princess of Wales.

London Wells.—A return giving an account of the public surface wells in the metropolis shows a considerable number still open. The City can boast of a well in Cornhill 25ft. deep, but sometimes the water is too low to rise into the pump; also two Leadenhall wells, but the water is gone; a well in Idol-lane, 23ft. deep, with water so good that Billingsgate fishermen fill casks with it to take to sea; a well in the Tower-garden, 27ft. deep, with a spout into Postern-row; Fenchurch-street pump, now in use, the well under 30ft. deep; a well in Bow Churchyard, Cheapside, about 32ft. deep; Honey-lane market pump, City School; Basinghall-street parish pump, the well about 30ft. deep, at present enclosed in the hoarding round the building of the City Library; a well in Bell-yard, Gracechurch-street, but the water has been withdrawn "by reason of some interference with the sewer;" and the Corporation pump in Guildhall-buildings, adjoining the Bankruptcy Court, the return stating that "the well is not permanently closed, but the handle of the pump is taken away." There is a modern well in Bream's-buildings, Chancery-lane, about 18 ft. deep, used by the public; a well in Red Lion-square, 20 feet deep; a well in Gray's-inn-lane, 25 feet deep; a well in Queen-square, Bloomsbury, 22 feet deep; a well in St. John-street, 22 feet deep; a well in King-square, 20 feet deep; a well and pump in New North-street, Theobald's-road; a well in New-inn, 25 feet deep; a well in Clement's-inn, but with no water; a well, 16 feet deep, under the church of St. Martin-in-the-Fields, supplying the pump in Duncannon-street; a pump in the churchyard, Canon-street-road. There are also public wells still open at Mile-end, Hampstead, Hammersmith, Deptford, and Charlton.

CALENDAR OF MEETINGS.

◆

INDIA CONFERENCE.

This afternoon, June 7th, a Conference will be held, at half-past four, on "Engineering Education in India," to be opened by Mr. Hyde Clarke.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon. ....London Institution, 4. Prof. Bentley, "On Elementary Botany."
Royal Geographical, 8½. Lieut. A. H. Markham, "On the New Hebrides and Santa Cruz Islands."
British Architects, 8
Social Science Association, 8. Miss Wallington, "On Mixed Education."

Tues. ...British Association of Gas Managers. (At the House of the Society of Arts.) Morning Meeting at 12. Evening Meeting at 7.
Photographic, 8.

Wed.....British Association of Gas Managers. (At the House of the Society of Arts.) Morning Meeting at 12.
Royal Literary Fund, 3.
Royal Society of Literature, 4¼.

Thurs...Royal, 8½.
Antiquaries, 8½.
Royal Society Club, 6.
Mathematical, 8.

Fri.......Astronomical, 8.
Quekett Club, 8.
Victoria Institute, 8. (At the House of the Society of Arts.) Annual Meeting.
Royal United Service Institution, 3. Commander T. A. Hull, R.N., "Practical Marine Surveying."

Journal of the Society of Arts.

No. 1,021. Vol. XX.

FRIDAY, JUNE 14, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

REVIEW OF SCHOOL DRILL.

His Royal Highness the Prince of Wales, President of the Society, has graciously consented to review the boys from the various district and metropolitan schools, in the Royal Horticultural Gardens, some day the latter end of July. As soon as the day is fixed, notice of it will be given in the *Journal.*

The drill of the schools will be previously inspected by Captain O'Hea (late 25th Regiment), and the prize banners, in accordance with his report, will be presented by H.R.H. the Prince of Wales, in the Royal Albert-hall, to the successful schools at the close of the Review.

The bands of the several schools will attend and will perform a selection of music.

DRILL COMMITTEE.

The Committee met on Wednesday, June 12, at South Kensington Museum. Present—Sir Charles Russell, Bart., V.C. (in the chair), Mr. G. C. T. Bartley, Mr. H. Cole, C.B., Mr. E. Chadwick, C.B., Capt. Donnelly, R.E., and Mr. E. Carleton Tufnell. Captain O'Hea attended.

FOOD COMMITTEE.

The Committee met on Wednesday, the 12th June, at 4 o'clock. Present, Mr. Benjamin Shaw (in the chair), Mr. F. A. Abel, F.R.S., Mr. E. G. Davenport, Rev. J. E. Hall, Mr. W. H. Michael, Mr. J. T. Ware, and Mr. J. A. Youl. The committee had before them some sugar-cured mutton hams from Australia. Mr. Jenkins laid before the committee a report on the fish supply in the Midland districts. This report will appear at length in a future *Journal.*

Sub-committee for Exhibition of 1873.

The Sub-committee met on Friday, the 7th inst. Present—Mr. Benjamin Shaw (in the chair), Dr. Peyton Blakiston, Mr. J. T. Ware, and Mr. J. A. Youl. Mr. E. J. Craigie attended on the part of Her Majesty's Commissioners.

CONVERSAZIONE.

The Society's Conversazione is fixed to take place at the South Kensington Museum, on Wednesday, the 19th June. Tickets have been issued to the Members.

IMPROVED CABS.

The Council of the Society of Arts offer the following Prizes:—

One Prize of £60 for the best improved Cab of any description.

Two Prizes of £20 each for the next two best.

Two Prizes of £10 each for the next two best.

The competing Cabs must be exhibited at the International Exhibition, to be held in South Kensington in 1873, and on their delivery at the Exhibition Building they must be certified to the satisfaction of the Judges as having been in regular use in the streets of London for three months previously. They must be delivered on or before the first Saturday in April.

The Council consider that the Cabs now in use in London are especially defective in the following particulars:—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.
2. The seats in the four-wheelers are too high, not commodiously made, and the space underneath is lost.
3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.
4. The arrangements for opening and closing the window in the Hansom.
5. The confined space and want of ventilation in the Hansom when the window is closed.
6. Imperfect locking of the wheels in four-wheelers.

The Council desire to point out, for the consideration of those likely to compete, that in Continental and some English towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

A suggestion for a cab, to be used either closed or open, has been brought before the Council, and a model submitted. The principle might be adapted to existing four-wheelers, but the Council do not prescribe this model or any special form of carriage; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges may report.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first published subscription list amounted to £351 3s. A further list will shortly be published.

THE LIBRARY.

The following books have been presented to the Library:—

The Journal of the Iron and Steel Institute. Presented by the proprietors of the Institution.

The Brewers' Guardian. Nos. 1 to 39. Presented by the proprietors.

Drawing for Cabinet-makers. Presented by Messrs. Cassell, Petter, and Galpin, the publishers.

The People's Blue Book: Taxation as it is, and as it ought to be. Presented by Mr. Thomas Briggs.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

FOOD COMMITTEE.

The Committee met on May 15th. Present:—Mr. Benjamin Shaw, in the chair; Sir Antonio Brady, Mr. E. G. Davenport, Mr. J. Jenkins, Mr. J. T. Ware, and Mr. J. A. Youl.

Mr. Richard Jones attended on behalf of the Food Preserving Company (Limited), and gave further information with regard to his process of preparing tinned meat, and exhibited a sample of meat (some of the first importation from Queensland) prepared by his process. He said in the old process the moisture from the meat comes out gradually into the tin, and does not escape; the consequence is, it boils away the juice of the meat, and it becomes jelly on the outside, whereas by his process he lost the water at a lower temperature as vapour, without disintegrating the meat, so that there was not the same amount of jelly in his process as in the older, because he got rid of the water in vacuo at a low temperature. Then the cooking goes on until preservation is effected. All the neutral salts are retained in the meat.

The Chairman asked how Mr. Jones reconciled the statement that he got rid of the water at a low temperature with what he had previously stated, that the meat was prepared at a high temperature owing to the use of the vacuum.

Mr. Jones—That is quite correct. We get the temperature first up to about 230° to commence with, and then after a time, after we have got rid of the water, we go up to 260° and keep it at that. We shut the tap communicating with the vacuum chamber when the water is off.

Mr. Jenkins—The larger portion of the neutral salts are supposed to be left in the jelly in the old process?

Mr. Jones—Yes, in the gravy; but we retain them in the meat itself; nothing escapes but simply the water. It is just the same as if meat is put down before the fire, it loses about 20 per cent. of moisture.

Sir A. Brady—That depends upon the feeding of the meat. Some meat that is ill-fed will lose a great deal more. The loss on pork fed in America is 50 per cent. If the cattle are fed on dry food there will be less moisture in the flesh.

Mr. Ware—Have you examined the liquor that comes out from the tins, so as to be able to speak positively as to its being only water.

Mr. Jones—It is just like distilled water. It has a slight colour, from some portion of the fat going over with it. When we first commenced we had a large quantity of the juice come over into the vacuum-chamber, so that we thought we should be able to rob the meat of that and sell it as extract, and then sell the meat separately; but experience taught us that we could accomplish the preserving of the meat with the whole of the juice in it. We are preserving fish to a considerable extent at Aberdeen, and it is superior to the old method.

The Chairman—Is this the first sample of your process which has been adopted out of the country?

Mr. Jones—It is the second consignment from Queensland; it is not being practised elsewhere, though we are making arrangements to have it carried out in Canada and in Texas.

Mr. Youl—Is this meat as good, in all respects, as that prepared in Aberdeen?

Mr. Jones—The meat itself is as good. I think the quality is quite equal to London meat, but I think it is too much cooked, and it is not a fair representation of the system of preserving. It is not manipulated with the same skill as that prepared by Mr. Forbes, the manager of the company. I have been very anxious that Mr. Forbes should be sent over to Australia, to teach the people out there how to conduct the operation, as he is so thoroughly acquainted with the process.

The Chairman—What do you think are the defects in this, Mr. Jones?

Mr. Jones—I think too great regard has been paid to not losing any weight in the tin; they have retained too much moisture at the onset, and therefore it has, in a slight measure, a peculiar twang common to most tinned meat. If they had used the vacuum a little more they would have got rid of that entirely.

Sir A. Brady—I think also it tastes of the tin. I do not think it has been put in the best quality of tin; there is an immense difference in the quality of tin plates. If they are mixed with any impure metal, lead or zinc, an action results, which gives the flavour of the metal to the meat. It is not surprising, because, having recently visited some tin works, I find that tin is now worth £150 a ton, so that there is a great temptation to lose as little as possible, and there is such an excessive demand for it, that a great many manufacturers use impure tin. They produce very beautiful-looking plates, but when they come in contact with the salts in the meat and the water an action is set up which in time would destroy it, but which, in the first instance, gives a flavour to the meat.

Mr. Jones—All prepared meats should be put up in the very best tins.

Mr. Jenkins—There are certain brands of tin plates which go into certain markets; certain houses send their tins into the English market, and never send them to America; whilst others will turn out cheaper tin to send entirely to America and foreign markets.

Mr. Youl—Would the voyage home make any difference in the quality of the meat?

Mr. Jones—I think not the slightest difference.

Sir A. Brady suggested that as the tin was sent out from England in boxes, it would save time and trouble in the colony if the plates were cut to the shape and size required for the canisters.

Mr. Jenkins said that the boxes of plates were sent direct from the works, and he did not think they could be cut in shapes, because all their accounts were based upon the number of boxes.

Mr. Jones exhibited a sample of fresh haddock prepared by his process, and stated that a large quantity was now being preserved and sent abroad, principally to France and India. The company formed for Canada had a great idea of bringing fish to England from that country prepared by this process, so as to supply the public cheaply. The sample produced had been a little salted, but there was no necessity for doing so; it was probably done to give a flavour to the fish.

Mr. Jenkins said he thought there would be a tendency, from the whole of the water being driven off, to have more salt in the meat or fish than was desirable.

Mr. Jones—There was no necessity for having it salted at all.

Samples of tin meat from Uruguay, prepared by Albert Scott and Co., from English half-bred oxen, and also from New Zealand, were submitted.

Mr. Clauson submitted to the Committee a specimen of dried meat which he had received from Italy, from Professor Chiconi. He said his information was that it had been prepared for two or three months, and that by merely soaking it in water for two or three hours, it would return to its pristine condition. Of course the Committee could not form a decided opinion upon it until after it had been soaked, but he thought it better to submit it as it was in the first instance, that the Committee might judge whether it was worth further experiment. There was some preparation rubbed over the surface of the meat which required to be brushed off after it had been soaked. The inventor was a professor, who evidently was not a very practical man, as he had only sent over this one piece, without considering that it only allowed opportunity for one experiment to be made.

Mr. Kent attended, and exhibited a model of a railway meat van, constructed on the principle of his patent ventilated refrigerator. He said the principle was the production of artificial ventilation or a downward current of refrigerated air by the use of ice. The van was divided into two compartments, and in the centre of the roof over each was an ice chamber, with a cylinder at the top finely perforated, through which the air would pass into the ice chamber, and there be brought to a low temperature; it would then enter the upper part of the van, and slowly descend and carry with it all effluvia or gases emitted by the meat, &c., and pass out through vents in the bottom of the van. There was a pipe under the centre of the ice chamber through which the water would escape. The vent-holes at the bottom were made with vanes, so as to turn round if the carriage came to a junction and had to be reversed. The air was made perfectly dry in passing through the ice-chamber, the ice taking up all moisture and other impurities with which it might be contaminated. In fact, the ice chamber is really an air filter; the ice arrests the air as it enters, and not only deprives it of all humidity, but there can be no doubt that it also intercepts myriads of imperceptible insects which in summer float in the air, and which insects, if not intercepted, would settle on and hasten the decay of provisions. The consumption of ice was comparatively small; he should think about 70lbs. in a 24 hours' journey of a van filled with meat. Along the inside of the roof of the van were hooks for hanging up the carcases of the meat, which was divided into two, in order to get a better circulation. This had never been used as a meat-van, but his safes and refrigerators, constructed on the same principle, had proved a perfect success in the preservation of fresh provisions of every kind. In short, he considered that, with the exception of his rotary knife-cleaner, it was the most successful of his inventions, and it would not be expensive to apply this principle to existing railway meat-vans.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

Sir,—Guilds or communities of persons associated together for purposes of mutual protection and support have probably been common in all ages, and certainly existed in this country in the time of the Anglo-Saxons. When the City companies or guilds first assumed positive shape and efficiency is unknown. Mr. John Nicholls, in his introduction to his work entitled "Some Account of the Worshipful Company of Ironmongers," says some of the laws and ordinances of our Anglo-Saxon ancestors by which such communities were regulated have come down to us in the vernacular language of that period, and the close resemblance between the laws of the Anglo-Saxon guilds and the rules and observances followed by the trading companies of London at a later period seem to indicate a common origin. "Such communities," says Sir Francis Palgrave, "had religion as their foundation," and the titles of some of those referred to in my first letter clearly prove that fact, but they ultimately constituted the elements of that burgher aristocracy which assisted in destroying the abuses which had sprung out of the servitude of the soil. Towards the close of the 13th century these associations became the means by which the principal towns of the kingdom were enabled to obtain many important privileges, and were for the most part constituted bodies corporate. Stow, in his account of Portsoken Ward, describes the circumstances under which the establishment of Knighten Guild by King Edgar took place; and that monarch so highly esteemed the working in metals, and as the clergy were the best artificers, he enacted a law "that every priest to increase knowledge should diligently learn some handicraft;" and Dunstan, Archbishop of Canterbury, to the arts of music, painting, and writing, added the craft of smith, and was an expert workman.

The guilds were also the guardians of the interests of those who followed the crafts or mysteries of its members.

The weavers of London received a charter as early as the reign of Henry II., during which reign there were also eighteen other London guilds, but they were unlicensed, and were fined by the king accordingly.

Although licensed, the guilds were not generally incorporated till the reign of Edward III., when that monarch, conscious of the growing strength and prosperity of the country, through the instrumentality of trade fraternities, raised them at once into the highest estimation and honour, and confirmed in many cases, by letters patent, the privileges they had previously enjoyed, more by prescription than right, he also, as previously stated, enrolled himself as a member of the Merchant Tailors. In the course of time abuses in trades began to grow up, which abuses ultimately led to the recognition of the trade guilds as the authorities by which the laws regulating trade were settled. In the same reign (Edward III.) it is recorded that there were thirty-two companies in the City of London, and they began to contend for the right of electing the chief officers of the City, and to make ordinances for the government of the City, a duty which had previously been performed by the representatives of the various wards, and the mayor and aldermen appear to have exercised a jurisdiction and control over the trading companies. The mayor, with a view to settle the dissensions which had arisen, and acting under the advice of five aldermen and eight commoners, directed the "mysteries to choose several aldermen, and a great many commoners to meet at the Guildhall, who, having met, ordained, among other things, that the persons who should hereafter be called to the Common Council of the City, should be elected by every sufficient mystery, and that those persons and no others should be summoned to the election of mayors and sheriffs."

This ordinance continued in force till 1384, when the Common Council were again ordered to be elected by the wards. The example set by Edward IV., who has been called the Merchant King, rendered the pursuit of trade honourable, and, by becoming himself an extensive merchant, he imparted a noble impulse to commercial enterprise, encouraged the industry of his people, and laid the foundation of the future wealth and power of England. The government of the companies, as they now exist, is by Courts of Assistants, elected from the senior members of the liveries, and they comprise a master, senior and junior wardens, and a certain number of assistants who succeed in rotation to the higher offices.

These, in the first instance, self-constituted authorities, ultimately held the power of admitting or rejecting additional competitors into the trades they represented, and the freedom of a guild implied a right to follow a particular trade within the precincts of the City. When apprentices were taken by the members it was generally covenanted that the apprentice should be made free of his master's Company, and a small fee was paid to the Company in such cases.

The freedom of the City is now obtained—1st by servitude; 2nd, by patrimony; 3rd, by gift of the City or honorary freedom; 4th, by redemption or purchase; and lastly, by persons neither holding premises nor carrying on business within the City or its liberties, but wishing to be admitted (either with or without the interference of a company) on the Chamberlain obtaining an order of the court on their application. A fine, in this case amounting to £27 18s. 4d., including 5s. to the Freemen's Orphan School, has to be paid. The sons of aliens born in England are now admitted the same as natural born subjects. It was a natural sequence to the establishment of companies for regulating trades, that those who fell into distress should seek the aid of their brethren of the craft, and this no doubt gave rise to many of the charitable bequests for which the majority of the guilds have become trustees.

The Commissioners appointed in 1837 to inquire into the Municipal Corporations of England and Wales, describe the existing companies as so many trusteeships for charitable purposes, and state that one of the earliest objects sought by the guilds, and in some the primary one, was the foundation of a common stock for the relief of poor or decayed members. Large sums were bequeathed by benevolent persons, and in the course of time they became so numerous, that Stowe devotes twenty-five pages of his "Survey" to the mere enumeration of them, under the title of the "Honour of Citizens, and Worthiness of Men, a noble chapter in the History of London."

Among the benefactors to some of the companies during the last century are the names of many members of the Society of Arts; but none stand forth with more prominence than that of John Stock, who by will left £50,000 in trust to the Company of Painter Stainers, of which he was a freeman, and which company also included at that time among its members Sir Joshua Reynolds, and other artists of distinction.

To the action of some of the City companies in the present day, I must refer in my next.—I am, &c.,

H. G. H.

Sir,—"On what ground," asks "A Reader of the *Journal*," "can the Society of Arts ask persons who are not members to contribute funds?" and "Is it not beneath the dignity of science to receive contributions for purposes of public utility from the public?"

It seems to me, Sir, that these questions are easily answered. The Society of Arts is not a scientific society in the usual acceptation of the term, and if it were its dignity must be very touchy indeed did it object to dispense public money for public purposes. But the very terms of the second question contains the answer. Its contributions for purposes of public utility are, of all others, precisely those which it is fitting to ask of the public. The Society is not a commercial undertaking, but a voluntary labourer for the public. Surely the public could not spend its superfluous cash better than in furnishing the Society with tools and material.

But there is a broad, general answer to the queries raised in the short note already alluded to, which I will take the liberty to try and put into words. The Society is essentially an association of persons who desire to aid in all beneficial movements, and especially such as have for their object the prevention of vice and crime, in short the well-being of society at large. It takes no part in politics proper; it fosters no general theories; the course it has selected for itself is simple and practical. It sees a want, an abuse, or a vacuum—it tries to supply or to correct it. Now it is especially at this moment, when general theories and vague demands unfortunately occupy far too much of the public attention, that the action of such a Society becomes doubly valuable. I see no very great objection in the promulgation of political Utopias, but I see a monstrous objection in waiting with folded hands for the millenium. I have no kind of objection against accepting a heap of benefits in the future, but I like to help myself to a little fruit as I toil along the road to perfection and perfect bliss.

In plain language, the Society of Arts is a collection of practical men, who think it is better for us all to mend the holes in our garments one by one, and as soon as possible, than to go in rags till we can buy a bran new suit, and other practical men will, I am inclined to think, believe they are right. But the action of the Society is entirely for the general good, and therefore it may most logically ask for general support. Doubtless, the Society does not always please all the world. Who can? But I never yet knew any man or body of men who were intent on the reform of any social abuse, or upon the amelioration of any social institution, that was not desirous of having the Society on its side.

The answer to a note of "A Reader of the *Journal*" is ready made. The Society can most properly appeal to the public for contributions, because it is entirely occupied with purposes of public utility.—I am, &c.,

Verbum Sat.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The following is a return of admissions during the first six weeks:—

	Season Tickets.	Payment.	Total.
Private views	13,916 ..	nil ..	13,916
1st week, ending May 4	5,957 ..	1,914 ..	7,871
2nd ,, ,, May 11....	7,983 ..	22,733 ..	30,716
3rd ,, ,, May 18....	5,571 ..	22,484 ..	28,055
4th ,, ,, May 25....	4,524 ..	52,332 ..	56,856
5th ,, ,, June 1	4,160 ..	29,688 ..	33,848
6th ,, ,, June 8	4,547 ..	28,065 ..	32,612
		Grand total	203,874

Evening Promenades.—It is intended that four evening promenades shall take place in the Exhibition Galleries on the following Friday evenings:—21st June, 28th June, 5th July, and 12th of July. Only season ticket holders and their friends will be admitted. Their Royal Highnesses the Prince and Princess of Wales have fixed the 28th June for their visit to the second of the series of evening promenades. The Galleries of the Exhibition will be lighted up, and the arcades of the gardens of the Royal Horticultural Society illuminated.

Cotton Cultivation.—The hot-house for cotton plants in the west grounds of the Exhibition was opened on the 1st June. It has been arranged under the superintendence of Major Trevor Clarke and Mr. Barron, and contains nearly a hundred cotton plants in different stages of growth, and of the following varieties:—Sea Island, New Orleans, Sea Island crossed with New Orleans, Uplands (green seed), Egyptian, Borneo, Chinese, North-West Provinces of India, Hinjunghât, Juree, vine cotton, Assam, arboreum, and hybrids raised by Major Trevor Clarke.

Indian Jewellery.—A case of jewellery has lately been transmitted through the Colonial Office from the government of Ceylon to the International Exhibition, and its contents have been arranged in the jewellery gallery. The ornaments are such as are worn by the natives of Ceylon, and are characteristic of the native instinct for certain peculiar forms of decorative ornament. The collection embraces, firstly, Singalese jewellery, as worn by the peasantry of the low country; secondly, Kandyan jewellery, worn by women; thirdly, Tamil jewellery, such as commonly used by the peasantry of the west and north-west provinces; and, fourthly, Tamil jewellery worn by the peasants of the north provinces.

The "Walter" Printing Press, exhibited in the East Machinery Annexe, adjoining Room XII., is the machine on which the outer sheet of the *Times* is printed at 11 a.m., and a portion of the second edition at 2 p.m., daily. On Mondays, Wednesdays and Fridays, at 3 p.m., the *Mail*, a tri-weekly reprint of the *Times*, is printed. It is exhibited by John Walter, Esq., M.P., and the following descriptive account of it is taken from that published in the *Scotsman* of 1st February, which was copied into the *Times* of 7th February:—"The 'Walter' Press is what is called a 'perfecting' machine, as it prints both sides of the sheet at one operation, and for this reason the 'register' is necessarily perfect—that is to say, the pages on one side are printed exactly on the back of the pages on the other side. The manual skill required in other machines to lay on sheet after sheet with the requisite accuracy is entirely dispensed with. There is a great reduction in the number of inking rollers, less ink is required, fewer blankets, and the whole details of the machine are so simple and solid, that, with ordinary care, there is nothing liable to get out of order. The new press ensures greatly diminished waste of paper, and gives a knowledge, never before realised, of the kind of article supplied by the papermakers — how it counts and weighs per ream, and with what degree of uniformity it is produced. Even to the uninitiated, the 'Walter' press, when seen in operation, at once proclaims its merits by its rapid and accurate production, its almost self-acting character, and its simplicity. A reel of tightly-rolled paper, in the form in which it leaves the paper-mill, fully four miles in length, and weighing nearly 6 cwt., is placed at one end of the machine, and in the process of unreeling is damped, printed first on one side, then on the reverse with unfailing precision, is cut into sheets, and delivered at the rate of fully 12,000 copies per hour at the other end of the machine. The delivery takes place on two boards, each of which receives a sheet alternately. The boards are watched by lads who, notwithstanding the great speed, have still time to see that the work is properly done. The sole attendants necessary are those two lads at the delivery boards, and a third, the striker, who starts the machine, and looks after the rolls as they are unwound. While printing, the paper travels through the machine at the rate of nearly 1,000 feet per minute, and a reel four miles long is thus printed in less than twenty-five minutes. The delay in changing from one reel to another scarcely exceeds a minute, so that the production is thus almost continuous. The manner in which the printing is done on the 'Walter' press is as follows:—The paper is led from the reel into a series of small cylinders, where it gets damped, and is then brought between the first and second of four cylinders raised perpendicularly above each other. The top cylinder is encircled by stereotype casts from four pages of type, and the lowest of the four cylinders is similarly surrounded by stereotype plates of the remaining four pages of the newspaper. The paper, in passing between the first and second cylinders, receives the impression on one side. It then passes backwards between the second and third cylinders, and resumes its forward direction in passing between the third and fourth cylinders, from the latter of which it receives an impression from the stereotype plates on the side of the paper exactly opposite the part printed by the top cylinder. The paper continues its course onwards till it passes between two cylinders exactly in the centre of the machine, where, by a very ingenious contrivance, it is cut into sheets, each forming a complete newspaper. Adjoining the cutting cylinders is an index, which counts each sheet as it is cut. After the cutting is accomplished, the sheet is led forward by a set of tapes till it reaches the apex of the triangle formed by the left portion of the machine. From this point it descends perpendicularly, and the sheets are thrown alternately forwards and backwards on to the boards held by the two lads. The series of rollers to the left of the reel, and a similar series on the left of the upper printing cylinder, supply and distribute the ink, which is pumped up by mechanical contrivances from a cistern placed beneath the floor. Compared with the speed of the 'Walter' press, the fastest presses of the old construction look as if they were going to sleep. Their speed was governed by the limit of dexterity in the layer-on, and as, for all practical purposes, he could not feed in more than from 30 to 32 sheets per minute, it was only possible to get the power of printing large numbers by multiplying the impression cylinders for each type-bearing surface. But when beyond four, or, at the outside, six impression cylinders in a press are reached, the complication becomes objectionably great. The stoppages are frequent, the waste excessive, and the risk of accident to the machine and material formidable. The working cost of such machines must be heavy, and the working cost is the essential thing to consider; especially when the circulation of a newspaper rises beyond the producing power of one press, and it becomes necessary to duplicate, triplicate, and quadruplicate, to meet the demand. The speed of the 'Walter' press being, on the other hand, independent altogether of manual dexterity, and regulated solely by mechanical appliances, is capable of increase in a way that no printing machine on any other principle can possibly be. Experiments have shown that the machines can produce excellent work at the rate of 15,000 and even 17,000 complete copies of an eight-page paper per hour."

EXHIBITIONS.

THE VIENNA EXHIBITION.

The Minister of Agriculture and Commerce of France has addressed a circular to the Chambers of Commerce throughout France, relative to the Exhibition to be held at Vienna next year. The minister dwells impressively on the necessity of France not only taking part in the exhibition, but in a manner worthy of the rank she has taken in all exhibitions, from the first Great International Exhibition of 1851 inclusive. The circular says:—"It is not necessary for me to dwell on the general results of the great national exhibitions; but with regard to that of Vienna, I must draw your attention to the fact that it will be the rendezvous of populations to whom our productions are yet but little known, and amongst whom new and highly-advantageous markets may be opened." These are important hints, and they apply equally well to British as to French manufacturers, in fact, more so; for while the rich inhabitants of the outlying provinces of Austria and of the surrounding countries are pretty well acquainted with the elegant and costly productions of France, the mass of the people in that part of the world are far from sufficiently acquainted with the thousand-and-one excellent and cheap articles of common use produced every day in the factories and workshops of Great Britain. It is not likely that our manufacturers will neglect the opportunity thus offered them of exhibiting their productions on the banks of the Danube; but the French minister's words are worth transcribing. The French government, in order to aid its manufacturers and merchants, has taken upon itself to defray the cost of the space allotted to France, but leaves to the exhibitors themselves that of cases, fittings, installation, and transport. The last item, however, will be greatly reduced by an arrangement made between the French and German railway companies. The minister, moreover, invites the Chambers of Commerce to undertake the duties of juries or committees, by receiving the applications of proposed exhibitors, and deciding on the admission or rejection of articles proposed to be sent to the exhibition.

In connection with this subject, it may be mentioned here that, in consequence of the happening of the Vienna Exhibition, and the expenses undertaken by the French government in connexion with it, it has been decided that France will not take part in the English International Exhibition next year. This is a rather strange determination, to the detriment of French producers, especially as the building at South Kensington is ready, and the expenses must be comparatively small. The only compensating feature is the leaving of additional space free for Great Britain and other countries.

The following are the particulars of a competition for prizes to be awarded for the best instruments for cultivating and raising sugar beetroots at the Vienna Exhibition:—

1. Austro-Hungarian beetroot-sugar manufacturers and cultivators of sugar beetroots have opened a subscription, and put at the disposal of the undersigned chief manager a considerable amount to be distributed as prizes on the occasion of the Universal Exhibition of 1873, for the best instruments for cultivating and raising sugar beetroots.

2. The competition comprises all machines and instruments necessary for cultivating and raising beetroots:—(*a*) A beetroot drill, depositing the seed in tufts, eventually combined with a distributor for artificial manure. (*b*) An instrument (harrow or roller) which, without injuring the beetroots, pulverises the soil hardened by showers, and facilitates the thriving of the plants. (*c*) A hoe for hoeing the weeds as soon as the beetroot begins to shoot, and a scarifier for destroying the weeds, and, at the same time, for loosening the soil to a greater depth. (*d*) A machine for raising beetroots which acts without damaging them. (*e*) An instrument (tool) for cutting off the tops of the beetroots, and which may at the same time be used for cleaning the beetroots. (*f*) A hand instrument for cutting up beetroots. (*g*) A hand instrument for raising beetroots.

3. The competitors can either compete for all the machines and instruments enumerated, or only for one or more of the same.

4. The following prizes will be awarded:—(*a*) For the two best beetroot drills, two prizes of 2,000 florins and 1,000 florins, Austrian currency. (*b*) For the best harrow or roller for pulverising the soil, a prize of 500 florins, Austrian currency. (*c*) For the best weeding machine, a prize of 1,000 florins, Austrian currency. (*d*) For the two best scarifying machines, two prizes of 1,000 and 500 florins, Austrian currency. (*e*) For the best beetroot raising machine, two prizes of 3,000 and 2,000 florins, Austrian currency. (*f*) For the best instrument (tool) for cutting off the tops and cleaning the beetroots, a prize of 200 florins, Austrian currency. (*g*) For the best hand instrument for cutting up beetroots, a prize of 200 florins, Austrian currency. (*h*) For the best hand instrument for raising beetroots, a prize of 300 florins, Austrian currency.

5. The prize donors, having the greatest interest in the success of the competition, will also appoint the jury for judging the machines sent for competition. The undersigned chief manager will send in due time the invitations to the prize-givers.

6. The jury will be composed of five members, out of whom the chief manager will appoint a president. All business will be done in the usual manner.

7. Prizes can only be awarded to those instruments which have really been worked with in the field, and which have been judged accordingly. In consequence, the jury, together with the chief manager, will choose the beetroot fields where these trials will have to be made. Care will be taken that those machines which will have been constructed for a special kind of soil only work in that soil, whilst those which ought to be fit for every kind of soil will be tried in different kinds.

8. The competing machine manufacturers must send all machines and instruments, excepting the raising machines, &c., at the beginning of the month of March, 1873, to the undersigned general direction. Beetroot raising machines may be sent until the beginning of September.

9. The award and distribution of prizes will take place in the course of the month of October, or at the latest during the month of November, 1873.

10. The principle of the jury must be to award only prizes to those machines and instruments which are quite adapted to their purpose. If no such machines and instruments be sent, or if they only be reproductions of instruments for the cultivation and raising of beetroots already known, no prizes will be awarded.

11. Consequently, if one or more prizes be not awarded in the year 1873, there will be another competition the next year, and the jury, in that case, will again have to distribute the prizes, or else another competition will take place the year following.

12. Moreover, a sum of 300 florins will be placed at the disposal of the jury, to be awarded for machines and instruments which are not mentioned in Art. 2, but which have been sent for this competition, and which are particularly adapted to the purpose.

13. The above-mentioned special jury and the international jury of the Universal Exhibition, 1873, are entirely independent of each other, and the money prizes distributed by the former differ totally from the prize medals awarded by the latter. The machine manufacturers who compete for these money prizes have, therefore, the right to exhibit duplicates of their instruments at the Universal Exhibition of 1873, in order to have them judged also by the international jury, and to compete for the prize medals, which are awarded by the latter in accordance with the general programme of the exhibition.

Archduke Regnier, President of the Imperial Commission.
Baron de Schwarz-Senborn, Chief Manager.
42, Praterstrasse, March 20th, 1872, Vienna.

Brussels Fine Art Exhibition.—This exhibition, known as the Belgian General Exhibition of Works of Art, which is open to artists of all classes and nations, is announced to open on the fifteenth of August, and to close on the fifteenth October this year. Works for exhibition must be delivered at the École des Beaux-Arts, Brussels, on or before the 15th of July, after which day nothing will be received. The commission defrays the cost of carriage by ordinary railway trains within the boundaries of the country.

Opening of the Fine Arts Exhibition in Nottingham.—The Midland Counties Fine Arts and Industrial Exhibition, in connection with the South Kensington Exhibition, has been formally opened by the mayor, at the Exchange Hall, Nottingham. Since the preliminary opening, when the mayor gave three *conversazioni*, the display has undergone some modification, many things having been added and others removed. The ante-rooms, which were set off for the purpose of enhancing the appearance of the building to give festive effect, have undergone an entire change. The floral and drapery embellishments have given way to objects of interest in the museum, so that what is lost in ornamentation is compensated for in sterling worth. Mr. H. Cole, C.B., and Mr. Wallis, of the South Kensington Museum, and most of the members of the corporation, as well as many of the principal gentlemen of the town, met in the mayor's parlour, and walked in procession with the mayor to the Exhibition. After the Mayor's address, Mr. Cole said they in Nottingham had a School of Art at the head of all other art-schools in the country, and it had seemed to him that they were bound to have a permanent museum. They had now got it, and he heartily congratulated them on having done so. He declared he never saw anything equally successful. It was altogether a striking collection, and he was glad to see that those who had taken an interest in it had acted in such a catholic and admirable spirit. He had seen the museum at Lyons, and, in the way of lace, they had made in Nottingham as good a begining in their own way as Lyons, with its hundred years' experience. It was true that South Kensington was becoming the storehouse of the country, and there were other public institutions which he hoped might also become storehouses. He trusted that the National Gallery would furnish an institution like that, with a great many of its superfluous pictures, and that the British Museum would send objects of art and science, for they were smothered with things that could not be seen. But it was all very well to bring these objects to the town, they must find a building to hold them. They had found a most excellent one, and, although it was small, it would lead to a much larger one whilst they had the guardianship of the chamber.

THE USE OF CHINA CLAY IN COTTON MANUFACTURES.

Dr. Buchanan's report "On certain sizing processes used in the cotton manufacture at Todmorden, and on their influence upon health," has been presented to Parliament. On the 20th July, 1871, a memorial on the subject was addressed to the Privy Council, signed by about 1,650 weavers of the district of Todmorden, in the counties of Lancaster and York. (See *Journal* 976, vol. 19.)

Dr. Buchanan says he was instructed to inquire, as a medical inspector, into the subject of complaint. The inquiry, postponed from various unavoidable causes, has been made during the past month. In recording its results, he proposes to give a general consideration to the sizing system, and to omit, almost wholly, the names of individuals and establishments. The report goes on:—

"My personal investigation into the subject was confined to the district of Todmorden, but I learnt that processes similar to those there observed, or modified in certain respects, were very widely employed in cotton factories throughout Lancashire and Yorkshire. Up to 20 years ago, 'sizing' of cotton consisted in the use of some fermented flour and tallow, in order to give tenacity to the warp and to lessen friction in the weaving process. The amount of such size required for this purpose to cotton of the quality that was usual 20 years ago averaged for ordinary cotton goods about 20 per cent. of the weight of the warps. About 20 years ago, it was observed by some sizers that the brownish colour given to cotton cloths by size made from inferior kinds of flour could be reduced by the addition of a small quantity of china clay to the size; and further, that this material so far reduced the glutinous quality of the flour that the sized warps would weave easily with a less amount of tallow in the size. In 1854, at the time of the Russian war, the increased price of the usual sizing materials led to a further substitution of china clay. Some manufacturers, when these facts came to their notice, would have nothing to do with the new substance, and insisted on having the desired whiteness and freedom in weaving by the use of good flour and tallow in the size. But other firms were content if they got the results they wanted in the appearance of their cloth, and could get their sizing done more cheaply by employing sizers who used china clay. This was the first stage in the use of the substance, a certain quantity of the clay entering into the composition of the size, and the number of factories becoming more numerous that used such sizing, but the total amount of size in proportion to cotton not becoming materially increased.

This was the state of matters when, in 1862, the American war produced the English cotton famine. Cotton then very rapidly rose in price, and the better sorts were almost unattainable. Now, it appears that warps of shorter fibred cotton are difficult to weave unless the needful tenacity of the twist be given by a larger amount of size than would be wanted for better sorts. Of size made of flour and tallow, warps from the worse kinds of cotton are stated to require even more than 20 per cent. of their weight. The product is, of course, worse in quality than cloth made from better raw material; but as poor cotton had to be employed, it was necessary to use such quantity of size as would allow it to be woven. But the lack of cotton in 1862 introduced another practice. Weight for length had been, as it is, the chief test of the goodness of any description of yard-wide cloth; and with the scarcity of raw material came the practice of giving a fictitious weight to cloths containing less cotton, in order to make it appear that they contained more. It became a matter of rivalry with sizers which of them could, on the order of manufacturers anxious to meet the demands of merchants, 'put on' most foreign matter upon the cotton warps.

"From the practice of 'heavy sizing' the more reputable manufacturers long kept aloof, but they did so at the expense of their immediate trade; and for the last three years every yard of cotton cloth made at Todmorden, and many other places, has been weighted with quantities of size not required for any manufacturing purpose, but used as an adulteration.

"The 'size' that is thus put on to cotton warps is of various composition. It may still consist in the main of flour and tallow, some sort of salt being added, either for the purpose of lessening the glutinous quality of the flour (which otherwise would, when used in quantity, stick the warps altogether), or else for the further purpose of retaining moisture, and thus of increasing weight. Epsom salts and chloride of magnesium (with sulphate and chloride of zinc, not yet in common use at Todmorden) have been the principal salts used for one or both of these purposes; and these substances go by the generic name of 'antiseptics,' a name which would appear to belong more properly to those of the salts which have the further property of preventing mildew in the artificially weighted cloths. This class of substance is that to which the memorialists refer as 'poisonous ingredients.'

"The salts above mentioned are not in the ordinary sense 'poisonous;' that is, the small quantity of them that comes off the cotton warps in the weaving process would not if taken into the stomach kill a person. It is, indeed, asserted that more mischievous substances have for their 'antiseptic' properties been put into size. These are the terms in which a newspaper refers to certain of such: 'Size is fermented vegetable and animal matter, and when once life—vegetable or animal —has been started in it, it rarely and with great difficulty extinguished. And here again comes another source of mischief. The antiseptic Mr. Molesworth so mysteriously vapours about is an addition intended, practically speaking, to keep the mixture of cotton size and clay from vegetation, and as a rule consists of alum, arsenic, or baryta. None of these compounds are desirable elements of our daily bread or food, but their effect and quality have also been exaggerated.'

"After the best inquiries I was able to make, I have satisfied myself that this statement, so far as regards the use of arsenic and baryta, has no application to the process of sizing as practised at Todmorden. It will subsequently be seen that this opinion is supported by chemical analysis. I think it doubtful whether arsenic has anywhere been at all commonly used. But although the sizing that shall give the desired amount of weight does not necessarily include china-clay, yet in practice that substance is far more commonly added in heavy sizing; for not only does it give a whiteness to the over-sized cloth, and help the weaver by 'opening the twist' —that is lessening the cohesiveness of the warp-threads that would result from the over-use of the flour-size alone—but the clay itself serves with particular efficiency the desired object of giving weight to the cloth.

"In weaving warps of inferior cotton weighted with china clay and flour mixed with deliquescent salts, there is especial occasion to keep the weaving sheds damp, as in this way the brittle compound of cotton, flour, and clay is less liable to break, the clay comes off less, and the resulting cloth is also heavier by the weight of the retained moisture. The conditions that are most favourable to the weaving were being, during the winter weather of my visit, ensured by windows and so-called 'ventilators' being habitually kept closed. Beyond those here mentioned, however, no other sources of artificial dampness were seen at Todmorden. But it may here be noted, with reference especially to remonstrances which have been addressed to my Lords of the Council by weavers at Blackburn, that there are certain cotton-weaving sheds in Lancashire where other means of procuring the desired dampness are adopted. These means consist in the injection of steam into the shed from perforations in the heating-pipes, and in 'degging,' or keeping the floor of the shed damp with water, the sheds in either case being kept closed as much as possible; and these practices are adopted, in part at least, as the corollary of a system of sizing, not indeed identical with that in use at Todmorden, but not differing from it in any such essential respects as to need record in this connection.

"In the course of my inquiry at Todmorden, I visited 17 weaving sheds on the premises of 12 manufacturers. In four sheds, belonging to two manufacturers, there was in daylight no perceptible haze in the atmosphere. In all the others there was more or less of haze, caused by very fine particles of dust. In all the sheds there was more or less dust on every surface where it could settle, and this though the floors and looms had been cleansed of the dust on the previous evening or in the course of the same day. This dust was generally loose, but in one or two establishments it tended to adhere to the floor. These were places where sizing was done in the establishment, and where fatty material but no 'antiseptic' was used. The looms were in all cases covered with opaque dust, varying in amount from a slight bloom in the sheds of the just-mentioned establishments to a thick layer in some other sheds. The quantity of dust was found to depend in part upon the sort of cloth that was being made. In the most dusty sheds the clothes and hair of the weavers were seen covered with fine, white dust. Further, the stranger-visitor experienced in all the more dusty sheds, and roughly in proportion to the amount of visible dust, very great irritation in the nose, and in a less degree to the eyes and throat. To this irritating effect of the dust a frequent visitor, and still more a weaver, gets speedily accustomed; though there is a certain number, apparently a minority of weavers, who remain incommoded by it whenever their work is more than usually dusty. I need hardly say that there is no cause for satisfaction in the deadening of sensations that should be sentinels against irritating matter entering the throat and lungs. Speaking of 'clay' in its ordinary sense—*i.e.* anhydrous clay, with the addition of about one-eighth its weight in moisture—from one-third to one-half the dust consisted of this substance.

"As for the china clay, against which especially the representations of the memorialists are directed, the statement is confidently made by manufacturers that, through its weight, the particles must fall directly downwards from the looms, and cannot reach the face-level of the workers who stand over them. This statement is little less than absurd to anyone who goes, without preconceived notions, into an average Todmorden weaving shed. Whatever dust can lodge, at all levels of the shed, on the hair and caps of the workers, on the heating pipes 8ft. from the ground, everywhere the dust is of the same opaque, white kind. When the gas is lighted the spaces between the lights are white in weaving sheds, while in the adjacent throstle-room the spaces between the gas jets are perfectly black. That this dust is, in effect, the china clay, quite as much as other matters, has been proved by direct experiment.

"Examining the yearly death-rates of Todmorden from lung diseases and consumption together, and comparing them with the corresponding rates of England at large, there is found to have been in 1851-60 no excess of such mortality among persons of the middle period of life (the figures are 467 against 448), but some excess among persons over 55 years of age (1,340 against 1,190). The Todmorden death-rates of the last few years, as compared with those ten years ago, from lung disease and consumption, show only one important change, and that consists in a considerable increase—from a rate of 1,340 to a rate of 1,860—of such mortality among people over 55 years old.

"Examining the mortality registered as from lung diseases separately from that registered as consumption, there would appear to be great and growing excess of 'lung diseases' in Todmorden; while there has been a lower death-rate from 'consumption' there than in England, and this death-rate is less now than formerly. However, experience has shown that in an instance like the present it is unsafe to draw inferences from the death returns, in regard to the prevalence of the one class of diseases apart from the other, as the appearance of disease in the death register under the one or the other class may be more a question of nomenclature than of facts.

"All the medical men in Todmorden agree that lung diseases are greatly prevalent there, and that the circumstances of employment in the cotton manufacture conduce to such diseases. There is a general agreement, too, that cotton workers with a family tendency to consumption have that tendency developed, and that those who without such tendency continue to work in mills up to 40 or 50 years of age very commonly break down with lung disease. It is also agreed that they suffer much, and more than other people, from dyspepsia. But here the general agreement ends. On the whole, medical opinion inclines to there being more ill effect on the lungs of weavers now than formerly, and to the weavers approaching now more than formerly to carders in their liability to chest complaints.

"There can be no doubt that there is a widely-spread, though not a universal, belief among weavers in the injurious effects of 'china clay.' I was given the opportunity of personally conversing with 20 weavers who thought they had been injured by the processes newly incident to the occupation of weaving, or, as they put it, by the china clay. They were of various ages and both sexes, and had had experiences of weaving of very various durations. The commonest complaint among them was shortness of breath coming on at various times after they began weaving, incapacitating them from any active exertion, and ceasing quickly in such as changed their employment for home or outdoor work. Among 11 who had experienced this, four, aged respectively 53, 50, 39, and 19, had distinct emphysema of the lungs; one, aged 18, with family history of consumption, had some consolidation of the apex of one lung; and another, aged 19, had a questionable similar consolidation. Three others had suffered, or were suffering, from bronchitis. Of the 20 persons, 10 gave the history of prolonged subacute dyspepsia. Four had suffered under more or less permanent epistaxis.

"By the persons themselves, often with medical authority, these complaints were connected with the conditions of occupation in the weaving sheds. Besides that the ailments had ceased or had been relieved by cessation of such occupation, statements, apparently trustworthy, were made by several of the weavers that the more dusty sheds increased the intensity of symptoms, and two of them, who had long experience of particular establishments, spoke with confidence to having begun to suffer in their chests only after the introduction of new methods of sizing. All the weavers who were questioned stated that they knew of other weavers who had suffered in some similar way to themselves. A very intelligent overlooker who accompanied me through one of the most important establishments of the town, expressed his own belief that weaving was not so healthy a branch of the cotton manufacture as before heavy sizing was in vogue, and that fewer weavers now pass middle age without getting something the matter with their lungs.

"Such, then, are the facts I have been able to gather bearing on the relation between the disease and the heavy sizing processes used in Todmorden. The evidence converges from various sources, I think, to prove that a slow but certain injury to health results from the circumstances under which weavers work at Todmorden. Experience tells that the diseases set up by dusty occupations are not, as a group, rapidly fatal. During the years that their victims are only disabled (and even disablement comes but slowly) no record is kept of their prevalence. When at last they kill, perhaps after having driven the worker to some other occupation, and having made his life miserable for 10 or 20 years, then for the first time they get registered.

"These conclusions are of quite exact application to the sizing processes used in Todmorden. Of late years, by the use of excessive quantities of 'size,' the amount of dust in the process of weaving has been enormously increased, until it has come to pass that in many mills weaving makes more dust than carding, while there seem to be no means applicable to looms, such as there are to carding engines, of preventing the dust from entering the workroom. Formerly, weaving was notably the healthiest of all departments of the cotton manufacture, and the fact could be connected with the greater freedom from dust in weaving as compared with other kinds of work. Now, in Todmorden it has come to be doubtful whether there is much difference in health between weavers and other operatives. Accordingly, we have already an increase in the previously high death-rate from lung disease and consumption together among residents in the town who have passed 55 years of age; an increase that, under these circumstances and in view of the fact that it all appears on the registers as lung disease and not consumption, must be presumed to result essentially from an increase in those prolonged and miserable diseases that are engendered by dusty occupations.

"Further, unless in the practice of sizing, or in other ways, important changes occur, it is to be expected that the already excessive and increased mortality will still further increase; for the dust diseases are slow in their nature, and the heavy sizing processes that are giving rise to them have not yet had time to produce their full effect."

THE COTTON AND WOOLLEN MANUFACTURES OF BAVARIA.

In a report recently addressed to the Bavarian Government is a mass of information concerning the condition of the cotton and woollen manufactures of Bavaria. An idea of the magnitude of these trades will be at once perceived when it is mentioned that the annual value of these goods manufactured is over 22 millions florins, or in English money about £1,875,000. The number of spindles in Bavarian Suabia alone is over 418,000; the number of power-looms, 3,785; and the number of workpeople employed exclusively in the production of these goods about 10,000. Germany itself, especially Wurtemburg, Baden, and some districts of the former Northern Confederation, constitute the chief markets for that portion of the yarns produced in Suabia which is not appropriated to the supply of the local weaving mills. In recent times, only small quantities of the coarser kinds of yarn have found their way into the Austrian States, inasmuch as the alterations made within the last few years in the Austrian customs tariff have almost put a stop to the export of Bavarian yarn to these states. The general results of the operations of the spinning mills of the province of Suabia are said to be somewhat unsatisfactory of late—this being especially the case in 1869. This want of prosperity is attributed mainly to the fluctuations in the price of cotton, and to the fact that the prices of yarn were almost constantly lower, proportionately speaking, than those of cotton. The weaving establishments, too, are described as having, during the periods mentioned, fared even worse than the spinning mills, prices having been at one time reduced below the point at which sales could be effected without positive loss. The manufactures produced by the looms of Suabia are principally smooth-faced, unbleached cotton cloths, destined either for subsequent printing, or for use as linings, &c.; but some of the Augsburg (Suabia) weaving establishments also manufacture wove pattern, fancy, or coloured cotton goods for dresses, bed coverlets, and other similar purposes, which enter so largely into the commerce of the draper. The chief markets for the cotton cloths intended for subsequent printing, as well as the bleached cloths, are the towns of northern Germany, and especially Berlin, at which latter place the wholesale merchants engaged in the drapery trade, &c., contract to receive exclusively the whole of certain manufacturers' produce. A small quantity of these cloths also go from Bavaria to Switzerland and Bohemia; and of the coloured or fancy pattern cloths some portion find a market in North America. Generally speaking, however, it may safely be said that the cotton manufactures of Bavarian Suabia are confined almost entirely to the precincts of the German Customs' Union.

Hand-loom weaving, which, until quite recent years, was carried on to a considerable extent in different rural districts in the province of Suabia, has declined much in the same proportion as weaving by machinery has increased in the towns. This trade was followed originally by the peasants in their own cottages, who, in most instances, worked for the wholesale dealers in the towns; the loom as well as the yarn being generally provided by the latter, and the work done paid for by the piece. At the present day, the total number of hand-looms still at work is supposed to be under a thousand, the entire product of which is quite insignificant as compared with the power looms of the regular manufactories. The manufacture of cotton twists employs from 350 to 400 persons in the province of Suabia; and it is estimated that there are about 14,000 spindles at work upon this manufacture, the computed value of the product being annually about £65,000, certainly a large amount considering the circumstances. Sewing cotton, the manufacture of which was scarcely known in any of the Zollverein States ten years ago, may now be considered as one of the established articles of production of Augsburg (Suabia) and the adjacent towns, and a ready sale for the sewing cotton is found in the markets of northern and southern Germany. All descriptions are manufactured, both white and coloured, and the several operations of bleaching and dyeing, as well as that of making the cardboard winders, or the wooden reels, on which the sewing cotton is sold, are, as a rule, performed in the same establishment as that in which the cotton itself is manufactured. Sewing cotton in balls is now made in but small quantities in Bavaria, its place having been almost entirely taken by reel cotton, which is said to be accounted for by the very general use made now-a-days of sewing machines. Of late, especially during the year 1869, the manufacture of sewing cotton in Bavaria has been somewhat under a cloud; but it has recently revived to a most satisfactory extent. The fluctuations in the value of cotton, and the disproportion between the price of the raw material and the manufactured article, have been felt by the manufacturers of this useful commodity—so universally in the draper's stock—and other circumstances also weighed unfavourably upon the manufacture, such as the necessity of obtaining from abroad the very finest description of yarn required for it, and especially the fact that, owing to the high import duties imposed in later times in the United States, the chief English manufacturers of sewing cotton have been obliged, in a great measure, to relinquish America as a market for their produce, having consequently especially directed their attention to Germany. Here they have established a very severe competition with the native producers, and, indeed, with true British enterprise have, so far as the fine kinds are concerned, succeeded in acquiring almost a monopoly; the import duty of 4 dollars (12s.) per 100 lbs. Zoll. weight (110¼ lbs. English) being found, as in the case of that of the fine yarns, quite insufficient as a "protection" to the native manufacturers.

Statistics of the cotton manufacture of Bavaria for the last thirty years reveal facts of considerable interest, indicating the great progress made therein. Thus, we find that the quantity of raw cotton imported into the country for home consumption has increased, in the period mentioned, from 396,000 cwts. to 1,309,000 cwts., or at the rate of 330 per cent. The export of raw cotton increased at the great rate of 913 per cent.; and what is still more remarkable, the exportation of unbleached one and two thread yarn augmented, during the thirty years to which we refer, about twenty-eight fold, or at the rate of 2,809 per cent. These figures are assuredly of much significance.

The spinning of flax, hemp, &c., which is now carried on to a very considerable extent in Suabia, is quite of modern origin in that district, and has only recently acquired its present importance. The principal markets for such portions of the linen yarns, &c., produced by these establishments, and specially manufactured for sale, in contradistinction to that spun for third parties, or for use in the local weaving mills, are to be found in the agricultural districts of Bavaria and Wurtemberg. Baden and Switzerland also draw part of their supplies of linen yarn from the Augsburg manufactories. Of late years the operations of these spinning mills are said to be highly satisfactory, the demand for yarns having been steady, and the fluctuations in the price of both the raw materials and the produce of the mills inconsiderable. Owing to the comparatively short period during which the flax and hemp spinning industry has been in existence on anything approaching an extensive scale in Suabia, the number of skilled factory hands is reported to be short of the demand, and in order to supply this deficiency some of the manufacturers have found it necessary to resort to the labour markets of other countries; but this proceeding appears to have been attended with considerable expense and trouble. The weaving of linen yarn into cloth by hand-looms, which formerly was an important branch of industry in the province of Suabia, in connection with both the home and foreign trade, is now reduced almost entirely to manufacture of the coarser sorts of table and bed linen and shirting material, &c. The number of hand-looms for the production of linen at work in the province fell from 4,182 in 1847, to 2,600 in 1861, but subsequently this diminution has been still greater. On the other hand, several establishments for the weaving of linen by machinery have been set going in the province of Suabia during modern times, and especially in the towns of Kemper, Weiter, and Nordlingen, but well-nigh exclusively for the manufacture of coarse fabrics used for linings, mattress covers, &c. Yarn spun from jute is made use of to some extent in these establishments, which also manufacture corn sacks; but the sale of this latter product is seriously interfered with by the large quantities of the ready-made jute sack, which are imported from abroad (Great Britain), the duty on which, under the Zollverein tariff, is very low.

The woollen manufacture of Bavaria, has of late years been in a state of greater activity than it was previously. To this happy state of things the abundant supply and low price of wool mainly contributed; the supplies sent to Europe from Australia, the Cape of Good Hope, and South America having been, in 1868-9, unprecedentedly larger. The most extensive establishment engaged in the woollen manufacture in the province of Suabia is the Augsburg Wool Spinning Company's mills, which employs over 1,000 workpeople, has 37,000 spindles at work, consumes, as an average annual total, 17,000 Zoll. cwts. of wool, and produces about 8,400 Zoll. cwts. of yarn, worth about two million florins, or £166,600 sterling. The manufactories of woven woollen goods in Suabia are chiefly at Augsburg, Nordlingen, Themmingham, and Kaufbeuren. The total number of looms at work was nearly 200, the principal articles produced being blankets, horsecloths, ordinary flannel, and the coarser description of cloth made use of by the rural population for the purposes of their dress and attire. There is also at Nordlingen one manufactory which turns out a common kind of carpet to a considerable extent, but this production appears not to have been developed so successfully as it might be. It is certain at least that Nordlingen carpets are not well known in this country, and it will doubtless be a long time to come ere they can fairly compete with those of Brussels, Kidderminster, &c., so generally in use among the population of this and continental countries.

The printing of cotton and woollen goods has for the last century formed an important feature in the industrial operations of Suabia, and the printed goods sent from Augsburg are well known, not only in the markets of the Zollverein States, but in those of Austria and Italy, and of even still more distant foreign countries. One printing establishment alone—that of Messrs. Schoppeler and Hartmann, which is described as being one of the largest and most complete of its kind, is returned as employing about 500 workpeople, and is producing annually 100,000 pieces of cotton, woollen, and half-woollen printed goods. There are also in the province of Suabia about thirty establishments for the bleaching, dyeing, and dressing of cotton textures, the total quantity of goods turned out by them in the course of the year being reckoned at about 350,000 pieces. Of these goods a considerable proportion is sent to these manufactories in the rough state from neighbouring countries, to be dyed and prepared for the market. After having gone through the necessary process, the goods are forwarded for the most part to Vienna on account of the original producers. Silk weaving, which was carried on to some extent in this province until within the last few years, has by degrees been completely given up, and the mills in which it was conducted have been turned to other purposes—chiefly to that of cotton weaving.

FOREIGN INDUSTRIES AND FORESTS OF VICTORIA.

Last year a Royal Commission was appointed by the Governor of Victoria, to consider and report how far it might be practicable to introduce branches of industry which are known to be common and profitable among the farming population of continental Europe, to specify which of such industries were most suitable to the soil, climate, and circumstances of the colony, &c.; and to consider and report on the best means of promoting the culture, extension, and preservation of state forests in Victoria. This commission has issued a preliminary progress report, with a copy of which we have just been favoured. Among the rival industries known to be profitable to the peasant proprietor or small holder in other countries, the commission recommend for extensive adoption by the colonial agriculturists, olive culture, the drying and preservation of fruits, the growing and dressing of flax, and other fibre-plants, the cultivation of the poppy for oil and opium, the beet root for sugar, plants producing silk, medicinal and dye plants, hops, tea, the cork and Valonia oaks, the castor oil bush, and others named in the list appended. The Commission states that:—

"The olive tree grows in Victoria and many other parts of extra-tropical Australia with a luxuriance rarely attained in Europe, and bears fruit abundantly with little or no care. In the course of our inquiries we have learned that already considerable quantities of olives are grown at Brighton, Heidelberg, Moonee Ponds, Pentridge, and other places in the neighbourhood of Melbourne; but, owing to there being no sufficient means available for pressing, the olives have, in most cases, either been allowed to fall from the trees unused, or else have been applied to so poor a purpose as fattening fowls. To encourage the utilisation of this important fruit, as at Adelaide, we think that mills should be erected in the several local gaols, where the olives could be pressed by prison-labour at a rate to be fixed by the State. It is, we are informed, the custom in Portugal and in South Australia to return to the cultivator one-half of the oil yielded by the olives he delivers, the other half being retained to defray the expenses of maintaining the mill. We would advise the erection of a mill at Geelong gaol, available for the extraction of other kinds of oil besides olive. In that vicinity the almond has been rather extensively cultivated. One gentleman has informed us that he has 900 trees in full bearing, and that he will plant largely next year. Some cuttings of the true Sultana vine, as also several thousands of the white mulberry, have been distributed by the Commissioners, with a view of aiding in the more general adoption of these plants for Victorian culture. We are aware that, for years past, measures of this kind have been adopted by the director of the Botanic Garden in the department under his control, but we think the practice should be carried out more extensively throughout the colony. We feel warranted in reporting to your excellency that the extensive cultivation of flax, if carried out in the first instance under the management of persons thoroughly competent, will result in a remunerative industry, giving to thousands congenial employment. We may mention that as much as seven and a half millions' worth of flax and flax-seed have been imported into Great Britain and Ireland in one year; and that, according to evidence taken before a Committee of the British House of Commons, scarcely a year passes without the Belfast and Dundee mills working short time for want of the raw material. We therefore think no time should be lost in introducing experienced persons, and providing seed and machinery for the full local development of this as well as other important new industries among our colonists. In our opinion prompt and decisive action should be forthwith taken to put an end to the wasteful practice hitherto incidental to the felling of trees and the stripping of bark in the forests of Victoria. We are at present considering the rules and regulations which have from time to time been promulgated by the Board of Land and Works, for the cutting and removal of timber under license, and for the prevention of waste of such timber, in order to ascertain in what manner such rules and regulations could be modified so as to provide a greater check on illegal or wasteful cutting of timber or bark. We think that the number of State forests should be increased; and we concur in the recent action of the Board of Land and Works in proclaiming new reserves for the preservation and growth of timber under the 53rd section of the Land Act, 1869. We are of opinion that, within convenient proximity to the principal railway stations, suitable portions of land should be chosen for forest nurseries, where trees valuable for timber and other purposes might be economically raised from seed in large quantities, for planting out in the forests and reserves of different parts of the colony, or to be bestowed on such selectors under the Land Acts as would be willing to plant them in strict accordance with a code of printed instructions on aboriculture, to be issued by the State. In all the great mining districts and the densely occupied agricultural areas, every encouragement should be afforded to tree growth, by providing State nurseries. In addition to the subjects enumerated, our attention will be given to the inquiry how far the production of wood-tar, wood-vinegar, wood-spirits, potash, tanning principles, volatile oils, pitch, turpentine, and various dyes from native or cultivated trees and shrubs, can be brought within the remunerative reach of local artisans; and it will also be our object to learn how, on a commercial basis, the gathering of the seeds of native trees and other plants, as well as the collecting of resins, gums, medicinal and other indigenous substances, can be efficiently encouraged by public or other means.

Industrial plants, hardy in Victoria, in reference to which further evidence will be collected.—Oil-plants:—Olive, flax (linseed), almond, poppy, *Ricinus* (castor oil), rape, hemp, earthnut, sunflower, hickories, walnuts. Fibre-plants:—Flax, hemp, cotton, ramee (grass cloth), jute, *Phormium* (New Zealand flax), native *Cyperus*, poa. Paper-plants:—Swordsedge (*Lepidosperma*), native *Cyperus*, *Xerotes*, *Cladium*, *Stipa*, *Phormium*, grass-tree, stringy-bark, *Casuarina*. Silk-plants:—Mulberry, *Ailantus*, *Ricinus*, Japan oak, *Maclura*, *Sponia*. Fruit-plants:—Figs, almonds, American and raisin vines, Zante currant, European and American walnuts, hickory, chestnut, Pecan-nut, filbert, helicia-nut, pistacia, ground nut or pea-nut, trapa. Condiment-plants:—Mustard, caper, bitter almond, capsicum, anise, coriander, carraway, dill, olive. Sugar-plants:—Beet, sorghum, maple, melon, *Helianthus*. Starch-plants:—Arrowroot, millet, Chinese mountain rice, *Typhas*. Medicinal-plants:—Cinchona, rhubarb, aloe, camphor, squill, aconite, hemlock, henbane, foxglove, belladonna, buchu, coloquint, poppy, gentian, chirita, *Erythræa*, *Sebæa*, *Pimelea*, jalap, sweet flag, juniper, liquorice, *Uva ursi*, *Veratrum*, *Helleborus*, *Arnica*, *Podophyllum*, *Taraxacum*, senna, peppermint, colchicum, sarsaparilla, *Ricinocarpus*. Scent-plants:—Damascus and other roses, lemon, bergamot, lavender, patchouli, sandal, rosewood, myall, peppermint, wattle, orange, melia, *Pittosporum*. Dye-plants:—Madder, saffron, various woads, *Carthamus*, *Rhamnus*, cochineal cacti, valonia, various native plants of use for their barks or foliage. Tanning-plants:—Sumach, scotino, valonia oak, various oaks and wattles, native catechu, native kino, various native trees. Tea-plants:—Chinese tea, Assam tea. Gum-plants:—Various acaciæ, tragacanth-cisti. Resin-plants:—Various pines, Canada balsam trees, mastix, sandarchs, kauris, Japan varnish tree, grass-tree. Wicker-plants:—Various osiers, various hardy bamboos, xerotes. Broom-plants:—Broom-corn and others. Hop-plant:—Hop in several varieties. Tobacco-plants:—Various species and varieties of nicotiana. Cork-plants:—Cork oak. Culinary-plants:—Various new fruits and vegetables. Fodder-plants:—Various new grasses, clovers, and other herbs; carob-tree. Plants used in the manufacture of woollen goods:—Soapwort, teazel.

PARIS ASSOCIATION OF ARTISTS.

The annual report of this society, presented at a general meeting, held at the Ecole des Beaux Arts, shows how large is the artistic element in France. The association, which is founded for the relief of its own members or their widows and orphans, numbers at present more than 3,500 adherents, and although the annual subscription is but six francs, and a life subscription but 100 francs, with the aid of donations it possesses at the present moment an annual income from the funds equal to £1,467.

In consequence of the sufferings of artists during the late war, the association formed a committee for the collection of works of art, for sale in aid of the funds for the distressed; the committee succeeded in obtaining more than 200 works of art, which produced a sum equal to £1,298, the auctioneer, the expert, and all concerned giving their services gratuitously.

The association, during the year 1870, distributed, in the form of pensions and temporary assistance, more than £1,300, besides purchasing stock to the extent of £2,476. Last year it distributed £730 in pensions, and £700 in temporary relief, medicine, &c.

The association confines its aid rigorously to its own members, and insists on subscriptions being paid up, but it affords every possible facility for this by receiving monthly payments of half a franc each; moreover, several of the members have subscribed sums in aid of their poorer brethren, to whom even that light subscription is a burthen.

The benevolence of the artists was called into operation not long since, by the misfortune of M. Anastasi, who lost his sight; the association at once offered the unfortunate painter the sum of 500 francs, but the sale of a picture enabled him to decline the proferred gift; a committee was then formed to collect works of art to be sold for his benefit; 235 contributions were received, almost all from members of the association, and the sale realised a sum equal to £5,481, with which an annuity has been purchased.

The pensioners of the association amount at the present time to seventy-five, of whom twenty are orphans. Since the society was formed it has adopted 110 orphans, some of whom have won positions which reflect honour upon the benevolent artists.

The list of deaths amongst the members of the association during the past two years is a sad one, including amongst them the talented sculptor, Pollet, whose beautiful statue of the female slave seated was seen at the International Exhibition last year, and who, being in very delicate health, is said to have died for want of proper food during the siege; Morel-Fatio, marine painter and keeper of the marine museum in the Louvre, who died from excitement at the entry of the Germans; Belier de la Chavignerie, author of a biographical dictionary of artists, who died of small-pox caught in an ambulance, to which he had devoted himself, at St. Malo, during the siege; Joseph Cavalier, sculptor, killed in the affair of Malmaison; Henri Klagman, painter, son of the sculptor, who served first in the campaign of the Loire, and afterwards in the Army of the East, and died of his wounds at Bagnières; Victor Giraud, painter, whose last work, "The Bird Charmer," was shown at the International Exhibition last year, although a victim of consumption, persisted in doing his duty in the National Guard, and died of fatigue during the siege; Mongodin, painter, struck with paralysis on the ramparts; Charles Durand, painter, killed at Sedan; Vincelet, a clever flower painter; Richard, still a pupil of the Ecole des Beaux Arts, and Conichon, son of a sculptor, all three killed in the field; and Henri Regnault, the most famous of the rising artists of France, killed at Buzenval.

Amongst the most devoted friends of art and artists were the young Duc de Luynes, killed at the age of 23, while serving with the Army of the Loire, and his brother, the Duc de Chevreuse, perpetual secretary of the association, who was seriously wounded at the same time.

Many other artists and honorary members of the society were wounded, and many more had their ateliers destroyed, and were in some instances utterly ruined.

One of the earliest acts of the society after the capitulation was to lodge the sum of 2,000 francs with the Minister of Fine Arts, for the benefit of the wounded and sufferers by the war.

During the reign of the Commune the society also lost several members. Gence, architect, killed in the street; Jules Bouchet and his son, struck down in their house by a shell; Jules Brandon, captain of artillery and painter, killed at the Barrière du Maine; the Archbishop of Paris, honorary president of the society, whose sad end is but too well known. During the same period, M. R. Anet, M. Laureas, M. Perrier, and M. Langlet, as well as M. Gatteaux, the famous collector and patron of artists; and Dr. Fraigniaud, one of the warmest friends of the association, had their houses and property all destroyed by fire. Such are a few only of the misfortunes which the war drew down upon the members of a single society, to which might be added a long list of privations which, for twelve months, fell heavily upon the poor artists, many of whom passed through months of the severest suffering, often utterly without the means of living, and little fitted, from constitution and habit, to endure the soldiers' privations, and subsist on the coarsest food. It is a sad picture, though only a very small portion of it is here exhibited to public view.

RESTORATION OF BURNT EDIFICES IN PARIS.

The Municipal Council of Paris has determined on the reconstruction of the Hotel de Ville upon its present basis, that is to say, using all the portions of the building which remain uninjured by the fire; these are, however, generally considered to comprise little more than the back wall and the foundations. The work is to be thrown open to public competition.

The rebuilding of the Tuileries, which had been announced in error as determined on, is not likely to be undertaken at present. It is not very likely that a Republican government will weight its budget at the present moment with the cost of re-erecting the most monarchial monument in the capital; and, moreover, great diversity of opinion exists as to the course to be pursued. A proposal put forth some time since has the great recommendation of appealing to the popular mind especially; the plan alluded to is the rebuilding only of the burnt wing on the Rue Rivoli side, with its corner pavillion to match that on the water side, the Pavillon de Flore, which is all but uninjured, leaving the central portion free, and thus extending the open space for public benefit from the Place de la Concorde to the Place de Carrousel, the façade of the Louvre forming the third side of the quadrangle; this arrangement would be very similar to that of the Palace of Versailles, with its great fore-court and flanking wings.

It may seem surprising at first view that the architectural portion of the *Salon* now open (and what it may be here stated in parenthesis is now announced to remain open until the end of the present month of June), contains no projects for the reconstruction of the Hôtel de Ville, and only one for that of the Tuileries. This is really not extraordinary, as architects who hope to compete for these works can scarcely be expected to lay their crude plans open to others, and the production of complete sets of drawing for such undertakings is a formidable undertaking. Two young architects, MM. Chardon and Lambert, form, however, exceptions to the rule, they having sent in a series of elaborate plans for the complete restoration of the palace, with this difference, however, that they propose to make a grand public way in the centre of the new building, corresponding somewhat to the great porticos of the Louvre, which would thus give direct thoroughfare from the Place de la Concorde to the Rue de Louvre, opposite the church of St. Germain l'Auxerrois. Such an arrangement would, in the event of the Tuileries being used as the residence of the chief of the government, have the serious inconvenience of cutting the ground-floor into two portions, as is the case with the Louvre at present.

M. Viollet-le-Duc proposes that the Tuileries shall be rebuilt on a grand scale, so as to render it not only fit for the residence of the chief of the state, but to include such offices as it is desirable to have in the immediate vicinity of the monarch or president of the Republic. The old palace, as M. Viollet-le-Duc says, was one of the most inconvenient imaginable, all the state rooms opening one out of the other, and therefore very ill-adapted for large assemblies. When the new buildings of the Louvre were erected, accommodation was found in them for the residence of two ministers, the Minister of State and of the Beaux Arts, and also for that of the Superintendent of the Beaux Arts, M. Neuwerkerke. M. Viollet-le-Duc would apparently make these an integral portion of the Tuileries itself. But, as already stated, the moment for the rebuilding of a palace is scarcely yet arrived.

As regards the Hôtel de Ville, M. Viollet-le-Duc declares it to have been more incommodious than even the Tuileries, and in its re-construction he proposes a totally opposite plan to that advocated in the case of the latter. The Hôtel de Ville has heretofore been not only the residence of the Prefect of the Seine and the scene of all great municipal fêtes and entertainments, but the centre of all the public offices belonging to the city; and not only were the various departments crowded in the most inconvenient manner, but an immense building opposite, also burnt, was required to give additional space for the offices of the engineers who had the direction of the water-supply, sewage, and other public services.

It is not, often, happily, that the reconstruction of great public establishments is suddenly forced upon a city, and the projects put forth under such circumstances cannot fail to supply valuable opportunities of study. The decision of the municipal council in favour of public competition in the case of the Hôtel de Ville adds to the general interest. The administration is now occupied with the drawing up of the details of the plan, which, before being submitted for competition, will be examined and approved by the council.

NOTES ON ART.

M. Charles Blanc, director of Beaux-Arts, will, it is said, immediately after the close of the *Salon*, offer a sum equal to £120 for the best landscape sent in for competition, the subject to be selected by M. Corot. The idea of classification of works of art in exhibitions has often been mooted, and there is certainly something illogical in competition amongst all classes in oil painting. Perhaps, should the proposed competition have a satisfactory result, we may in future see the medals for oil paintings divided into classes, as, for instance, figure pieces, portraits, and landscape. At any rate, the idea of a landscape competition is a happy one, and if successful must lead to further innovations. The number of medals usually given at the annual exhibitions in Paris in the class of painting which includes water-colour drawings and works in pencil, chalk, pastel, or any other manner, is forty. The prizes for the present year are not yet awarded, but in 1870 the medals were distributed as follows:—24 for figure, 11 for landscape, 4 for portrait, and only one in the whole sub-class of water-colour, chalk, or other drawings. In former times medals were awarded of three classes, and thus landscape painters, those who aimed only at the more modest forms of composition, and painters of inanimate objects, obtained a due amount of notice. At present, the medals are all of the same value and denomination, whether given for a splendid composition of the highest class or a well-painted portrait; the only higher rewards that exist is the medal of honour, one only of which is given in painting and another in sculpture in most years, and the decorations of the legion of honour. Probably no class suffers by this arrangement so much as landscape painters, who, because landscape is not held in sufficient esteem by most juries to cause them to award one of the unique class of medals, obtain for years no recognition whatever of their efforts and talent. Again, the award of one medal in the class of water-colour, chalk, and all other kinds of drawings, in which class there were, in 1870, as many as 1,238 works exhibited by considerably more than half that number of artists, is evidently insufficient. It is true that the proportion of medals awarded to landscapes was considerable; but it is evident that one class or the other must almost always suffer by this heterogeneous competition, and it will be a highly satisfactory thing for art should M. Charles Blanc cause the inauguration of a better, that is to say, more graduated and defined system of rewards.

Since the above was in type the list of awards made by the juries of the *Salon* has been published. The juries have followed the desires of M. Charles Blanc, and have been sparing of superior medals. It was arranged that in case of all the first-class medals not being awarded in any class two second-class medals might be given in place of each first-class medal withheld. In the class of paintings and drawings the jury has only awarded four out of eight first-class medals, and has in consequence increased the number of second-class medals from sixteen to twenty-four; in the class of sculpture the jury has awarded only two instead of four first-class medals, and has increased the number of the second-class of awards from eight to twelve. The jury has also exercised its power of awarding honourable mention in twelve cases in the class of painting, one in that of sculpture, and five in the class of engraving and lithography. The grand medal of honour is awarded to M. Jules Breton, whose clever realistic pictures of French peasants are well known. His two pictures now at the *Salon*, "La Fontaine" and "A girl watching Cows," have attracted great attention.

The contributions of French artists to the fund for the relief of the sufferers from the great fire at Chicago, collected by MM. Goupil and Co., have been sold in New York, and fetched the respectable sum of 38,087 dollars, or upwards of £7,617. Amongst the most remarkable items were "Une Italienne," by Cabanel, which sold for 800 dollars; "A Souvenir of Mount Sinai," by Gérôme, 1,035 dollars; "Industry," by Merles, 2,000 dollars; "Allan Macaulay," by Horace Vernet, 1,300 dollars; "Spring," by Williams, 925 dollars; and a sketch of a soldier of the time of Louis XIII., by Meissonier, 2,275 dollars. Seeing the number of pictures that now find their way to America, and the large prices for which they sell, the exorbitant rates lately obtained in London and Paris are not surprising.

Amongst the recent acquisitions added to the Paris museums, a work by an English artist is remarkable. This is a charming portrait of a lady, drawn by Sir Thomas Lawrence, and presented to the Louvre by Madame Ducreit de Villeneuve. It is placed in the small pastel room. The Louvre has also added to its stores two remarkable pictures, a "Descent from the Cross," by Roger Van der Weyden, bequeathed to the nation by M. Misbain Moage, and "Peter denying his Master," by the brothers Sinans, presented by M. Jules Vallée. The museum of coins and medals at the Hôtel des Monnaies, the Mint of Paris, has just placed two new cabinets at the top of the grand staircase; one of these contains a complete collection, or what is said to be so, of the postage-stamps of every country in the world, not disfigured by the obliterating stamp, but clean and fresh as from the hands of the printer. The other cabinet contains a variety of highly valuable and interesting objects, including a collection of antique medals in very good preservation, and an immense gold ring, bearing the cypher of Chilperic II.; this interesting relic was found at Tournay, and presented to the museum by M. Lecavalier, of Caen.

The Prince Albert's Memorial, Hyde-park, is approaching completion. Mr. J. B. Philip has completed his two sides of the marble base, illustrative of architecture and sculpture. The figures in bas-relief, 89 in number, display on one side a line of illustrious architects, and on the other a company of eminent sculptors. The *Standard* says the earlier masters are of course creations of the brain, more or less—men of the noblest mien, draped after the sculptor's idea. Mr. Philip has dealt wisely and liberally with his representative men. The choice is perfect. Each country and nationality which has favoured the arts in question finds a place in the composition. Glancing at the ancients, the Hirams, Bezaleels, Cheops, and Sennacheribs, we touch upon the Phidian era, and mighty names succeed to mighty names too numerous to particularise here, until we are set down in the lower spheres of our own and neighbouring countries among lesser men. Suffice it to say that there is hardly a known sculptor or architect of distinctive genius omitted. What Mr. Philip has achieved for his histories Mr. H. H. Armstead is doing for music, painting, and poetry, but has not quite completed his labours.

NOTES ON SCIENCE.

A discussion that is going on among scientific photographers, relative to meters for guaging the power of light by means analogous to those by which barometric or thermometric fluctuations are determined, reveals the fact that an actinometer that shall determine the chemical power of light by a graduated scale is by no means the impossible thing that many physicists have long believed it to be. If a hydrometer be left immersed in a liquid which has the property of altering its specific gravity, according to the intensity of the light to the action of which it is exposed, the hydrometer will sink and rise by each variation in the luminous intensity; and this vertical motion of the hydrometer can, by obvious means, be either converted into circular motion, like the common barometer with the round dial, or its indications may be registered by means of a graduated vertical scale. One part each of nitro-prusside of sodium and perchloride of iron, dissolved in five parts of water, yield a solution which is decomposed by the action of light, although it remains stable for a long time when kept in the dark. In virtue of this decomposition, prussian blue is precipitated, and the specific gravity of the fluid is so altered in consequence that a hydrometer, if immersed in the solution when brought out into the light, will gradually sink as the solution becomes less dense from the deposit that is gradually formed. This, however, does not provide the means of continuous registration, as the solution just described does not re-compose in the dark. It is said that this desideratum is on the verge of being obtained, a solution having been nearly perfected which possesses every requisite feature for the effective registration of the intensity of luminous action. Another method of actinometry is based on the liberation of certain gases from liquids by means of light. Peroxalate of iron, when exposed to light as an aqueous solution, liberates carbonic acid, protoxalate of iron being precipitated. The pressure of the liberated gas may be utilised for metric purposes, by means of the rise or fall of any liquid in a tube to which the liberated carbonic acid gas has access. In like manner is this acid liberated from a mixture of a saturated solution of oxalic acid and nitrate of uranium.

When lecturing at the Royal Institution, on "Substitutes for Gunpowder," Mr. Abel, F.R.S., chief chemist of the War Department, commented on picric powder, which he considered one of the safest of the violent explosives, and therefore well adapted for charging shells. Nitro-glycerine, which, in its pure, liquid state, was one of the most dangerous of explosive compounds, had been converted by Mr. Alfred Noble into the solid form termed dynamite, and thus brought within the range of safe and convenient use. When contrasting the powers respectively of dynamite, gun-cotton, and gunpowder, the lecturer said that, in respect of mere power, the first two were about equal; but the latter could not be satisfactorily replaced by these, or any other kind of violent explosive, for certain kinds of work in which the gradual action of the gunpowder was a specially valuable feature. One great objection to nitro-glycerine had arisen from its being a fluid; but since Mr. Noble had mixed it with finely-divided silicious earth, and made it into a pasty mass (dynamite), there was no longer any danger to be apprehended from this cause; and its explosive force, when most advantageously employed, is about six times greater than that of gunpowder. The chief advantages of dynamite and compressed cotton were a saving of time and labour in tunnelling or in blasting hard rock, and also in the rapid removal of submerged wrecks. The best effects in work of this latter kind were obtained by employing first the more violent explosive, to produce extensive rending and shattering, followed by gunpowder, which had a greater displacing effect. Concerning picric acid and its salts, Professor Abel said that a mixture of ammonium picrate with saltpetre proved the least sensitive to explosion by blow, thus contrasting remarkably with the violently explosive mixtures of potassium picrate which have been made the subject of experiment in France. The mixtures of ammonium picrate with saltpetre and chlorate of potash, although less explosive than when the potassium or barium picrates are similarly used, are considerably more so than gunpowder, and the saltpetre mixture, which has been called "picric powder," has been shown by extensive experiments to be as safe as powder in manufacture and use, and as permanent in character, shells charged with it having been repeatedly fired from guns of a large calibre with heavy powder charges; and there consequently appeared strong reason for placing confidence in this material as fulfilling the conditions, in regard to safety and power, of a very efficient powder for shells.

Mr. Spottiswoode, F.R.S., in the course of a lecture on "Optical Phenomena produced by Crystals submitted to Circularly Polarised Light," which he delivered before the Royal Institution, exhibited the phenonema by means of a plate of mica split to such a thickness that one of the two rays into which plane polarised light is divided on entering it, is retarded by an odd number of quarter-wave lengths behind the other. This contrivance is known by the name of a "quarter undulation plate." In terms of the wave theory, light was said to be "circularly polarised" when the vibrations were circular, as distinguished from plane polarisation when they were rectilinear.

What is the nature of a diatom? This question is one that will interest every possessor of a microscope. Professor Weiss, of Lemburgh, demonstrates that the silicious investment of diatoms has cellulose for its base. He shows that silicious coal is capable of polarising light, and that it contains iron oxide compounds; and he contends that each frustule of the Diatomaceæ is composed of numerous minute but individualised cells.

It is suggested by Dr. Morton, of New Jersey, in a recent number of the *Chemical News*, that when a magic lantern is so arranged that its optical system is vertical instead of being horizontal, the objective may be supplanted by an empty watch glass. A striking popular illustration of refraction, and its relation to the formation of images by means of lenses, may be arranged in the following manner:—First, fill the spherically curved watch glass by means of liquid having a low refractive power—water for example—and then throw an image of any striking object, such as a statue, on the screen. Next remove the watch glass, empty out its contents, and replace them by a liquid having highly refractory powers—chloride of tin, for example. The image will be indistinct until the lens is brought nearer to the object, the image on the screen being of course larger than it was previously. He suggests that this method might be applied to the measurement of indices of refraction. Fluid lenses having, we believe, originated in this country, it was scarcely to be supposed that the properties of fluids of different degrees of refrangibility, when enclosed in curves of glass, were overlooked; still, the idea of the American physicist is excellent as a popular means of showing the phenomena of refraction. In stating that the Lentmayer view lens (which is composed of two single meniscus lenses made of crown glass) compares favourably with the "best corrected lenses," Dr. Morton must be held as speaking of American, not English, corrected lenses, for when tried side by side with the doublets of any of our leading London opticians, the Lentmayer, or American doublet, is found to be greatly inferior, unless when the diaphragm is reduced to a very small proportion of the focal length, and, under these circumstances, a pair of meniscus spectacle glasses will give a good image. We have seen Lentmayer's lenses tested side by side with those of London manufacturers; and when large apertures were used, the latter were so much superior to the former as to preclude the idea of close comparison. Besides, the American Lentmayer combination was first made, and its principle of partial achromatisation first enunciated in this country, by Mr. Towson, who, in or about 1847, contributed a paper on this subject to the *Philosophical Magazine*.

The late Sir John Herschel was, perhaps, the most indefatigable investigator into the laws which regulated the decomposition of numerous substances by exposure to light. The various processes introduced by him, in which iron (in conjunction with cyanogen and potassium), gold, silver, mercury, platinum, and the colouring matter of flowers were used, are now matters of history, and were described by him in the *Philosophical Magazine* of the period. At the last meeting of the Photographic Society, a paper by Professor A. S. Herschel, B.A., "On some Early Glass Pictures produced by the late Sir John Herschel," was read. These pictures were originally three in number, and were the first photographs on glass that were produced. One of them was subsequently fractured, hence two only now remain. The subject of these early photographs is the old 43-feet telescope at Slough, and by the subject delineated the date of the production of the pictures is now ascertained to have been September, 1839. That year, it may be observed, was not alone memorable as having been that in which the first photographs on glass were obtained, it was also the year in which the famous discovery of M. Daguerre was first announced; and, further, in the beginning of that year also, Mr. Fox Talbot read before the Royal Society his first paper on the subject of his investigations on the photographic properties of nitrate and chloride of silver, and exhibited at an evening meeting of the Royal Institution a number of photographs he had taken. It was when trying to ascertain how far organic matter was indispensable to the rapid discolouration of silver salts, that Sir John Herschel was led to try the process by which the first pictures on glass were obtained. He mixed together a solution of nitrate of silver with a solution of common salt, both being so much diluted as merely to form a liquid that was only slightly milky. This was poured into a somewhat deep vessel, on the bottom of which lay a very clean glass plate. After several days, when the chloride had precipitated, the greater part of the liquid was drawn off by a syphon, and the last drops carefully drained away, drop by drop, by a syphon composed of a few fibres of hemp, the glass remaining unmoved till quite dry. It was now found to be coated with a uniform film of chloride of silver, of delicate tenuity and chemical purity, which adhered with considerable force, and was scarcely sensitive to light. A solution of nitrate being now applied to the plate, which was done by dropping it on and tilting it gently until it spread over the surface, it became so sensitive as to yield a picture when exposed in the camera. When the image was sufficiently well impressed, a solution of hyposulphite of soda was carefully applied; and when the image was thus fixed, and the plate subsequently dried, an impression could be obtained by using it as a negative. The two existing plates were backed by being smoked all over, and this gave them somewhat the appearance of dauguerreotypes.

Lieutenant Abney, R.E., has published before the Photographic Society some researches of a valuable kind concerning the action of light or bichromated films. He had previously discovered and utilised the fact that if the development of a carbon print were delayed for some hours, the result was an over-spread picture. Having investigated this action on the sensitive surface, he subsequently suggested that inasmuch as the image on the undeveloped tissue increases by time, a picture might receive only half the exposure in the light, and then be laid aside in the dark, until the action that goes on in darkness has sufficed to put it in the same state as a print that had received its full measure of exposure in the printing frame. In illustration of the feasibility of this, he, in April last, submitted to the above society some prints produced according to this principle; and in the case of photo-lithographic transfers he had found that an exposure of the prepared paper under the negative for only ten seconds, followed by retention in the dark for about twenty-four hours, gave fully exposed transfers, the inking having been effected when the imperfectly exposed print was removed from the printing frame. Since that time he had been assiduously following this track, and on Tuesday he communicated, as the result of farther investigation, the fact that if bichromated paper were exposed under the negative for only half a second, the action thus instituted could be continued by withdrawing the sensitive paper from the light and exposing it to the action of a yellow, an orange, or a red light. The decomposition set up by the white or actinically active light is continued by those rays which have been popularly considered as being quite ineffective in so far as chemical energy is concerned. The experiments of Lieut. Abney are corroborative of those made by M. Edmund Becquerel, who first discovered the wonderful property of the various-coloured rays as above indicated. In the course of his researches on the chemical radiations which accompany the solar and electric light, M. Becquerel found that rays which cannot produce a sensible impression upon a prepared substance out of the sphere of all radiation, may continue in a very energetic manner an action which different rays have begun to exercise upon it. The first of these he designated "exciting rays;" the others, "continuating rays." The first experiment made to establish this law was as follows:—A sheet of paper, having been prepared with bromide of potassium and nitrate of silver, two pieces of similar size were cut off and placed at the bottom of a wooden box, and were then covered entirely with a metal plate, the middle of which was cut out, so as to represent a bouquet of flowers. This was then exposed to the light of a cloudy sky for one second, and when the papers were taken out and examined by the feeble light of a taper, only a few faint traces of an image were visible. One of these sheets was then placed under a plate of red glass, and exposed for four hours to the diffused light of a northern sky, the result being that at the end of that time the phantom image had been developed into one of great intensity, the whites of the picture remaining perfectly pure. The second sheet was kept in the dark, and, when examined, it had undergone no change. So long ago as 1842, the use of the "continuating glass" was suggested as a means of securing instantaneous pictures, but the matter was in a great measure allowed to remain in abeyance until 1847, when the the late M. Claudet made a communication on the subject to the Royal Society. It again fell in desuetude until the present time, when, owing to the practical and utilitarian turn given to it by Lieut. Abney, it seems destined to be recognised universally as a great power in the hands of the practical photographer. When tested by the spectroscope, the orange rays of the spectrum are found to possess more of this "continuating" energy than any of the others.

GENERAL NOTES.

Indian Corn in the Ear for Fuel.—An Illinois paper says that in Harding County in that state, hitherto farmers came twenty and thirty miles for coal, and often waited at the coalbanks three days and nights for their turn to get coal, during which time their families were saved only by burning corn, and the conscientious scruples of almost any man against such a use of the great staple of food would have mellowed down. Corn is only eighteen cents per bushel, fifteen or twenty miles from the railroad; as it is worth six cents. per bushel to haul it to market, reduces the price to twelve cents. At this price it is cheaper fuel than coal at five dollars per ton. At this time—and it will continue all winter, unless coal becomes more plentiful and cheaper—thousands, if not millions, of bushels of corn will be used in Northern Iowa for fuel.

Home-grown Sugar.—Mr. James Caird, in a letter to the *Times*, says:—"We import annually about 2,000,000 tons of wheat and 700,000 tons of sugar. Our foreign supply of these two great articles of consumption is thus in the proportion of nearly 3 to 1. Adding the home supply of wheat and converting the whole into flour, the annual consumption per head is something over four of flour to one of sugar. Next to bread, sugar has thus become a main necessary of life in this country, and contributes immensely to the comfort of the poorer class of the population, and especially during times of low wages and irregular employment. The Lancashire grocers will tell you that at such periods the consumption of sugar and tea by the labouring class largely increases, for then they cannot so well afford the greater luxuries of beef and beer, for which in prosperous times like the present there is so great a demand and so large a consumption. High wages have become synonymous with a high price of butchers' meat, low wages with a rapid increase in the demand for sugar. There is now no tax left the abolition of which would be so generally and immediately felt among the poorest class of the people as the duty on sugar. The supply is not equal to the demand, and yet every effort is being made, both in the tropics and on the Continent, to increase the production of cane and beet sugar; but the price continues to rise, and nothing, therefore, can be more encouraging than the prospects of the sugar-grower. Notwithstanding this, only one vigorous attempt to introduce the cultivation of sugar has yet been made in England. The fourth season at Lavenham, in Suffolk, closed in February last. The growth of sugar-beet has each year increased, beginning in 1868 with 1,000 tons, rising to 3,400 tons in 1869, 4,500 in 1870, 6,200 in 1871, and the promise of a growth for the present season of 8,000 to 10,000 tons. The crops have varied with the seasons, both in quantity and quality; but these figures show very plainly that the farmers of Lavenham have found it to suit their business to grow sugar-beet at the price of 20s. per ton; and the manufacturer, Mr. Duncan, on the average of these years, is equally satisfied with the result to him. During the four months of the manufacture, about £500 a-month was spent in wages, nearly the whole of which was a clear addition to the ordinary wages fund of the locality in the winter season. The past season proved unfavourable for the manufacture all over Europe. The yield of sugar was small, as is proved by the fact that, notwithstanding a large increase of acreage under sugar-beet, the Continental sugar crop of 1871 is estimated to have produced only 860,000 tons, as compared with 942,000 tons in 1870 on a considerably smaller area. The same influence of season operated unfavourably in England. It paid the grower, because the crop was bulky; but the manufacturer had a smaller per-centage of sugar. These vicissitudes of season must be expected, and Mr. Duncan has satisfied himself, by personal examination on the Continent, that the deficiency of saccharine yield in France and Germany was at least as great as he had found it in Suffolk. This has not checked the progress of beet culture. New factories are springing up in France, Germany, and Austria. In Belgium alone, eighteen new factories are now being erected, and in Holland nine. This is an agricultural industry that has made most rapid strides on the Continent, and with great and general benefit wherever it has been introduced. It necessitates and pays for a higher and more enriching system of farming, and is uniformly attended by a great increase in the production of fat cattle and the yield of corn. The climate and soil of Suffolk have proved that it may with equal success be introduced and extended in the eastern and south-midland counties of England; and as it is a method which unites the advantages of live stock and corn with the profits and larger returns of the manufacturer, we should hail it as a welcome addition to our agricultural system. One great difficulty in modern English agriculture, where high farming is practised, is to get beyond a certain high average produce of corn. That difficulty has been solved in some of the northern counties by the more extensive growth of potatoes. The culture of beet would be more suitable to the southern and eastern counties, and more enriching, as the pulp is returned to the farm to be consumed by fattening cattle, and it might prove an agreeable change both to the farmer and the soil from the uniform routine of the four-course system. If sugar should come to be regarded as a prime necessary of food, which, like bread, should be untaxed, we might see a very rapid development of sugar culture in England, with advantages to consumer and producer even greater than have everywhere followed its introduction on the Continent.

Italian Wines.—Efforts are being made by the Italian government to improve the wines of Italy and its islands, and to induce foreign countries to make trial of them. The municipality of Naples, to further the views of the government in this respect, projected a wine fair, to consist of an exhibition of Italian wines, and proposed to provide the necessary funds by means of shares of five lire each. Viticulturists were invited to send samples, in quantities sufficient to leave a residue at the end of the fair, to be divided by lottery among the shareholders. The fair has now closed, the surplus wine been allotted, and several holders of five lire shares have received as many as 200 bottles of wine. Wine fairs are becoming general in Italy; one was held last year at Florence, and the first of its kind the previous year at Alessandria. The Italian government has also established a *Societá Enologiche*, or wine school, in several provinces, which are calculated to work great improvements in the wines of Italy. With the exception of the Pontine Marshes and the Etrurian Maremma, there is scarcely a spot, from the slopes of the Alps to the Gulf of Otranto, which is not adapted to the cultivation of the vine. The *L'Economista d'Italia* of March 31, states that the Industrial Inquiry Commission appointed by the government to visit in succession every centre of industry in the kingdom, for the purpose of inquiring into the position and progress of its principal staple manfacture, the difficulties it has to contend with, its means of obtaining raw material, and the fiscal and other impediments it meets with, is at Florence, and one of the principal subjects of inquiry will be the state of viticulture in Tuscany.

Strikes and the Labour Market.—The past month, says the *Manchester Examiner*, has been remarkable in Liverpool for emigration to the United States, Canada, and other parts of the American continent. The number of steamers which left Liverpool during May is 52, 34 of which went to Boston, 8 to Quebec and and Montreal, and 2 to Halifax, Norfolk, and Baltimore. Of these vessels 17 belonged to the Cunard Company, 11 to the Inman Company, 5 to the National Company, 5 to the White Star Company, 10 to the Allan Company, and 6 to the Guion Company; indeed, there is not in the records of the Liverpool Government Emigration Office such a list of steamers as that which left the Mersey for the United States, Canada, &c., during the past month. The number of vessels which left Liverpool "under the Act" in May were:—To the United States, 39, with 1,164 cabin and 25,225 steerage passengers; 7 ships to Canada, with 225 cabin and 4,380 steerage passengers; 1 for Valparaiso and intermediate ports, with 65 cabin and 126 steerage passengers; and 2 to Halifax, Nova Scotia, &c., with 48 cabin and 84 steerage passengers; making a total, "under the Act" for May, of 31,317 cabin and steerage passengers, of whom 11,765 were English, 442 Scotch, 5,344 Irish, and 13,756 foreigners. The number of vessels which sailed during the past month without coming under the provisions of the Emigration Act was 28, having on board 749 passengers, which number, when added to those which sailed under the Act, makes the total emigration for the past month [illegible]—an increase of 4,754 over the same month of 1871, and a total increase since January, as compared with the corresponding period of last year, of 17,598.

The Mint in Japan.—The opening of a mint in Japan, which took place during the past year, marks a change in currency and coinage which cannot fail to be of interest to commercial nations, and may not improbably exercise considerable influence on the existing relations between Europe and the East. The erection of the necessary buildings at Osaka having been completed, the mint was formally opened on the 4th of April, 1871, by the Japanese Prime Minister, in the presence of the diplomatic representatives of foreign governments. The occasion was made a high holiday for the whole population of Osaka. Displays of fireworks were provided by the government, and the day after the inaugural ceremony the mint was thrown open to the populace, who for three successive days thronged the buildings in one unbroken crowd of all ages and both sexes. An interesting account of the proceedings is given in a dispatch from Sir Harry Parkes, the British Minister, which is appended to the second report by the Deputy-Master upon the Royal Mint. A reform in the currency of Japan has been much needed; a clumsy, and in a great degee a spurious coinage, has to be replaced by one of superior make and undoubted purity. The steps which have been taken for the establishment of a currency suitable to the wants of the country, and based upon sound principles, were communicated to the British Chargé-d'Affaires, and shortly afterwards made known to the public in a remarkable decree issued in the form of a pamphlet. The decree states that it is his Majesty's intention gradually to change the old coin for the new, to re-coin all the existing currency, and to fix and determine what the kinds shall be. Proceeding on the principle that coins are the common treasure of the inhabitants of the empire, it is intended to coin all bullion which may be presented for change into specie, and to return it to the owners in the form of the new currency. Then all the old gold and silver which, in accordance with the ancient error, has been looked upon as hereditory treasure, before many years are over, will become the same thing as bullion, and it is important that attention be directed to changing them at once, so that they may preserve their essential nature as coins by entering into circulation. The construction of the new mint is simply caused by the desire to perform the duty of diligently protecting the people; let the population therefore undestand this well; let each be diligent in his calling, and perform the duties enjoined on him by Heaven. The principles of the new coinage are, that the *yen* is the title of the basis of the new coinage, and all calculations are made by adding the names of the numbers to the original appellation *yen*, no matter what their amount. The subdivisions of the *yen* are *sen* (the hundredth part of a *yen*), and *rin* (the tenth part of the *sen*), which are to be used in calculating small sums. The decimal system is used in calculation; ten *rin* make one *sen*; ten single *sen* make one ten-*sen*; 10 times 10 *sen* (or 100 *sen*) make one *yen*. Above one *yen* a ten, hundred, thousand, myriad, all advance one degree by multiplying by 10. In addition, the half-*sen*, the 5-*sen*, 50-*sen*, and 5-*yen* are decimal fractions of each other; twenty *sen*, 2 *yen*, and 20 *yen* are multiples of 10, and are not foreign to the rule. No coin will be struck of less value than the *rin*, but if the exigencies of calculation require it, *mô*, *shi*, *kotsu*, *bi*, *sen*, may be used in expressing small fractions. Above a myriad are ten myriad, a hundred myriad, a thousand myriad; ten times a thousand myriad is a myriad, or one *oku*, to be used in large calculations. Hitherto it has been the custom for the government to call in and re-issue the currency, but now, acting in accordance with the universal principles of justice, gold and silver bullion, and old gold or silver coins, and foreign coins without distinction of name, will, from the sixteenth day of the sixth month (August 2, 1871), be re-coined at the Mint in Osaka, on the application of either Japanese or foreigners, and returned at the rate of their real value, in accordance with the regulations.

The Mint.—The Deputy-Master of the Mint has presented a report for the year 1871, and states that the coinage of gold and silver in that year far exceeded the average. The large gold coinage was rendered necessary by withdrawals of specie from the Bank of England, amounting in the last half of the year to more than ten millions sterling, including two millions transmitted to Germany. The total number of coins struck at the Mint in 1871 was 30,022,404, of the nominal value of £10,580,061. There were no less than 8,767,250 sovereigns struck, 2,062,970 half-sovereigns, 3,425,605 florins, 4,910,010 shillings, 3,662,684 sixpences, 4,627 fourpences, for Maundy money only, 1,004,121 threepences, 1,290,318 pence, 1,075,280 halfpence. The demand for coin in 1871 was very great; but, apart from its magnitude, the gold coinage of 1871 was not marked by any special feature. The amount of light gold received by the Mint for re-coinage was £701,000, almost entirely imported by the Bank of England. As is well known, silver, when extracted from its ores, contains a small quantity of gold, and it is possible now to extract with profit any quantity of gold exceeding two grains in the pound troy of silver. The half-crowns now in process of withdrawal from circulation contain an average of four grains in the pound; and when, therefore, any considerable quantity of these coins has accumulated in the Mint, the gold will probably be extracted from them before the silver is recoined. In regard to the operative department of the Mint, the Deputy-Master observes that the accuracy of the automatic weighing machines, in which each piece of gold and silver is weighed before it is issued, was severely tested in the large coinages of last year. It may give some idea of the work performed by these machines if we state that the hundredth part of a grain is sufficient to cause a sensible deflection of the beam. The actual loss on coinage was £327, or £50 per million. The most important change which occurred in 1871 was the introduction of a new coinage of gold into the currency of Germany; but it is regretted that the coinage adopted is objectionable. There are several gold coins, issued or proposed, containing nearly the same quantity of pure gold—the English sovereign, 7·32 grammes; the United States half-eagle or 5-dollar piece 7·52 grammes; the proposed 25-franc piece, 7·26 grammes; and the proposed Spanish piece of 25 pesetas, of equal value with the 25-franc piece; but the German 20-mark piece, containing only 7·16 grammes of pure gold, will be equal to not more than 19s. 7d. in English money, presenting a further divergence from the uniformity so much to be desired, and an additional obstacle to the adoption of an international gold coin.

British Trade in Foreign Metals.—Many interesting and important facts appear in the returns for the first four months of the year concerning our trade in foreign metals. We have imported 16,844 tons of copper ore, contrasted with 15,188 in the corresponding period of 1871, and 14,979 tons in the previous year. Spain has has sent pretty nearly the same quantity as in 1871; Chili a tenth of the quantity furnished in 1870; Australia one-third of last year's supply; while "other countries" twice the quantity of last year. To the end of April, our regulus imports were nearly the same as for the same period in the two previous years. Partly wrought copper has reached us in nearly double the quantity it did two years ago—namely, 14,819 tons, contrasted with 6,584 tons. Of ingots, cake, or slabs, we have sent away during the four months 78,602 cwts., or 8,297 cwts. more than in the corresponding term of last year. France has had twice as much as in 1871. Our exports of manufactured copper reach 7,182 cwts. less, and of copper sheathing 3,915 cwts. more than last year. Turkey and India have had much less wrought copper than last year or in 1870. Our total exports of copper are 5,030 cwts. above those of the first four months of 1871, but 82,706 cwts. less than 1870. It is generally believed by well-informed persons that prices would soon have an important advance, if India and Turkey would show some briskness. Concerning tin, we have been doing an extraordinary trade, and have imported much larger quantities than last year or the year before. The last returns give 72,515 cwts., value £461,324, compared with 58,436 cwts., value £365,450 in the first four months of last year, and 18,716 cwts., compared with £111,636 in 1870. Of British tin we have exported 37,376 cwts., contrasted with 22,913 cwts. last year, and 35,996 cwts. in 1870. France required about five times as much as last year, and America twice as much. The tin-plate trade has still further developed to a remarkable extent, and the demand seems to be steadily increasing.

Imports of Cotton into the United Kingdom.—The following table shows the quantity of cotton imported until end of April, 1872, as compared with the corresponding period of 1871, from—

	1872 cwts.	1871. cwts.
America	2,989,888	5,357,089
Brazil	450,352	265,995
Turkey	31,301	5,718
Egypt	770,722	663,361
British India	1,435,602	888,298
Other countries	91,928	93,054
Totals......	5,769,793	7,267,515

The above table shows a decrease of 1,497,722 cwt. in the total; but there is a decrease of 2,361,201 cwt. on the cotton received from America, and an increase of 863,489 cwt. on that received from other countries.

Wool.—The following table shows the estimated production of the countries which contributed wool to Europe and America during 1871:—England, 159,969,000lbs.; Australia, 152,500,000; Van Dieman's Land, 6,136,000; New Zealand, 28,875,000; Cape of Good Hope, 38,000,000; La Plata, 138,070,000; East Indies, 18,797,000; Russia, 90,760,000; Sweden, 6,082,000; Norway, 6,395,000; Greece, 7,618,000; Denmark, 7,034,000; Holland, 6,130,000; Belgium, 3,500,000; Switzerland, 1,336,000; United States, 177,000,000; France, 91,608,000; Spain, 74,433,000; Germany, 52,080,000; Austria, 31,075,000; Italy, 24,840,000. Total, 1,121,519,000 lbs.

CALENDAR OF MEETINGS.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....Anthropological, 8.

Tues. ...East India Association, 8. (At the House of the Society of Arts.) Major Evans Bell, "Trust as the Basis of Imperial Policy.
Statistical, 7¾. Sir James Anderson, on "Statistics of Telegraphy.'
Zoological, 9.

Wed.....**SOCIETY OF ARTS, 8½.** Conversazione at the South Kensington Museum.
Geological, 8. 1. Col. A. Lane Fox, "On the Discovery of Palæolithic Implements in association with *Elephas primigenius* in the Gravels of the Thames Valley at Acton." 2. Mr. R. H. Tiddeman, "On the Evidence for the Ice-sheet in North Lancashire and adjacent parts of Yorkshire and Westmoreland." 3. Prof. P. Martin Duncan, "On a new species of Coral from the Crag."

Thurs...Chemical, 8. Mr. H. Deacon, "On Deacon's method of obtaining Chlorine, as illustrating some principles of Chemical Dynamics."
Royal, 8½.
Antiquaries, 8½.
Linnæan, 8 Dr. Murie, "On the Structural Peculiarities of the Bell Bird (*Chasmorhynchus*)."
Numismatic, 7.
Philosophical Club, 6.

Fri.......Quekett Club, 8.

Journal of the Society of Arts.

No. 1,022. Vol. XX.

FRIDAY, JUNE 21, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal*, in accordance with Sec. 42 of the Society's Bye-laws, which provides that, at the Annual General Meeting, the Council shall render to the Society a full account of their proceedings, and of the receipts, payments, and expenditure during the past year; and a copy of such statement shall be published in the *Journal* of the Society on the Friday before such general meeting:—

TREASURERS' STATEMENT OF RECEIPTS, PAYMENTS, AND EXPENDITURE, FOR THE YEAR ENDING MAY 31st, 1872.

Dr.

	£	s.	d.	£	s.	d.
To Cash in hands of Coutts and Co., 31st May, 1871	1,283	14	7			
Do. do. Secretary		13	10			
				1,284	8	5
To Subscriptions received during the year, from Members and Institutions in Union	6,065	10	9			
Life Contributions	312	18	0			
				6,378	8	9
To Dividends on Stock:—						
Consols, £4,746 19s. 5d.	138	16	10			
,, £167 7s. 3d., North London Exhibition Trust	4	18	0			
Great Indian Peninsula Guaranteed 4 per cent. Railway Debenture Stock, £2,170	84	12	6			
Reduced 3 per cents., £434 8s. 6d.	12	14	0			
New 3 per cents:—						
Dr. Fothergill's Trust, £388 1s. 4d.	11	7	2			
Indian 4½ per cent. Notes, 52,000 rupees	244	2	7			
				496	11	1
To Sale of Stock:—						
Indian 4½ per cent. Notes, 52,000 rupees, at 99¼ per cent.				5,161	0	0
To Interest on Deposit Note per London and Westminster Bank				5	10	11
To Transfer of Sir W. C. Trevelyan's Prize from London and Westminster Bank to Deposit Account with Messrs. Coutts and Co.				70	0	0
To J. Murray's Donation to a Building Fund				50	0	0
To Subscriptions and Donations:—						
Endowment Fund	32	2	0			
Memorial Window Fund	275	4	0			
				307	6	0
To Examinations:—						
The Prince Consort's Prize	26	5	0			
Royal Horticultural Society's Prizes	16	0	0			
The Earl Fortescue's Prize	5	0	0			
H. Cole, Esq., C.B., Prizes	6	0	0			
Mrs. Chester's Prizes	5	0	0			
Candidates' Fees	9	7	6			
				67	12	6
To Sales of:—						
Pamphlets, Books, &c.	1	8	0			
Cantor Lectures	0	5	9			
Journals	140	14	4			
Messrs. J. M. Johnson and Sons advertisements	366	12	0			
				509	0	1
To Committees:—						
Musical Education (Concerts)	1,466	11	6			
Drill Committee	151	18	4			
				1,618	9	10
To House and Office				16	8	0
To South Australian Institute	200	0	0			
Blenheim Literary Institution, New Zealand	14	18	0			
				214	18	0
				£16,179	13	7

Cr.

	£	s.	d.	£	s.	d.
By House and Premises:—						
Rents, Rates, and Taxes	281	11	9			
Insurance, Gas, Coal, and House Charges	217	7	1			
Repairs and Alterations	43	11	9			
				542	10	7
By Office:—						
Salaries, Wages, and Commissions	1,811	4	2			
Stationery and Printing	245	14	6			
Advertising	125	13	4			
Postage Stamps and Parcels	191	2	1			
				2,373	14	1
By *Journal*, including Printing, Stamps, and distribution to Members	1,778	5	8			
Library, Bookbinding, &c.	118	9	4			
Conversazione	238	0	4			
				2,134	15	4
By Union of Institutions, including Examinations, Prizes, Postage, Printing, &c.	578	7	0			
Prince Consort's Prize	29	8	0			
				607	15	0
By Art-Workmanship Prizes	191	13	0			
Society's Albert Memorial Medal	21	11	6			
,, Medals	39	8	4			
				252	12	10
By Exhibitions	13	5	10			
North London Exhibition Prize	4	18	0			
				18	3	10
By Committees:—						
General Charges	11	10	0			
Cab	1	2	0			
Drill	379	3	0			
Education	13	8	8			
Food	13	19	10			
Telegraph	1	2	2			
Government and Inventors	5	13	6			
Indian	9	11	1			
Musical Education, including Concerts	2,421	13	0			
Life-boat	2	1	2			
Postal	24	16	0			
Memorial Tablets	15	0	0			
				2,899	0	5
By Memorial Window Fund (postage, &c.)	20	16	9			
Endowment Fund	5	8	7			
Irish Exhibition	17	9	6			
Registration Fee	0	2	6			
				43	17	4
By Purchase of £2,450 Bombay and Baroda Guaranteed Railway Stock, at 104 per cent.	2,548	0	0			
Stamp, Brokerage, and Registration	25	15	0			
Purchase of £2,460 8s. Oude and Rohilcund Guaranteed Railway Stock, at 104 per cent.	2,558	8	0			
Stamp, Brokerage, and Registration	26	1	0			
Purchase of £841 7s. 6d. Reduced 3 per Cents., at 91 per cent.	765	13	0			
Brokerage	1	1	0			
Deposit with Messrs. Coutts and Co.	345	0	0			
Power of Attorney to Messrs. Coutts and Co.	0	11	6			
				6,270	9	6
By South Australian Institute	216	19	0			
Cantor Lectures	266	6	5			
				483	5	5
				15,626	4	4
Cash in the hands of Messrs. Coutts and Co., 31st May, 1872				552	19	8
,, in the Secretary's hands				0	9	7
				£16,179	13	7

Liabilities.

	£	s.	d.	£	s.	d.
To Sundry Creditors:—						
Balance of Bequest by Alfred Davis, uninvested	5	12	6			
Sir W. C. Trevelyan (for Prize)	70	0	0			
Memorial Window Fund	275	4	0			
John Murray (for Building Fund)	50	0	0			
Endowment Fund	32	2	0			
Prince Consort's Prize	26	5	0			
North London Exhibition Trust	2	9	9			
Examination Prizes (Society's)	166	0	0			
Do. Royal Geographical Society Prize	5	0	0			
Do. Royal Horticultural Society's Prizes	16	0	0			
Do. Thomas Twining's Prize	2	0	0			
Do. Mrs. Harry Chester's Prize	2	0	0			
Examiner's Fees	179	11	0			
Rents, Rates, and Taxes	270	0	0			
Tradesmen's Bills	973	0	6			
South Australian Institute	33	13	7			
Blenheim Literary Institute, New Zealand	14	18	0			
				2,123	16	4
By excess of Assets over Liabilities				4,698	0	7
				£6,821	16	11

Assets.

				£	s.	d.	£	s.	d.
By Society's money invested in—									
Reduced 3 per Cent. Stock, £1,275 16s., at 94 per cent., less 1-14th reserved to meet trusts stated below				1,068	17	6			
Consols, £146 19s. 5d., at 93½ per cent.				135	18	11			
Great Indian Peninsula Railway 4 per cent. Guaranteed Debenture Stock				200	0	0			
Oude and Rohilcund and Bombay and Baroda Guaranteed Railway Debenture Stock				353	11	6			
Deposit account with Messrs. Coutts and Co.				345	0	0			
Subscriptions of the year uncollected	1,220	2	0						
Less 15 per cent.	183	0	0						
				1,037	2	0			
Do. of former years unpaid	2,092	5	0						
Less 50 per cent.	1,046	2	6						
				1,046	2	6			
Barry's Pictures and other property				2,000	0	0			
Prince Consort's Prize				26	5	0			
Royal Horticultural Society's Prizes				16	0	0			
Royal Geographical Society's Prize				5	0	0			
Thomas Twining, Esq., Prize				2	0	0			
Mrs. Harry Chester's Prize				2	0	0			
Journals, per Bell and Daldy				30	10	3			
							6,268	7	8
Cash in hands of Messrs. Coutts and Co., 31st May				552	19	8			
Do. in the Secretary's hands					9	7			
							553	9	3
							£6,821	16	11

P. Le Neve Foster, *Secretary.*

Stock and Cash Standing in the Name of the Society.

	£	s.	d.
Consols	£4,914	6	8
New 3 per Cents.	388	1	4
Reduced 3 per Cents.	1,275	16	0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Oude and Rohilcund ,, ,, ,, ,,	2,460	0	0
Bombay and Baroda ,, ,, ,, ,,	2,450	0	0
Cash in hands of Messrs. Coutts and Co., on deposit	345	0	0

Trust Funds included in the above.

	£	s.	d.	
Swiney's Bequest	£4,500	0	0	Consols, chargeable with a sum of £200 once in five years.
John Stock's Trust	100	0	0	,, ,, ,, the Award of a Medal.
North London Exhibition Trust	167	7	3	,, ,, ,, Award of the Interest as a Money Prize.
J. Murray, Esq., in aid of a Building Fund	50	0	0	Invested in Reduced 3 per Cent. Stock.
Subscriptions to an Endowment Fund	30	0	0	Do. do. do.
Fothergill's Trust	388	1	4	New 3 per Cents., chargeable with the Award of a Medal.
Dr. Cantor's Bequest	5,049	9	7	Invested in Bombay and Baroda and Oude and Rohilcund Guaranteed Railway Debenture Stock.
Alfred Davis's Bequest	1,800	0	0	Invested in Great Indian Peninsula Guaranteed Railway Debenture Stock.
Memorial Window Fund	275	0	0	Deposited with Messrs. Coutts and Co.
Sir W. C. Trevelyan's Prize	70	0	0	

The Receipts of the Society set forth above have been credited by Messrs. Coutts and Co.

The Payments set forth above have been made by authority of the Council.

The Assets, represented by stock at the Bank of England, and securities, and by cash balance at Messrs. Coutts', have been duly verified.

Thomas Robert Tufnell, *Auditor.*

Society's House, Adelphi, 18th June, 1872.

ANNOUNCEMENTS BY THE COUNCIL.

ANNUAL GENERAL MEETING.

The One Hundred and Eighteenth Annual General Meeting, for the purpose of receiving the Council's report, and the Treasurers' statement of receipts, payments, and expenditure during the past year, and also for the election of officers, will be held, in accordance with the Bye-laws, on Wednesday next, the 26th of June, at four p.m.

The Council hereby convene a Special General Meeting of the Members of the Society to ballot for members, such meeting to take place at the close of the Annual General Meeting.

By Order,

P. Le Neve Foster, *Secretary.*

Society's House, Adelphi, June 19th, 1872.

FINAL EXAMINATIONS, 1872.

It having been brought to the notice of the Council that Candidate No. 627, John W. Palliser, of the Leeds Young Men's Christian Association, had incorrectly stated his occupation on his return as Art Student, whilst he was a "teacher and second master in the Leeds School of Art," as well as head master of the drawing classes at the Leeds Young Men's

Christian Association, which position disqualified him from taking prizes, the first prize in writing from dictation awarded to him has been withdrawn, and re-awarded as follows :—

1st Prize of £3 for writing from dictation to 169, William H. Taylor, 25, Birmingham and Midland Inst., clerk (instead of the 2nd prize, as already published).

In consequence of this alteration the 2nd and 3rd Prizes for this subject have been awarded as follows :—

2nd Prize of £2 to 860, William R. Kerr, 19, City of London College, clerk (instead of 3rd prize, as already published).

3rd Prize of £1 to 116, John B. Gass, 17, Bolton Mechanics Institute, architect's pupil.

The following additions have been made since the issue of the list of awards :—

3rd-class Certificate for English history to

47—Brock, Joseph O., 21, Aldershot and Farnham District Local Board, soldier (in addition to Arithmetic 3d) as already published).

2nd-class Certificate in Logic to

1199—Clarke, Thomas R., Salford, W. M. Coll., clerk (in addition to Bkpg (1st); with first prize of £5; and Eng. Lang. (1st), as already published).

3rd-class Certificate in German to

927—Kingdon, Amelia 30, Royal Polytechnic Inst. (no occupation stated).

IMPROVED CABS.

The Council of the Society of Arts offer the following Prizes :—

One Prize of £60 for the best improved Cab of any description.

Two Prizes of £20 each for the next two best.

Two Prizes of £10 each for the next two best.

The competing Cabs must be exhibited at the International Exhibition, to be held in South Kensington in 1873, and on their delivery at the Exhibition Building they must be certified to the satisfaction of the Judges as having been in regular use in the streets of London for three months previously. They must be delivered on or before the first Saturday in April.

The Council consider that the Cabs now in use in London are especially defective in the following particulars :—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.

2. The seats in the four-wheelers are too high, not commodiously made, and the space underneath is lost.

3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.

4. The arrangements for opening and closing the window in the Hansom.

5. The confined space and want of ventilation in the Hansom when the window is closed.

6. Imperfect locking of the wheels in four-wheelers.

The Council desire to point out, for the consideration of those likely to compete, that in Continental and some English towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

A suggestion for a cab, to be used either closed or open, has been brought before the Council, and a model submitted. The principle might be adapted to existing four-wheelers, but the Council do not prescribe this model or any special form of carriage; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges may report.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first published subscription list amounted to £351 3s. A further list will shortly be published.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

CONVERSAZIONE.

The annual Conversazione of the Members and their friends took place at the South Kensington Museum, on Wednesday, 19th June, 1872. The following were the arrangements:—

A Vocal Concert, consisting of glees, by the London Glee and Madrigal Union, directed by Mr. Land, was given every half-hour from 9 to 11 o'clock, with intervals, in the Lecture Theatre; and a Promenade Concert was given by the Band of the Coldstream Guards in the North Court.

The Music performed by the Band of the Coldstream Guards was as follows:—

Overture	"Les Diamans de la Couronne"	*Auber.*
Waltz	"Die Hydropaten"	*Gung'l.*
Selection	"Fra Diavolo"	*Auber.*
Glees	"Here in cool grot"	*Mornington.*
	"The Sisters of the Sea"	*Jackson.*
Reminiscences of Balfe	Selected and arranged by	*F. Godfrey.*
Waltz	"Minna"	*F Godfrey.*
Selection	"Genevieve de Brabant"	*Offenbach.*
Part Songs	"When evening's twilight," &c.	*Hutton.*
Fantasia	"Les Huguenots"	*Meyerbeer.*
Reminiscences of Verdi	Selected and arranged from his admired operas by	*F. Godfrey.*
Galop	"Sleigh"	*Kuhner.*

Conductor—Mr. FRED GODFREY.

The London Glee and Madrigal Union (Miss Jane Wells, Messrs. Baxter, Coates, Lawler, and E. Land, director) sang as follows:—

Madrigal (5 voices)	"O, by rivers"	*Ford and Saville,* A.D. 1667.
Glee (4 male voices)	"Crabbed age and youth"	*R. T. S. Stevens.*
Four-part Song	"O hush thee my babie"	*A. Sullivan.*
Glee (4 male voices)	"Are the white hours"	*Dr. Calcott.*
Glee (5 voices)	"When winds breathe soft"	*S. Webbe.*
Serenade (4 male voices)	"Sleep, gentle lady"	*Sir H Bishop.*
Glee	"There is beauty on the mountain"	*Sir John Goss.*
Catch	"Would you know"	*S. Webbe.*
Madrigal	"Now is the month of Maying"	*Thomas Morley,* A.D. 1593.

The visitors were enabled to make the tour of the Art-Schools on the first and second floors; and the Raphael Cartoons, the Sheepshanks', and the National Gallery's Picture Galleries and Art Library were opened.

Lord Henry G. Lennox, M.P., Chairman of Council, with the other Members of Council, received the company as they arrived. The number present was 3,840.

The *Daily News* says:—The Society of Arts held their conversazione as usual, at the South Kensington Museum, and it was in every respect as brilliant and as well-attended a réunion as any of its predecessors in the same place. In consequence of the numerous and interesting objects to be seen, the company began to arrive at a comparatively early hour, and were received in the South Court by Lord H. G. Lennox, M.P., the Chairman of the Council, and the Council. Though the space was ample, it was not more than sufficient for the great crowds who attended, especially in the picture galleries, where there was an evident disposition to linger on paintings which had been contemplated perhaps a dozen times before. The rooms and galleries were brilliantly illuminated, and their artistic contents appeared to the greatest advantage. The ladies alone, in their beautiful and variegated evening dresses, would have made a picture worthy of admiration; but, taken in connection with the other parts of the scene, the conversazione of the Society of Arts presented a picture which it would be difficult to match elsewhere. Were it not for the almost countless number of objects of real interest contained in the museum, it would be difficult to afford amusement for so many thousands; as it was, there was not one probably who left without satisfaction.

CANTOR LECTURES.

MECHANISM.

By the Rev. Arthur Rigg, M.A.

Lecture I.—Delivered Monday, February 5, 1872.

In the spring of the year 1869, a course of Cantor lectures was delivered in this room by John Anderson, Esq., of Woolwich. The subject of that course was "Applied Mechanics." Mr. Anderson closed those lectures with the following sentence:—"It will be found that so long as any of Nature's secret laws remain unexplored, well-directed irrepressible thought will alight on new discoveries one after another; and to the endless variations of mechanical combinations there is practically no limit." To some of the elementary forms of "these endless variations of mechanical combinations" our attention in the present course of Cantor lectures is to be directed. It may appear disheartening to enter upon an inquiry which at the outset is said to consist of "endless variations;" but by classification and division, not only all the inhabitants of the world, but all of which the world itself is made, and even the very universe, has been brought under careful and minute examination. The words—animal, vegetable, and mineral—comprehend the world and its inhabitants. Division and sub-division have so placed these that those with similar distinctive features are soon classified side by side.

A digression upon these words for a few minutes, even thus early, will not be out of place. To Aristotle, who was born about 384 years before the Christian era (he died 322 B.C.), we owe much in respect of a development of the system of classification and division. When Aristotle was classifying natural history, and seeking for some distinctive feature by which to distinguish men from every other animal placed in the same class, he selected for him a name appropriate at this day—he called man "a tool-making animal;" for man was the only animal in the creation that made tools for his own special purposes. Had Aristotle lived now, how much more appropriately would this characteristic have applied, and yet our surroundings might have deprived us of the man; for Aristotle was appointed tutor to a youth then 14 years of age—that youth is afterwards known in history as Alexander the Great; but Lord Bacon, in his "Advancement of Learning," writing of Alexander the Great, says "that he does not choose to consider him Alexander the Great, but prefers to call him 'Aristotle's pupil.'" In these days, and in this country, more indebted as it is than any other in the old hemisphere to the scientific development of the tool-producing faculty, and to many other science faculties, we may look in vain for such encouragement. Alexander did not forget his science tutor, for history records that he allowed Aristotle 800 talents per annum (a large sum, however the talent may be estimated) with which to prosecute his studies in natural history. May it not be that in England in the present generation there are no Aristotles because there are no Alexanders?

By a like law of broad classification we may say of our present subject there are two marked groups, under one or other of which may be arranged all our mechanistic contrivances. These groupings are comprehended in the words structures and machines. The considerations which present themselves vary considerably, according as one or other of these divisions is under notice, and unfortunately for the science and practice of mechanics in the full acceptation of the term mechanics, modern usage has disjoined what should always have been united. The class of men whose business requires that they should attend to the branch called structures disregard the branch called machines. The compliment is repaid. The mind of the man who thinks of structures is ever dwelling upon contrivances for securing stability and perpetual rest, whereas the thoughts of the mechanical engineer dwell upon contrivances for securing motion, and he sometimes dreams of making motion, and not rest, perpetual. Although each of these men look to mechanical aids for accomplishing his purpose, they look at them from two very different standpoints, and in very different coloured lights. The man who deals with structures is always thinking of struts, tensions, pressures, and frictions, and he adopts those means which seem most likely to secure what he calls stability and immobility. The other man considers that to put the machine in a state of rest, to so proportion the powers as that each elementary part of that machine shall be in equilibrium, is to put a machine in a state of absolute idleness. Now, idle machines, like idle people, do us no good; they destroy themselves, they rust, they in fact decay, and, to borrow the phrase from the workshop, we may say of idle machines that they really "eat their heads off." The true state of a machine, as those who are concerned with them know well, is a state of motion. So completely is this idea of motion impressed upon mechanists, that rest as accomplished by struts, and stays, and rods, forms no part of the mental employment of the mechanician. A mechanician has no faith in the machine requiring rest. If a mechanician wants a piece of machinery to pause in its work, in order that another part of that machine may go through some operation or other, he accomplishes it by establishing such a relation between and amongst the motions of the respective parts as shall produce the result he requires. As two waves of light or of sound in opposite phases produce, by coalescing, darkness or silence, so two motions can be so mechanically combined as to produce absolute rest. The owner of a machine considers a machine worthy of room on the floor of his factory only so long as it can move and is moving; and, indeed, nowadays, that is hardly sufficient for manufacturers and owners of machinery. Machines are expected to be not only diligent when they are at work, but to go back, when they have done their work, with a speed which no employer has ever yet considered too great. There is no law upon a labourer to return an empty spade to the ground at twice or three times the speed with which he lifts a full one. A machine, however, is expected to do this. It is expected when it has done one stroke of work, literally without turning round, to run backwards at twice or thrice the velocity at which it does its work in order to start and do another stroke. Nor is it in readiness to return to its work at an increased speed that any great triumph of mechanistic skill is noticed. There is hardly a plan or device for the saving of bodily labour, nay, there is hardly a scheme for saving mental thought, that mechanism is not both expected and requested to undertake. Mechanism burrows in the earth, it builds our houses, it conveys us by land and by water, it clothes us, it supplies us with teeth, it will even do a large portion of the work of digestion if we wish, it counts for us, it determines the weight of our gold and silver coins, accepting or rejecting those coins, as, in its mechanical judgment, it deems best; and, to crown all, it thinks for us; it calculates, it sets up its own type, it prints its own calculations, and if by any accident it makes a mistake, it rings a bell and tells us it has done so.

Thus, not only English society, but all society depends upon mechanism, and it is, therefore, singular that educational books, and even treatises upon mechanics, lay the foundation of all the information and instruction that they give, not in states of motion, but in states of rest. To put levers, pullies, inclined planes, wedges, and screws in states of perfect equilibrium, to demonstrate by tedious and complicated reasoning what is called the parallelogram of forces, to be poring over problems for establishing equalities by both geometric and analytical formulæ—these constitute a large portion of the so-called scientific mechanical knowledge contained in our treatises upon machinery for students—at least for those who are beginning to study. If a few advance beyond elementary knowledge, they are generally confronted by still more complicated and uninviting discussions upon the laws which have much to do with motions in the universe, but little or nothing to do with motions on the earth or in our machines.

In 1788, when Lagrange published a great and fine example of analysis, he wrote in the preface of the book (it was upon machinery):—"The reader will find no figures in this work; the methods which I deliver do not require either instruments or geometrical or mechanical reasoning, but only algebraical operations." Lagrange herein made mechanics subservient to analysis. Analysis ought to have been made subservient to mechanics. Our books of mechanical science deal with questions chiefly of rest or of celestial motion only; hence the man who wants a machine for a given purpose, who wants to combine certain motions, turns in disappointment from volumes that he considers are delusions and snares. So far as power, and so far as strength of materials are concerned, he is satisfied that these are ample for all his requirements. Until he can obtain such a combination as shall secure a special end, questions of construction and equilibrium are not felt by him as matters really of even momentary consideration. He knows that if the motions he needs are won, he will have no difficulty whatever in producing rest. To modify control, and regulate the motions of connected materials, constitutes the chief object of study with those who hope by machinery to improve upon manual labour. This study is clearly independent of the building of the machine; it is clearly independent of all those parts of the machine that are comprehended under the word "structure." It is also equally independent of the source whence the machine derives its power; and, further, it is quite independent of the work to be done by that power, after it has passed through the machine. What it does involve, however, are any mechanistic contrivances by which motions may be changed, or constrained, or diverted, and that, appearing in one form, existing for a specific purpose, they may be transformed into another exactly adapted to the purpose required. Thus it will be for a pre-arranged object, and to follow a predetermined law. This is that which is comprehended under the word mechanism, and it is in consequence of the development of this aptitude in the few minds given to the special study—and they have been but few—that England owes all her present manufacturing industries.

Having thus explained what is comprehended under the word mechanism, it may be well to regard what it is that is excluded. All our experience tells us that motion is a consequence of force. So sure are we of this, that we say that whenever force acts motion ensues. If, however, it is wished to arrest an ensuing motion, it is usually done by the introduction of an opposing force. Thus, even in this aspect, rest, observe, is the result of a combination of motions.

The branch of mechanical studies which thus considers force as compelling rest, or preventing a change of motion, is called statics; and states of rest produced by opposing forces, except when the mechanism is called upon in the interval to perform some special operation, do not concern us, and further allusions to questions of statics may be put aside.

But force may produce change, either in the amount or direction of motion, and the branch of mechanical studies which comprehends this is called dynamics. The term dynamics is a marvellously comprehensive one. To say of an operation that it is a dynamical one, gives just about as much information of the operation as to say of a substance that it belongs either to the animal or vegetable kingdom. Division and sub-division must enter, in order to an accurate and instructive investigation of questions of a dynamical character. Two of these divisions are so intimately related in the branch of dynamics to be treated of in this course of lectures, that a distinction must be drawn between names much alike. M. Ampere, in the year 1834 (for that is about the time when this subject first began to attain special consideration), wrote:—"Long before I employed myself upon the present work, I had remarked that it is usual to omit, in the beginning of all books treating of sciences which regard motion and force, certain considerations, which, duly developed, must constitute a special science." He then proceeds to describe the science, and calls it kinematics, from a Greek word, *κινημα*, which signifies motion. Further, he makes a proposal which was taken up by others, and the progress of the idea is interesting. He (M. Ampere) defined a machine, not as it had hitherto been considered—an instrument "by means of which we may change the intensity and direction of a given force," but as an instrument "by means of which we may change the direction and velocity of a given motion," hereby excluding force from all considerations of mechanism. Mr. Willis, to whom I shall have occasion to refer again, proposes another definition, namely, to consider a machine as an instrument "by which to produce, not motion simply, but relations of motion between parts," thus setting aside M. Ampere's definition that a machine is an instrument to change the direction and velocity of a given motion. Dr. Whewell, in his "Philosophy of the Inductive Sciences," in the first volume, p. 144, has a very short chapter indeed on "Motion," and he was well competent to write a long one. He wrote in that chapter, in 1840:—"Motion should be considered quite independent of its cause—force. The science might be termed 'pure mechanism,' in contradistinction to 'mechanics proper,' or 'machinery,' in which force is taken into consideration. Such a science is the science of mechanism independent of force, and I consider it to be the solution of a problem which may be expressed in these words:—'To communicate any given motion from a first mover to a given body.' The necessity of this separation (says Dr. Whewell) has been seen by those who have taken a philosophical view of the sciences." Dr. Whewell, it will be observed, excluded force, and in this respect he follows M. Ampere's views, expressed just six years previously.

Thus has arisen the distinction between two very similar terms, kinetics and kinematics. Each term involves considerations of motion, but in two very different aspects. In kinetics it is not mere motion which is considered, but the relations that motions bear to forces. Hence questions in which the expenditure and nature of force, and the motions produced, are considered belong to kinetics. Kinetics comprehend the laws of energies, and the modes by which men may best avail themselves of these laws. We are too prone as a people to generalise laws; and what we find to be true under one set of energies, we assume to hold good under another set. Such is not the case. The energies of gravity, electricity, vitality, affinity, light and heat, require different treatments, in order that each may be most advantageously utilised.

An example or two may make clear the distinctions now insisted on.

The velocity and penetrative or destructive effects of a cannon ball, in relation to the character and explosive consequences of the energies of gun-cotton, gunpowder, nitro-glycerine, dynamite, or whatever other elements are used, would be a question in kinetics.

Again, that singular calculation, that if a man were engaged in producing a certain motion, as, for example, drawing water from a well, by the expenditure of his muscular energies through the period of his manhood, he would raise by the mechanism of his bodily frame no more water than could be raised by one load of the best Wallsend coal, hence completing the parallelism, and reducing it to the form of money value—and it is wonderful how much more we appreciate these things when they are put in a money value—the life energy of a man acting through the mechanism of his muscular system does not exceed the energy of a load of coals employed through the mechanism of a scientifically-made engine. In other words, given the two mechanisms, the life of a man is not worth more than about 60s. Had man been created for no higher destination than this, we may depend upon it he would have been put together as a piece of mechanism very different from that on which he is now constituted.

In kinematics these elements of force occupy no attention whatever. Neither the force that produces the motion, nor the forces impeding the motion, nor the forces that these two motions call into action, none of these belong to the division of the subject with which these Cantor lectures have to deal. Kinematics, therefore, is a science of mere motion; even elements of strength are not considered in it. The galloping tortoise which we see advertised in the windows in the streets of London, and that tricky little mouse that you see creeping up the hands of men in Oxford-street or Lombard-street, claim from mechanicians quite as much attention, and involve questions of mechanism perhaps quite as curious as Babbage's calculating machine, or those singular things, the orreries of the last century. It is, therefore, the division of the subject called kinematics with which the present course of Cantor lectures is chiefly concerned.

M. Ampere appears to have been the first to direct public attention to the importance of kinematics as a special study. Plato speaks of astronomy as "the doctrine of the motions of solids;" and to come to recent times—very recent indeed—there is a still valuable work by Emerson, which we have here, and which contains some very good illustrations. Here is one of the mechanism of a rat-trap, and very well it is done. The reason why the book is produced is this. It was probably first published about 1750; this copy, which is the second edition, corrected and very much enlarged, with 43 copper plates, was published in 1758. The title-page is well worthy of our consideration in connection with the present course of lectures. It is—

THE PRINCIPLES OF MECHANICS,
Explaining and Demonstrating
THE GENERAL LAWS OF MOTION.

The Laws of Gravity.
Motion of Descending Bodies.
Projectiles.
Mechanic Powers.
Pendulums.
Centres of Gravity.
Strength and Stress of Timber.
Hydrostatics.
Construction of Machines.

A work very necessary to be known by all Gentlemen and
others that desire to have an insight into the
WORKS OF NATURE AND ART.
And extremely useful to all sorts of Artificers, particularly to
Architects, Engineers, Shipwrights, Millwrights, Watch-
makers, &c., or any that work in a Mechanical Way.
The Second Edition, with 43 Copper Plates.
1758.

The order of Emerson's subjects is remarkable. They begin with motion, lead on to equilibrium, and end with structures. In our days the habit seems to be to begin with structures, descending through equilibrium, and very seldom proceeding so far as motion is understood in mechanism. In the preface he lays great stress upon motion, and not, as in modern books, equilibrium; on that he lays no stress. He writes:—"What else is there in the visible world but matter and motion? Mechanism is a science of such importance, as without it we could hardly eat our bread, or lie dry in our beds, and by it we come to understand the motions of the parts of an animal body—the motions of the celestial bodies. Without mechanics a general cannot go to war, and the meanest artificer must work mechanically, or not work at all, so that all persons are indebted to this art, from the king down to the cobbler."

Although pure mechanism or kinematics has thus been recognised as an important study in and by itself, yet no work appeared in the English language, as far as I know, until the year 1841, one year after Dr. Whewell's book, which was six years after M. Ampere had drawn attention to this subject. Then Professor Willis, the Jacksonian Professor of Natural and Experimental Philosophy in the University of Cambridge, published a volume on "The Principles of Mechanism, designed for the use of students in the University, and for engineering students generally." To this work all who have alluded to mechanism acknowledge great obligations.* In it the subject is treated as a mathematical one, and although in the present course of lectures the purely mathematical aspect of the problem must be ignored, that is no reason whatever why the young mechanicians should not study the subject with the only key that can unlock for them its treasures.

Whilst allowing the "open sesame" character of this mathematical key in the question of mechanism, it is well to avow that purely mathematical minds have claimed for their favourite science far too much of the power of a magician's wand over terrestrial mechanics and mechanism. Mathematicians boast that they hold the key of the gate; it is a reflection upon their good taste that they seldom walk in the pleasant pastures of which they have the key. If mathematicians would but become as familiar with the technicalities and wants of machinists and mechanists as they are with the omnipotence of x and y, they would often receive the right-hand of brotherhood, where now men are provoked to say, "Stand back; we do not want you." There will be no solid progress in the refinements and precision of mechanism, either constructive or kinematical, until there is less dissociation between mathematics, physics, kinetics, and practice. The youth of England are led in the dynamical relations of x and y to calculate the path of the earth in its orbit, and they can do it to a second in a year. The same x and y enable them to tell the periods of the revolution and rotation of the earth; to find the velocity of light, and to measure the length of its waves to the millionth of an inch; to calculate the exact curve of the spectroscopic diagrams in the solar corona, and this with an accuracy that even decimals fail to represent to the mind. Such is considered a triumph of mathematical dynamics. But ask a mathematician to determine the quantity of irregularity produced by an unbalanced fly-wheel; to say how a small weight on a large fly-wheel may produce back-lash through a mill, and destroy the teeth of some of the largest wheels in that mill, or to state in what motions or how to utilise the heat that passes away, or to what influences a ship is subject by the rotation of heavy machinery within, or to calculate in any given case what is called negative slip; and how is that slip in a screw propellor to be avoided? Ask the mathematicians to take a given problem, with given numbers, under any of these heads, and they will turn from it and think it beneath their notice—probably it is beyond their skill.

Mechanism, then, is the alphabet; machinery is the written expression, and that machinery is a combination of parts. These elementary parts are furnished by the mechanician. Hence the study of mechanism should precede the study of machinery; but it has failed and still fails to do so.

Apart entirely from the mathematical and scientific reasons why mechanism does not hold its own as a branch of well-defined and intellectual study, there are one or two obvious social ones. Mechanism is not directly allied to utilitarianism; it bears a relation to utilitarianism of a character similar to that which art bears to it. The necessities of life must first be met, and then may be entertained improved means for meeting them. Houses, boats, bridges, clothing, and food must first be procured, and then, and not until then, need be considered the best way for accomplishing these, or for rendering them more attractive when they are procured. Hence art and mechanism first succeed, and then precede, utility. Again, our very bodies, and the contrivances which nature has so profusely scattered around, have given man what may be called an intuitive knowledge of mechanistic combinations. Men avail themselves of these as they do of books in a library, and rarely give a thought to anything but the branch that they are themselves at the time wanting.

Mechanicians are only a numerous class of those who do this. To the extensive storehouse of nature's contrivances, perhaps every branch of art and science resorts more than it is willing to allow. When the government, about 100 years ago, referred the question of a lighthouse to Smeaton for the Eddystone rock, Smeaton, who was experienced both as a kinetical and constructive mechanician (he was the first to introduce the use of cast iron teeth in large wheels), did not contrive a lighthouse, or even consider he was called upon to design one. What he did was to look about through nature's storehouse, and to consider where and how resistances were met similar to the resistances he was called upon to meet. Hence, when he published a report, in folio, of the designing and executing of the present Eddystone lighthouse (three or four previous ones having being either burnt down or washed away), he printed, side by side with a drawing of the structure he proposed, the trunk and branches of an oak tree, which he took as his model. On the wall is a diagram taken from Smeaton's own account of the Eddystone lighthouse, and showing the peculiar mode in which he dovetailed the stones one into the other. The question of the Eddystone lighthouse is quite foreign to our present purpose, but the diagram there shows the mode in which the oak branch enters into the stem of the tree; and in the text Smeaton points out how beautifully the obtuse angle of the branch is fitted in with more material than the acute angle, and how it strengthens the acute angle; he also shows how the stem of the tree is fixed into the ground, and to this natural contrivance he owed his ideas, for from them he writes:—"I could make a figure not ungraceful; and at the same time carrying the idea of great firmness and solidity" (p. 42). That is sensible constructive mechanism. There may be many in this room who remember the year 1851, when the country was very much perplexed to know what to do with the Exhibition it had summoned, and did not know how to put it under cover. Architects, engineers, and others were completely baffled. They felt that if they raised a building, either of brick or stone, damp in the walls would spoil the treasures of art to be deposited there. No available suggestion originated with them. In the crisis a gardener came forward, and to him is due the credit of having suggested the design for the building. Sir Joseph Paxton, who owns he was no engineer, writes of the Exhibition of 1851:—"Nature was the engineer in this case," and he requests those who choose to do so to compare the leaf of the water lily (the "Victoria Regia") with the building erected in Hyde-park, for he says, "from this I obtained all my ideas," of what should be comprehended in the first iron and glass building that was ever seen. Let us look—the inquiry shall be as brief as possible—at a few more of similar illustrations. A spider's web across a garden path suggested the Menai bridge to Telford before 1818. The structure of bones suggested the tubular one which carries the railway across the Menai Straits. The little worm which perforates the wood of ships suggested the Thames Tunnel to Brunel; the telescope, the microscope, and the camera obscura are all clearly set forth in the eye; it was a lobster shell which gave the idea of curving wrought-iron tubes to Watt; wasps make paper, and there are other wasps that make paste-board. Spiders form nets; hail and shot are formed exactly alike. Bird's feathers suggested the slates to our houses, and bird's nests are lessons to this day in basket weaving. England, as an island, is warmed as this room is warmed. In the torrid zone there is a boiler and furnace, and the Gulf Stream is the enlarged pipe of a huge heating apparatus. In the hand we have a vice, and looking at that vice which we all possess from a mechanical point of view, it is evidently one more perfect than the most ingenious vice the accumulated skill of engineers could possibly produce. There are eight or nine different vices in one, that is to say, it is a vice of varying size and form; it needs no clams; there is no chance of damaging the work put in it by the serrated edge, as is the case in an ordinary vice, for, as you know, clams of wood, lead, cloth, and other materials are used to save the work. Look at it from any point of view, it is unapproachable. If you want to hold a circular piece of metal, how much more beautifully do you do it than can be done by any contrivance of engineers. You hold it between two fingers and a thumb. Although this is a question of statics, it is worthy of a few moments' consideration. You observe, many people put things upon four legs; theodolites*, instruments, tables, &c., are generally put upon four legs, but Nature tells us we should put them upon three. When this pencil is held on three sides by two fingers and one thumb, you cannot press it in any direction without its meeting with resistance, but once put it between four fingers and there are four places in which it may escape. Another peculiarity of this vice (viz., the hand) is, that you may hold a chisel in it so as to be quite steady, and yet it will slide along, and there is no vice known to me which will do this. This vice, then, is not only a very curious one, but, in respects which would draw us very far aside, it is one possessed by no animal except man. Look, again, at the wrist joint. We have vices with balls and sockets, and universal joints, but none equal to this universal joint at the wrist. There is a fortune for anybody who can make a vice to equal it, so simple and so universal. Then, again, the stomach is a perfect laboratory. The lungs are a bellows; the skull is an arched vault, beautifully put together; and the teeth!—what a complication we have of knives, saws, wedges, and mill stones; and in the jaws there is an arrangement which has often been tried, but which has never yet been successfully attained, called a draw-cutting action, the nearest attempt to which is in bread, hay, and paper-cutting machinery. Not only is the eye a telescope and a microscope, but there is in its apparatus, viz., in the "iris," a specimen of what engineers have been attempting for a long time—an expanding pulley. No expanding pulley has yet been successful. To adapt such suggestions as these supply, and to combine them with the structural schemes which ingenuity or necessity furnished, seemed to satisfy all the wants of men until the steam engine enlarged its usefulness by giving a rotary motion in addition to a reciprocating rectilineal one. Watt did this in 1770, and from that time we began to date our mechanical progress. Then it was that men who saw a high scientific and intellectual study in mechanics were gradually turned from such considerations as the mathematical demonstration of the parallelogram of forces, or the abstract beauties of algebraic analysis, to them ore important considerations which these engines producing rotary motion led them to entertain.

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* The second edition of this work has been recently published by Messrs. Longman, and to them and Professor Willis the Society of Arts is indebted for the loan of certain wood-cuts to be used in the printing of future lectures.

When we note how slowly, even in these days, the direction of men's thoughts change, we must not be surprised that comparatively few minds have left the beaten track, and entered on studies of pure mechanism. It is, both in its abstract and practical character, a very fascinating study, and those who promote it render the art of the mechanic less empirical and far more scientific than it is at present. As an architect should study engineering, so a mechanic should study mechanism. A mechanic, as the term is applied, means one who makes machinery. This view is just as narrow as that which would restrict the term engineer to one who drives an engine. If there is one occupation more than another which should win respect from the required combination of mental knowledge and handicraft skill, it is that of the mechanic; and of mechanics, none need these qualifications more than the smith—

> "A mighty man is he,
> With large and sinewy hands,
> And the muscles of his brawny arms
> Are strong as iron bands."

For that man can take an uncouth, shapeless mass of cold iron and so correctly judge of the volume of that uncouth mass as to select the required quantity, and no more, for a form to which it bears no resemblance, and to which form he shapes it, although he is never able to touch it with his fingers. Before you is one of the recent triumphs of skill in wrought-iron; and if there is any one present who has taste for work of that kind, it is well worth study. It has been lent by Messrs. Peard, Son, and Peard, and is a pure piece of wrought-iron. It is most artistic and graceful in form, and is put together without brazing in any part. How far it has been screwed together, or how far it has been simply welded, there are, no doubt, those in the room fully competent to judge. No one, however, can leave it without admiration, and recognising the truth of the statement, that of mechanics there are none who more deserve the thanks of the community than the class called smiths.

The relation which the machinist bears to the mechanist is easily defined. Setting aside the question of structure, the mechanist deals with designs; the machinist takes those designs and adapts them to his purposes. For the fitness of the designs for an end, they apply, when need be, to the mathematician. The mechanic takes the deductions of the machinist and the mathematician, and produces a machine as exactly adapted to the purpose required as the knowledge and experience of the time enables him to do. The distinction thus drawn between the machinist and the mechanician leads to modes of expression by these respective classes which, unfortunately, do not increase the respect of each for the other. For example, the mechanician aims only at a contrivance; the machinist or mechanic aims only at a commercial or manufacturing utility. A mechanician is contented with the most rude skeleton design; he does not care for either journals or plummer blocks being neatly and carefully curved out—anti-friction curves do not trouble him. On the black-board are two skeleton drawings—here is a very rude one of two wheels and a crank—these answer the purpose of the mechanician. A mechanic would not be worthy of the name of mechanic if he executed such a piece of work; as a mechanical drawing it is perfectly ridiculous. You see by the side of it some specimens of mechanical drawing, one a diagrammatical one, and another a most beautifully-finished drawing of a locomotive, which, perhaps, appears to many to be an engraving. It, however, is done entirely by hand. There are also working drawings, such as are taken into the workshop, from which the actual machines are made. It would certainly be a great improvement on scientific books if there were some advance in the illustrations they contain, which at present are often even less worthy of commendation than the rude mechanistic skeleton one alluded to.

It is quite possible, and it would be even prudent, to make mechanism a study altogether apart from mechanics; it would not, however, be prudent on the present occasion to do so. Whilst, therefore, associating mechanism with mechanics—to which it is not allied, and separating mechanism from mathematics—to which it is necessarily allied, in this course of Cantor Lectures we approach the subject in a species of bondage, and must therefore ask that favourable consideration generally extended towards a comparatively strange friend, by making use of our old friend, mechanics, for a favourable introduction and an occasional help.

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* The adjusting-screws of theodolites are, as a rule, four in number—the three-legged stand is the support of a four-legged instrument.

With mechanics we are all familiar. We can neither eat, drink, nor sleep, we can neither sit, walk, nor talk, except by the exercise of those mechanical arrangements with which nature has endowed us. When, however, in the course of nature the vital energy ceases by which man is enabled to put in action the machinery of his frame, then, however beautiful and perfect the machinery may be, the object for which it was constructed cannot be performed. At this stage (the power of the machinery having gone—the kinetical element having been removed) the mechanist takes up the parts, and may be said to analyse the contrivances by which the vital energies exercise their various powers. But the mechanic cannot operate without a motive power. The mechanician cares for none. He deals with contrivances in relation to motion. His peculiar province is to devise plans by which the motion he has may be changed into the motion he wants, and the requirements he wants are singularly varied, and they fully warrant Mr. Anderson's expression of "endless," for to them there is "practically no limitation." Farmers do not make more varied demands upon the weather than machinists do upon mechanists in relation to motion. There is no end to the variety of demands made by the public upon the mechanician. One man comes and says he has motion which he wants accelerated. Another says he has a motion which he wants retarded. A third comes and says his motion is not quite continuous, he would like it to be so; another says he wants the motion to be intermittent. One man says he wants a circular motion when he has got a rectilineal, another says he wants a rectilineal when he has got a circular; another wants it variable; another says he wants it uniform; one says it must be alternate, going backwards and forwards; another says he wants his motion brought to a state of rest. Another says, here is velocity, convert it into power; and another, here is power, convert it into velocity. None of these, and the list might be wonderfully extended, are out of the province of the mechanician. For example, a knife is to be sharpened. There are various modes of doing it. The shelves of the Patent-office have many plans for sharpening knives, but we will take the representative one, in which the stone revolves. We have an apparatus here for which we are indebted to Messrs. Holtzapffel. The problem before the mechanist is to convert the perpendicular motion of the foot up and down about eighty times in a minute into a continuous motion of the stone of about 500 feet circumferential per minute. The plan adopted here is to have a treadle for the foot, by which the up-and-down motion is transferred to a wheel, from which there is a band to a small pulley connected with the stone, and by this contrivance we have got the up-and-down motion of the foot converted into the continuous rotary motion of 500 feet per minute. That mechanism is perfect for all purposes, not simply for the sharpening of a knife, or razor, or lancet, but, as a mechanical contrivance, it will do for a hatchet, scythe, or any other edged tool. The machine has left the mechanician's hands as a contrivance, but the mechanic takes it up, and adapts the question of its structure to the particular use for which it is required, using such proportion of treadle, crank, and wheel as he pleases. The mechanist has done with it when the contrivance is produced, and it then becomes the property of the mechanic. If, however, the problem had been set before the mechanist in another form, as, for example, if he had a weight falling, and that had to be converted, or if he had got such a matter as the rise and fall of the tide, and that had to be converted, or, if he had got the explosive power of gunpowder, or the intense power at a short distance of electricity, or the elastic power of a steel spring, then clearly these would be new conditions imposed upon the mechanist, and a different piece of mechanism would have had to be designed for each of those cases. You have, therefore, according to the questions put before the mechanist, various machines, but one contrivance serving every purpose. In any case the mechanic takes the designs of the mechanician, and so avails himself of his own knowledge of material, and so adapts the amount of power at his disposal, and of that required to be utilised, as to make the machine.

Now it is clear that to sharpen a razor and a hatchet require from the mechanic two different machines—from the mechanician they require but one mechanistic contrivance.

Having thus explained and illustrated the position which mechanism holds in relation to other branches of mechanics with which it is allied, we should restrict ourselves to a consideration of the divisions and subdivisions under which it may be usefully studied. To do so in the present course of lectures would be to make the subject not particularly inviting, and we must sometimes therefore overstep the boundaries, and take a short walk into the not very inviting mathematical and prohibited fields, and perhaps a longer one into the more inviting mechanical fields. In thus, to some extent, trespassing into tempting bye-paths from the highway which the literal meaning of the title of these lectures prescribes, the Council of the Society, and the audience, who do not despise mechanistic drawings, must permit action to take place under a precept which not existing in our Christian code, I must borrow from another:—

> "For what saith the Koran in chapter the third,
> 'Confine not thy neighbour too close to his word.'"

A consideration of the classification of mechanism, as suggested by Professor Willis, may form an appropriate introduction to the next lecture.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

Sir,—But for the bequests in times past made to some of the City guilds, it may fairly be doubted if they would have perpetuated their existence to the present day. There are, however, still no less than 76 guilds, or livery companies, in existence in the City of London, 73 of which continue to take fees for admission to freedom; 36 have halls of their own, though many were destroyed by the fire of London in 1666; 53 are trustees for the administration of charitable bequests; 20 have almshouses for decayed members or their widows; and 14 have established and maintain schools in various parts of the metropolis or country. The Mercers' Free Grammar-school was the first school established in connection with the City companies, and dates back as far as the latter part of the reign of Henry VIII. The school originally formed part of the hospital of St. Thomas of Acon, and was sold, with a portion of the land attached to it, to the Mercers' Company by Henry VIII., who stipulated that the school should be maintained. The Merchant Tailors' School comes next in date, and was founded in 1561. This school is a noble instance of the application of the surplus funds of a City company, it having been established for the education of the children of all nations and countries, without limitation or restriction of any kind. Attached to this school are numerous fellowships, and several of the most successful scholars are annually sent to Oxford. Other companies maintain exhibitions at the Universities of Oxford and Cambridge, but among the most recently founded may be mentioned those by the Haberdashers, which, in addition to maintaining its schools in great efficiency, has this year declared its intention to establish four exhibitions of £50 each per annum, to be competed for by children, grandchildren, or apprentices of liverymen of the Haberdashers' Company, of not less than 16 nor more than 23 years of age, provided they have been scholars at a public school, and obtained some public mark of distinction, or have obtained a prize or passed a high-class public examination at one of the universities of Great Britain, or are students at law, of the medical science, of the fine arts, or candidates who have obtained high distinction or first-class certificates upon competitive examination for the Army or Navy, the East India or Civil Service. The exhibitions are to be tenable for a period of three years. To the above, a fifth exhibition of £50 per annum is to be specially granted to a scholar of any school of which the Haberdashers' Company are governors. A further sum of £150 is to be annually appropriated towards assisting the education of children and grandchildren of liverymen of the Haberdashers' Company. In addition to the above liberal grants in aid of education, the same company, bearing in mind its special mission, proposes to devote yearly the sum of £100, to be awarded as prizes to the actual inventors of new patterns, designs, or specimens of articles of haberdashery proper, such inventors not being manufacturers or dealers.

The last mentioned fact leads me to refer back to the action taken by the Society of Arts in the promotion of arts and manufactures, after the close of the Exhibition of 1862, which Exhibition was created by our Society. The great advances made by the workmen of England after 1851 was a matter of universal surprise to their foreign competitors in 1862. In the interval betwen 1851 and 1862, the Schools of Design in England had been remodelled, and the Society of Arts had promoted the establishment of new schools in the manufacturing districts. The Commissioners of the Exhibition of 1851 and the Council of the Society of Arts had co-operated with the government in the creation of a museum of art and industry at South Kensington, and the art-workmen of the country had not been slow to take advantage of those means of improvement and study. At the close of the Exhibition of 1862, the Society of Arts sought to render the treasures of the South Kensington Museum of increased practical utility to the art industries of the country, and in this work it received the hearty support and co-operation of the authorities at Kensington. The system of industrial instruction our Society sought to promote was effected by the offer of money prizes for the production of specimens of skilled art workmanship in various departments of industry, and, to carry out its system of art-workmanship prizes, it sought the co-operation of the City companies. The first of this series of prizes was offered in 1863, and included modelling in terra-cotta, plaster, and wax; repoussé work in any metal; hammered iron, brass, or copper; carving in ivory; chasing in metal; enamel painting on metal, copper, and gold; painting on porcelain; inlays in wood (marquetrie or buhl) ivory, or metal; engraving on glass; and embroidery. Photographs, chromo lithographs, or castings in metal of the work to be executed, were supplied by the Society of Arts, so as to start each workman as nearly as possible on an equality with his competitor, and the designs to be re-produced or adapted were generally selected from examples in the South Kensington Museum. In later competitions, the classes of work were greatly increased in number, and the workmen were also allowed to execute competitive examples from original designs executed in the various materials used in their respective trades.. The primary object of the Society was not, however, to create design, but to induce skill in workmanship, and to direct attention in some instances to styles and systems of workmanship not generally practised in our own country. In carrying out its object, our Society received the co-operation of the following City companies, viz.:—The Worshipful Company of Goldsmiths, which contributed £25 to be awarded as prizes; £15 for the encouragement of workmen in the precious metals, and £10 to be awarded at the Society's Educational Examinations. The Worshipful Company of Plasterers, which contributed £15 to be awarded as prizes for modelling in the Italian Renaissance style. The Worshipful Company of Clothworkers £10 10s., and the Worshipful Company of Salters £10 annually. The Worshipful Company of Coach and Coach-Harness Makers, and the Worshipful Company of Painter-Stainers co-operating with the Society, either in the award of medals or by contributing money to be awarded as prizes by the Society. The system of competitive industrial art competitions thus instituted continued in force till the present year, when, owing to the establishment of Annual International Exhibitions, it was thought unnecessary to continue the system longer. As showing the estimation in which the prizes were held, I may mention that some of the City companies held exhibitions of art industries in their own halls, viz., the Worshipful Company of Ironmongers, the Worshipful Company of Coach and Coach-Harness Makers; while the Worshipful Company of Painter-Stainers granted prizes, which were awarded to some of the exhibits at the workmen's exhibitions which have been held in the metropolis at various times since 1862. As an evidence of the appreciation of the Society's work by the workmen themselves, I may add that the Society of Wood-Carvers, in 1863, sought the aid of the Society in promoting the art of wood carving, and contributed the sum of £15 towards the prizes which were ultimately established. In addition, it may be stated that a surplus profit having been obtained from the North London Workmen's Exhibition, held in the Agricultural-hall, Islington, in 1867, the sum of £150 was placed in the hands of the Council of the Society of Arts, as trustees, for the award of a special prize, to be called the "North London Exhibition Prize."

I trust that I have said sufficient to show the intimate relation which has existed between the City companies, trade societies, and the skilled workmen themselves, and the Society of Arts, to render further allusion to the subject unnecessary. I propose, with your permission, to proceed in my next to a short review of a few of the works which the Society itself has undertaken in the interests of Arts, Manufactures, and Commerce, in addition to those to which I have already referred.—I am, &c.,

H. G. H.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-Gen. Scott, C.B., secretary.

Evening Promenades.—On the occasion of the visit of their Royal Highnesses the Prince and Princess of Wales, on Friday evening, the 28th June, the exhibitors in those divisions of the Exhibition which will be inspected by their Royal Highnesses will be summoned to afford any explanations, as was done in the Exhibition of 1851.

Manufacture of Paper Pulp from Wood.—One of the latest systems for the adaptation of wood-fibre to the production of pulp suitable for English manufactures is that of Mr. F. B. Houghton, who brought before the notice of the Paper Makers' Club such particulars of his process as to challenge particular attention, accompanied as they were by samples of pulp far superior (as we are informed) to any that had previously been obtained from the same material in this country. In a case, displayed in the section of the International Exhibition devoted to paper manufactures, Mr. Houghton has placed examples of the results of his processes, from the simple pine wood cut into chunks or slabs, to the fine, white, fibrous mass which is ready to be converted into paper, and he at the same time declares his readiness to show that he has entirely overcome the difficulties which have hitherto operated to prevent the use of this excellent material, especially in combination with other fibres. The *Paper Makers' Journal* says:—

"The chief of these difficulties, hitherto regarded as little less than insuperable, has been the necessity for using such large quantities of alkali, in the progress of disintegration by boiling, as to make the cost too great to bring the material into the market in such quantities and of such quality as to satisfy the requirements of English makers. In other words, the evaporation and waste of the alkaline liquor, and the necessity for using such large quantities of caustic soda or soda ash for every fresh disintegration, made the cost of production of a high quality of half-stuff from wood too great to admit of its adoption as a cheap substitute for higher-priced material. This necessity Mr. Houghton has superseded, and that by a process which also removes the dreaded danger from the heat or pressure required in the preparation of the fibre by some other methods. Patents for the requisite machinery and processes have been taken out, and a company is, or will shortly be, formed for working them, or granting licenses for them, in England, Sweden, and Norway. They are now being placed in operation on a large scale in France, Austria, and Belgium; and with a view to explain and demonstrate the various operations Mr. Houghton himself has established a small working plant at No. 40, Borough-road, where we were invited to inspect the very simple machinery.

"To begin with the wood itself—the pine wood of Norway, Sweden, America, and various parts of the world. It may be premised that the cuttings from the ends of planks, misshapen portions of trunks and limbs, misgrown timber, and what may be termed forestal waste, is completely adapted to the purpose. The cutting is effected by means of simple machinery, working a series of knives which slice the timber in a diagonal direction, so that the fibre easily separates by the splitting of the grain. These slices are broken with the utmost facility into small pieces, and are then delivered to the factory as the material to be rapidly converted into paper pulp.

"To this end they are first consigned to a patent boiler, so constructed as to endure great pressure, being composed entirely of welded rings upon welded rings double rivetted together transversely. They are heated entirely by hot water circulating in pipes which traverse them in sections throughout their length, and in which the heat can be so regulated from the external apparatus as to raise or lower the temperature to a single degree. The pressure employed in the process of treating the fibre is 180lbs., and the boilers are tested to 360lbs. to the square inch. The wood is introduced into the boiler in wire cages running upon a set of rails, so that while one batch is being removed another is ready for disintegration. When the boiling is completed, the small pieces of wood—which may be called fasces of wood-fibre —are quite soft, and of a dingy colour. not dissimilar in appearance to a piece of rather coarse field rhubarb after it has been cut up and baked in a pie. The material is now ready for bleaching in a vat, where it is treated with chlorine. pumped into the liquor in such quantity as not to injure the fibre; and the operation is afterwards completed by the use of permanganate of soda. The condition of the material is that of a soft, pulpy, highly-fibrous mass, which having been subjected to the action of a hydro-extractor, or, more simply, a "wringer," comes forth in the shape of a damp, fleecy mass, in which only a microscopic eye could detect the pristine wood fibre.

"In point of fact, one of the constituents which existed in the wood has been so completely removed that it affords a separate operation in the process of treating the alkaline liquor, a process which is, we understand, the achievement by which this system claims to inaugurate a new era for wood pulp.

"When taken from the boiler, the liquor with which the fibre has been treated is of a dark colour, and somewhat resembles "double brown stout." In this state it is pumped into a vat, where it is subjected to the influence of carbonic acid gas, which has the effect of coagulating, or, to some extent, solidifying the resinous particles; so that it changes in appearance from brown stout to muddy coffee. In this state it is transferred to a copper, where it is heated exactly to boiling point, the result of this being a complete coagulation of the resin, which is at once precipitated. or, in plain English, falls to the bottom, in large masses, not unlike great flakes of peat. For this resin, doubtless, some commercial or manufacturing use will soon be found; and at any rate it cannot fail to be a source of profit.

"The liquor is now of a clear, brown colour, about the tint of moderately strong tea, and is destined not to be thrown away as waste, but to be used again, after the balance of the alkali absorbed by the fibre has been restored to it. This is effected by the use of sulphalte of soda, so treated with coal as to produce a combined substance capable of restoring the necessary constituents. The material used for this purpose costs less than £5 per ton, and about 10 per cent. of it will restore the lost alkali, for which it is substituted weight for weight—a trifling cost when compared with that of making up the deficiency with either caustic or carbonate of soda at the present prices. By this process the liquor is made fit for re-introduction to the boiler, and on being removed is treated as before, so that it may be said to be constantly renewable.

EXHIBITIONS.

Royal Cornwall Polytechnic Society.—The 40th annual exhibition of this society will open on Wednesday, 21st of August, 1872. Medals and prizes in money will be awarded in the following departments:—Mechanics—Machinery and models; mechanical and other scientific inventions and improvements; specimens of naval architecture; essays and scientific papers, &c. Fine Arts—Pictures and drawings by professional artists and amateurs, sculpture, architectural drawings and models, and specimens of ornamental art. Photography —Photographs by professionals and amateurs. Natural History—Essays, local observations. collections of specimens, &c. School productions—Mechanical and free-hand drawings, specimens of penmanship, &c. Plain needlework, &c., British lace, and all objects of interest connected with science and the fine and industrial arts, which may be considered deserving by the judges. The exhibition will be open for 8 days. No charge is made for space. The society will defray the expense of carriage to and from the exhibition of pictures and drawings by professional artists, and photographs by professional photographers. The carriage of all other articles must be paid by the exhibitor, except in special cases, when an exceptional arrangement may be made. Exhibits should be forwarded so as to reach the Polytechnic-hall, Falmouth, not later than Tuesday, August 13th, after which no space can be guaranteed. Lists of prizes and premiums, and all further information may be obtained from the secretary, J. H. Collins, F.G.S., Polytechnic-hall, Falmouth.

Ancient Musical Instruments Exhibition.—H.R.H. the Duke of Edinburgh presided, at South Kensington, at a meeting of the Executive Committee, held on the 19th inst., for carrying out this exhibition. Lord Gerald FitzGerald, Mr. Henry Leslie, and Mr. Alan Cole, the secretary, attended.

CORRESPONDENCE.

AUSTRALIAN MEAT.

Sir,—I should be glad if any person who has tried the Australian meat will tell me through your columns which companies or importers supply the best meat, and what is the precise equivalent in Australian meat of any certain quantity, say 1 lb., of ordinary English meat without bone. The proof of the saving in cost entirely depends on this.

I should like to know also the best way of preparing the Australian meat.—I am, &c.,

E. F. D. C.

London, 1st June, 1872.

STEAM HAMMERS.

Sir,—I think the proper way of meeting the difficulty suggested by Mr. Reveley, is to adopt the duplex principle for large steam-hammers.

Each blow of an ordinary hammer does a specific quantity of mechanical work. Part of this, and sometimes not a very small part, is taken up by the material under the hammer, and another part by the resilience of the hammer. The remainder, in the case of a steam hammer, being a considerable portion of the total work, is wasted in shaking the foundations both of the anvil and of the buildings in the neighbourhood. The obvious remedy is to make the anvil move up as the hammer comes down, and we thus are led to the principle of the duplex hammer.

I do not mean to say that this method is suited to every kind of work, nor do I propose to enter into the modifications necessary in practice; but I think it clear that in this principle alone are to be found the means (even theoretically) of saving the foundations from fatigue. The use of a very heavy anvil, however formed or supported, is rather a palliative than a remedy. Nevertheless, a good palliative is by no means to be despised.—I am, &c.,

C. W. Merrifield.

31st May, 1872.

INSTITUTION OF NAVAL ARCHITECTS.

The following correspondence has been forwarded for publication:—

Board of Trade, Whitehall-gardens,
22nd March, 1872.

Sir,—I am directed by the Board of Trade to enclose some copies of a memorandum on "horse-power" of steam engines.

Representations have been made to the Board that the term "nominal horse-power" conveys no definite meaning. This term occurs in section 5 of the Merchant Shipping Act, 1862, of which a copy is enclosed.

The Board of Trade will be glad to receive any observations on the subject with which the Council of the Naval Architects may be able to favour them.

If some understanding can be come to on the point, a definition of the term might be agreed to which will be accepted not only by the manufacturers and users of engines, but by the legislature, in the event of the term "nominal horse-power" being retained when the statute is revised.

I am, Sir, your obedient servant,
(Signed) Thomas Gray.
The Secretary, Naval Architects, Adelphi.

Institution of Naval Architects, 9, Adelphi-terrace,
London, W.C., 4th June, 1872.

Sir,—In reply to your letter (M) of the 22nd March, in which you ask for certain advice with respect to the term nominal horse-power, I am directed to inform you that the subject has been carefully considered by a committee of the Council of this Institution, with the following results:—

The committee were unanimously of opinion that the term nominal horse-power, as at present ordinarily used for commercial purposes, conveys no definite meaning.

They were also unanimous in considering that the proposals contained in Mr. Mac Farlane Gray's pamphlet could not be recommended for adoption. The majority of the committee were of opinion that no formulæ depending upon the dimensions of any parts of the engines, boilers, or furnaces, could be relied upon as giving a satisfactory measure of the power of an engine, and that even if the varieties of engines and boilers now in use could be comprised under one general expression for the power, the progress of invention would soon vitiate any such expression or formula.

The entire abandonment of an old commercial standard, such as nominal horse-power, however inaccurate, must be a matter of considerable inconvenience, and accordingly great attention was given by the committee to the question whether that standard could not be amended and retained. Among the many plans considered, not one received unanimous or even general approval. That which met with least objection was that the indicated horse-power, as ascertained on a trial trip, should be taken either as the nominal horse-power or as a basis for it, being divided by a suitable divisor.

The committee were of opinion that, for the purposes of the Act, if any standard at all of horse-power is to be used with reference to the engineers, it would be better to name 400 indicated horse-power in place of 100 nominal horse-power.

The committee were also of opinion that all engineers of coasting and sea-going ships should be required to pass some examination, and the Council think it desirable that this opinion should be communicated to the Board of Trade.

I have the honour to be, Sir,
Your obedient servant,
(Signed) C. W. Merrifield.
Hon. Sec.

The Secretary, the Board of Trade,
Whitehall-gardens, S.W.

THE WALTER PRINTING PRESS.

The following letter on the above subject appeared in the *Scotsman* of July 14, 1872, and which is here inserted as it refers to a matter that was omitted in the article that appeared in the last *Journal*:—

Sir,—In your interesting article on the "Walter Press," it was stated that the idea of a rotary machine printing newspapers on a continuous sheet of paper was not novel; that Sir Rowland Hill had worked at it many years before, as had other persons in America. As to most of your readers this mention of a benefactor of theirs in another way as a mechanical inventor was, no doubt, something new and curious, it may be interesting to them to learn what Sir Rowland Hill's share of merit in this matter was. I send with this a copy of the specification of his patent for letter-press printing machines, taken out in 1835 (No. 6762, printed by the Patent-office in 1857), and an account of it given in the *Repertory of Patent Inventions*, No. 35. By these it will be seen that the most important achievements of modern printing were effected by Sir Rowland Hill thirty-seven years ago. His machine was to print either with stereotype plates or movable type (the difficulty of fastening the last securely to the cylinders revolving at great speed was met by special contrivances); was itself to keep the printing surfaces inked; to print a continuous roll of paper, of any length, and both sides, while passing once through the apparatus; to cut up the roll into sheets; and means were contrived of performing those operations on two rolls at once, so that at one revolution of the printing cylinders two copies could be struck off. Such a machine was actually constructed (at an expense of £2,000), and was frequently shown at work at No.

44, Chancery-lane, as many persons must remember. Though driven by hand it could produce at the rate of seven or eight thousand impressions in an hour. One great difficulty of most printing machines is that of securing perfect *register* (the exact coincidence of the printing on opposite sides of the paper). This was anticipated and met by the patent. The one thing the inventor failed to do was, to overcome the resistance the collectors of the stamp-duty presented to this printing on a continuous roll, and to the affixing of the stamps to the newspapers at the proper intervals during their passage through the machine. Many years afterwards they allowed this to be done by machinery contrived by Mr. Edwin Hill (who had assisted his brother in the preparation of the printing-machine), which was affixed to the presses of the *Times* and other papers, and which itself registered, for the security of the revenue, the number of impressions made. In 1835 the task of satisfying the Treasury that this could be done, with safety to it, was too formidable to be overcome, at least it was not overcome. Sir Rowland Hill's attention was soon afterwards absorbed by his plans of postal reform; and no one can regret this, seeing what work he did in the Post-office, which probably no one but himself could have done so well; while, if the fourteen years of his patent passed unprofitably to the inventor, other hands have carried to extraordinary perfection the scheme of a printing-machine. Of course the Americans and the "Walter Press" have greatly advanced on "Hill's Machine" of 1835, especially by the preparation of stereotype plates for this particular service. In his specification, Sir Rowland Hill made due mention of his predecessors, recording that an imitation of the process of printing calico by cylinders revolving rapidly was proposed for letter-press printing as early as 1790, by Mr. William Nicholson, and that this was applied to stereotype plates bent to a cylindrical surface, by Mr. Edward Cowper, in 1816. But the first practical scheme of newspaper printing on a continuous roll of paper, by revolving cylinders, was produced and set to work by Rowland Hill in 1835.—I am, &c.,

J. F.

London, February 12th, 1872.

LATEST RESULTS OF THE GENERAL ADMINISTRATION OF EDUCATIONAL GRANTS.

A paper was read on the 3rd instant, at the Association for the Promotion of Social Science, "On the Importance and Necessity of Improving our Ordinary Methods of School Instruction;" by Joseph Payne, Fellow of the College of Perceptors, which contained the following statement:—

It is a fair proposition that the value of a given system of means, professedly adapted to secure a certain end, ought to judged of by the results obtained through its ordinary working. These are, in fact, the test or measure of its efficiency; and if either in quantity or quality they fall greatly short of the calculated estimate, we decide that the system of means—the machinery in question—whatever may be its intrinsic theoretical value, is on the whole a failure. In speaking, however, of results of machinery, it must be distinctly understood that we speak of average results, and that the occurrence of extraordinary instances of success does not affect the general conclusion. It is obviously possible that these may be due to unusually favourably circumstances not contemplated by the theory of the machine, and therefore not due to its ordinary action. If, then, taking into account the entire working of any machine, we find that it fails more frequently than it succeeds, we have a right to say that the failures, not the successes, represent its true character, and hence to conclude either that the theory on which it is constructed is erroneous, and that it ought therefore to fail, or that, being good in theory, it failed because it was unskilfully worked. It is further possible that both these assumptions may be true; that the theory of construction my be erroneous, and the practical working of it unskilful.

Applying this illustration to our educational machinery generally, I fear it will be found that both allegations are well founded; that the theory which underlies the greater part of our practice is unsound, and that the practice is, generally speaking, unskilful, and therefore inefficient.

To discuss the theory of education generally is not my immediate object. I have considered it at some length in a lecture on the "Science of Education," delivered before the College of Preceptors, and to discuss it fully now would interfere with the business before us. It is sufficient for my present purpose to enunciate in general terms—that intellectual education—the branch of the subject which immediately concerns us—appears to consist in the development and training, by means of instruction, of the active powers of the pupil's mind, with a view to the attainment of knowledge and the formation of habits of thinking. If this view of education is correct, it must, of course, be applicable wherever the process of teaching is going on, and therefore to every kind of instruction, and to every class of pupils. The man who keeps these objects steadily in view, and systematically aims at securing them, is a teacher in the proper sense of the term. He, on the other hand, who from ignorance of the nature of the mind with which he is dealing, or from ignorance of the resources of his art, so operates as to quench rather than to quicken intelligence—a frequent result of teaching—may bear the same conventional name, but belongs to a different class from the other. Dr. Hodgson tells us that at a meeting of this Association, some years ago, he heard one of the school inspectors declare that at certain schools he could tell pretty accurately by the pupils' faces how long they had been at school. The longer the period, the more stupid, vacant, and expressionless the face.[*] Without, however, dwelling longer at present on theory, I shall now endeavour to show, by facts, that the average results of our instruction, whether in primary, middle-class, or public schools, answer neither to the demands of the theory of education that I have suggested, nor to those of any theory which is worth the name (for all practice involves a theory of some kind), and that they show conclusively the importance, and indeed the necessity, of some improvement in our ordinary methods of school instruction. We notice, first, the results of primary instruction. It would be absurd, in this case, to apply our theoretical definition of education. It is not even conceived, as far as I can see, by the syllabus of the Educational Department, that the children of our primary schools shall have their minds trained at all. Not one word appears in the instructions to lead us to infer that teaching has anything whatever to do with mind; the word does not even occur. What we do see is, that certain processes, which we may fitly call "grindings," are to be gone through, and that the quantity rather than the quality of the grist is to be periodically examined. All, indeed, that is demanded by the actual theory—if we may give it such a name—of primary instruction is that children (from the age of six to ten) shall, during the average term of four years of instruction, be qualified to pass the fourth standard of the Revised or New Code; *i.e.* that they shall be able (I quote from the authorised instructions) (1) to "read a few lines of poetry or prose;" (2) "to write a sentence, slowly dictated once by a few words at a time, from a reading-book used in the first class of the school;" (3) to work sums "in the compound rules (common weights and measures) of arithmetic." This is all that is really required by our petty and ignominious theory of primary school instruction; and taking the minimum number of attendances of the children throughout the year at 200, and reckoning five hours of school for each day, we find in the four years about 4,000 hours of practice allowed for carrying it out. Now, let us look at the results. According to the official report of 1866-7, it appears that at the examinations in 1866, 264,231 children were qualified by age and attendances to present themselves for examination, but, for want of qualification by advancement, only 161,773 were actually examined. Of these only 97,364 passed without failure above Standard III., which means, as the official report tells us, that only 97,364 children above ten years of age passed the examination, instead of 264.231 who ought to have passed; and, consequently, "that the difference, 63 per cent., or nearly two-thirds, marks children passing out of school to work with less of elementary knowledge than Standard IV. denotes." The reporters may well say, as they do with proper official calmness, "the general results of the individual examinations under the Revised Code still continue to show too backward a state of instruction." Things were much the same, if not worse, in 1870, the last year reported on. The reporters still call attention, in a marginal note, to the "unsatisfactory results of examination." Not without reason, as shown by the explanatory text, where we find these noticeable words:—"If we confine our attention to the scholars above ten years of age, it further appears that out of every 100 of these elder scholars examined, only 64 per cent. passed without failure, although 129.331, or 44 per cent. of the number, were examined in the three lower standards (which I interpret as meaning that only 20 per cent., instead of 37 per cent. as in the former report, of the scholars above ten years of age passed Standard IV.), while," the report proceeds, "those who passed without failure in the three higher standards were only 33 per cent. out of the 100." Surely these are very extraordinary products of the working of the prodigious machine called National Education; a machine evidently either so badly constructed or so badly worked, that it fails more than twice where it succeeds once. Is this the sort of engineering that we find in the manufactories of Birmingham and Manchester? How long would the proprietors or directors put up with a machine which so signally defeated all their calculations?

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[*] "Exaggerated Estimates of Reading and Writing." A paper read at the Belfast Meeting of the Association, 1867.

In the presence of so signal a failure, it behoves us to inquire a little into the causes. The elements of the problem to be solved are (1), school-houses; (2) school apparatus; (3) school time; (4) the average intelligence of the pupils; (5) methods of teaching. Now, we may safely eliminate the first three elements, the school-houses, apparatus, and time; nor will it be seriously pretended that English children, as compared with those of Switzerland and Saxony, for instance—countries in which it is rare to find a child ten years of age that cannot read, write and cipher well—are exceptionally stupid.[*] Observe these children at their games and their amusements, at their school tricks and subterfuges, in their intercourse with each other. It is quite impossible to question their general intelligence, or to suppose them naturally incapable of acquiring, in 4,000 hours of instruction, sufficient knowledge to pass the fourth standard. We are then, it appears, shut up to the conclusion that it is the fifth element—the method of teaching, the working of the machinery—that we must look for the cause of the default, and for this the masters themselves are proximately, and the Educational Department ultimately, responsible.

THE COUNTERFEIT WINES OF CETTE.

In an article recently published is some interesting information on the manufacture of counterfeit wines:—

The counterfeit wines for which Cette is principally noted are sherry, port, Madeira, Malaga, Cyprus, and Lisbon—the last a kind of sweet sherry. It also exports a large quantity of what is called Burgundy port, principally to the United States, where it is used, mixed with an equally fictitious sherry, in the composition of the well-known sherry cobbler. Cette likewise produces counterfeit Champagne, Alicante, Malmsey, Marsala, Sauternes, Hermitage, and Rhine wines. During last year the exportation of imitation wines from Cette was close upon a couple of million litres, or nearly 450,000 gallons, which was equivalent to one-third of its total export of wine. A considerable quantity of the counterfeit wine of Cette is, moreover, consumed in France, more particularly sherry, Madeira, Malaga, and Cyprus, so that there is little doubt that this fraudulent trade produces considerably more than half a million of gallons annually.

It is some consolation to find that the better class of counterfeited wines go to England, which takes "old crusted port" in large quantities, with a fair amount of "fine golden sherry," and also a moderate quantity of Madeira. The wines of an intermediate quality are reserved for Russia, Sweden, and the North of Europe generally, the first of which takes port, Madeira, Malaga, Marsala, and Lisbon; while Sweden and other Northern States take sherry and Malaga. The counterfeit wines of the lowest class—including the worst Madeira and sherry, the vilest Champagne, the poorest Sauternes, the most worthless Rhine wines, Alicante, and Malmsey—are all specially concocted for the American market, New York receiving what no other nation, save, perhaps, some of the South American States, would admit.

At Cette—next to Marseilles the most industrious, animated and prosperous town in the south of France—we were struck by the activity which was everywhere apparent. Half a score of omnibuses were awaiting the arrival of the train. The quays were encumbered with wine carts, discharging their loads for shipment, and at the bourse, which was being held in the open air, an immense crowd of *courtiers* and *negociants en vins* were largely dealing in newly-distilled trois-six and this year's Roussillon.

We found such large producers of imitation wines as we called upon quite ready to accompany us through their cellars, and invite us to taste any of their samples; but they proved unusually reticent when any questions were addressed to them on the subject of the means employed to produce this transformation of wine, which is a speciality of the industry of Cette. They all maintained that drugs were never had recourse to by respectable firms, who, moreover, they said, employed no chemists in their establishments; although it was well known that there were certain dishonest houses—there are degrees, it appears, in fraud—doing an insignificant amount of business, who had recourse to chemicals to produce different counterfeit wines. The judicious admixture of one natural wine with another, and the introduction of a small quantity of grape sugar or unfermented wine, which, by producing a new fermentation, renders the fusion homogeneous, supplemented by age or by exposing the wine in casks to the hot southern sun, were, according to the manufacturers themselves, the principal means they employed. No doubt artificial heat also plays a prominent part in the business.

The wines of Roussillon, more especially that of Banyuls, are employed, it appears, in the manufacture of port, which seemed to be a very simple affair, consisting in nothing further than the introduction into it of a considerable quantity of brandy—as much as from 15 to 21 degrees of spirit being added. The doctored wine has, however, to be kept three years before it is entitled to rank even as young port. The samples we tasted were of the brewings of 1867, 1865, 1861, and 1860, and we must confess to a perfect familiarity with the beverage, having met with it frequently at public dinners, besides at scores of provincial hotels. It was the same with the five years' old sherry, made from a dry white wine of the South, and rendered golden by the innocuous admixture of a little caramel, and which, although it had been brandied to the extent of 50 litres of "trois-six de Montpelier" to each butt of 500 litres, was less fiery than much of the sherry drunk in London. We had begun with this wine, and then turned to the port, which, after the exploded English fashion, we followed up with the claret. The only wine of this kind, however, offered us to taste proved to be a diluted St. George, one of the Montpelier wines, which seemed a very fair ordinary wine for palates already depraved by the products of Portugal and Spain.

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[*] Mr. Hepworth Dixon, in his "Switzers" (page 296), says, "Director Max Wirth, of Bern, assures me that no boy and no girl exists in this Confederation—save an idiot here and there—who cannot read and write;" and Mr. Mundella tells us that in Saxony he actually offered a premium (which he was never called on to pay) for the production of a child above ten years of age who could not read, write, and cipher well.

We noted down a few prices of these transformed wines. Port, the staple commodity, ranged from 475 to 550 francs the pipe of 533 litres—only 6½d. the pint, or 10d. the bottle—and yet we observe from the price-list of a Marseilles firm now before us, that it can be bought as low as 300 francs, or at the rate of less than 6d. the bottle, against 800 francs demanded for the genuine wine. Sherry which, warranted five years old, was 450 francs the butt of 500 litres at Cette, is offered, without any guarantee as to age, at Marseilles at 300 francs, against 900 francs demanded for pure Xeres. Madeira at Cette was from 450 to 550 francs the butt of 460 litres, while at Marseilles it is precisely the same price as the port. There was very little difference in the price of the Malaga, which was 450 francs at Cette and 430 francs at Marseilles. This wine, it may be remarked, had the peculiar flavour imparted to it from the goat-skins in which it is transported in Spain very successfully imitated at Cette. The counterfeit Sauternes commonly sold at from 75 to 100 francs the pièce of 228 litres, but this year prices would rule 25 per cent. higher.

Whatever may be the sins the "fabricants de vins" of Cette are guilty of in the matter of sophistication, or, to use their own milder term of "transformation," they are very far from being the sole culprits. For instance, at what is termed the "Office Vinicole" of Paris, the same establishment where the *Moniteur Vinicole*, the recognised organ throughout France of the producers and dealers in wines and spirits, is published, may be observed any number of foreign ingredients for "transforming" wines puffed in every number of the journal. Passing over Appert's "Pulvérine" and the "Poudres de Jullien," &c., pretended to be designed for the clarifying of wine, but which in reality "develop the predominating bouquet," "ameliorate the too intense colour of red wines,"—that is, convert the cheap black wines of Cahors into trebly dearer Bordeaux—and "lighten white wines that have become yellow;" in other words, transform a *petit vin blanc* of the South into Chablis or Sauternes — passing over these ingredients, we find the "Sève-arome de Médoc," which obtained honourable mention, we are informed, at the Exhibition of 1867, recommended for "the delicacy of perfume which it imparts to red wines, no matter of what origin," and a single flacon of which at 1f. 50c. is stated to be sufficient for a pièce of wine. One-twenty-fifth of a litre of the "Enanthique bouquet," at 30f. the litre, will, we are assured, "double the value of any pièce of red wine, by imparting to it alike age and bouquet," which last, by the way, will "endure for ever." The "Sève-arome de Bourgogne," converts, as its title insinuates, "the commonest growths into the most delicious Burgundy, imparting to them both body and remarkable delicacy of flavour. The Office Vinicole, by the way, does not limit its attention to wines. It has, in addition, a number of preparations for the improvement of brandy; among others, the "Liqueur essentielle de Cognac," which destroys," it states, in highly scientific language, "the empyreumatic flavours prevalent in trois-six de Marc, annihilates the sharpness of beetroot brandy, and ages and imparts aroma to both." Five francs worth of this compound is sufficient, it appears, to transform twenty-two gallons of raw spirit, distilled from beetroot, artichokes, or the husks and stalks of grapes into "fine champagne." Besides the foregoing, the special offspring of the Office Vinicole, the *Moniteur Vinicole* contains numerous advertisements of "Bouquet des Vins," "Sève de Sauternes," and other concoctions, which, as they are evidently very largely employed, it is to be hoped, are as innocuous as they are pronounced to be efficacious.

THE BETHNAL-GREEN MUSEUM.

The Bethnal-green Museum is to be opened on Monday next by his Royal Highness the Prince of Wales, on behalf of Her Majesty the Queen, at half-past twelve o'clock. It will be remembered that the land upon which this museum stands was purchased by public subscription, towards which purchase the Council of the Society of Arts voted one hundred pounds out of the funds of the Society, various members of the Council also contributing. The ground contiguous to Bethnal-green Church was purchased, owing to the exertions of Sir Antonio Brady and others, and presented to the government, on condition that they would erect the necessary buildings. After some pressure, this proposition was agreed to, and the removal of the iron buildings that did duty as the receptacle of the nucleus of the South Kensington Museum were passed on to Bethnal-green, and re-erected there in a form which is apparently intended to be permanent, inasmuch as they are inclosed in a red brick case, and the circular roof of iron has a second roof, slanting and of slate. Altogether, in appearance, the building has a handsome exterior, the walls being relieved by entablatures of mosaic, which have been done by the female students at the School of Art. Inside, the floor of the two side buildings has been raised about six feet, leaving a large central area available for such ceremonies as that on the opening day. This area is floored with tesseræ. The side buildings have also galleries, which are devoted to fine arts, and hold at present the magnificent Hertford collection of pictures, lent by Sir Richard Wallace. It is estimated that the value of this collection is over two millions of pounds; and the East-end of London owes a debt of gratitude to Sir Richard Wallace for the opportunity he has afforded of viewing such a grand collection of master-pieces. There is also a food collection and one of natural products. There are also a large number of works of art, cabinets, vases, &c., lent by the Science and Art Department. The Museum has been arranged by Mr. George Wallis, Mr. Thompson, and Mr. P. L. Simmonds, and is quite ready for public inspection.

MEETINGS.

The British Association of Gas Managers.—The 9th Annual Conference of the British Association of Gas Managers took place, by permission of the Council, in the Rooms of the Society of Arts on the 11th inst. The proceedings commenced with an address from the President, Mr. Jabez Church, M. Inst. C.E., F.G.S. This was followed by the reading of a series of papers on the various subjects connected with the mechanics and chemistry of gas manufacture. In the evening Dr. Odling delivered a very interesting lecture to the members upon a subject which is claiming the serious attention of gas engineers at the present time:—"The best means of getting rid of bisulphide of carbon." On Wednesday the reading and discussion of papers was continued during the day, and at the close of the meeting the officers for the ensuing year were elected. The choice of president fell upon

Mr. Angus Croll, Mr. W. H. Bennett being re-elected hon. sec. The members dined together at the Canon-street Hotel in the evening, and on Thursday they proceeded to inspect the new works of the Imperial Gas Company in course of erection. They subsequently visited the works of the Chartered Gas Company at Beckton, which are now in full operation.

GENERAL NOTES.

Black and White.—An exhibition of works of art in black and white will open on Monday next, at the Dudley Gallery, Egyptian Hall. As a large number of artists are contributing, the exhibition is likely to be very interesting.

"The Pearl" (Asher and Co., 13, Bedford-street, Covent-garden, W.C.) is the title of a new illustrated periodical containing original designs for jewellers and goldsmiths, edited by Martin Gerlach. The present number contains three coloured plates, with diagrams showing cross sections of the articles represented on the larger plates.

Historical Monuments.—At the request of Mr. Layard, late First Commissioner of Works, the Council of the Society of Antiquaries have been engaged in the collection of a list of such regal and historical tombs or monuments existing in cathedrals, churches, and other public places and buildings as, in their opinion, it would be desirable to place under the protection and supervision of the government, with a view to their proper custody and preservation. Although the council of that society have always considered it one of their chief functions to preserve all such interesting memorials of the past, yet they very gladly set the requisite machinery in motion for carrying into effect the expressed wishes of the Works Commissioner. For that purpose a special committee was formed at the beginning of the year 1869, and the results of their operations have been made public. The manner of their proceeding has been to distribute the counties of England and Wales among such fellows of the society, whether members of the committee or not, as appeared most likely, from their local knowledge or other reasons, to be able to furnish satisfactory information as to the monuments in existence in the districts respectively assigned to them, and to make returns according to a uniform plan suitable for tabulation. At the outset it was thought highly necessary to circumscribe the inquiry, and the following resolutions were accordingly adopted :—1. That the inquiry be limited to monuments of persons who died not later than the year 1760. 2. That for defining the meaning of the terms "Regal and historical tombs or monuments," the word "regal" should be held to comprise the following classes.—1. Kings and queens regnant of England or Scotland. 2. Queens consort. 3. Princes consort. 4. Parents of the kings and queens before mentioned. 5. Children and grandchildren of such kings and queens. 6. Male descendants of kings' sons in an unbroken male line. 7. Such other descendants of kings as have transmitted a right of succession to the throne. 8. Such brothers and sisters of kings and queens before mentioned as are not included under the previous heads. And the word "historical" shall be held to include the following classes.—1. All archbishops of Canterbury and York. 2. All lord high chancellors and lord-keepers. 3. All lord high treasurers. 4. All chief justices. 5. Eminent statesmen and ambassadors. 6. Persons eminent in theology, science, literature, and art. 7. Eminent naval and military personages. 8. Eminent merchants. 9. Other persons of note. In drawing up these resolutions and presenting the consequent researches, it will be seen that regard was not had to the value of the monuments as mere works of art, but to the importance of the persons commemorated as actors in the great drama of our national history.

The Process of Preparing Telegraph Poles.—When the telegraph system was transferred to the government, arrangements were made with various contractors for providing the trees necessary for supplying the demand of the prospective increase of telegraphic communication. In the North of Ireland, Messrs. Hamilton, of Cookstown, were the contractors, and a glance at their process of manufacture may not be uninteresting. The preparation of the trees which are to serve as telegraph poles is under the superintendence of a government official, and a large staff of workmen are engaged in the process. The manufactory, as it may be termed, is situated in the middle of an extensive field, and consists, in the first place, of a quadrangular structure; four strong poles, some 60 ft. in height forming the angular points. Within 6 ft. of the top is a platform, on which are two or three vats, each capable of containing 200 gallons. In the bottom portion of this structure are pumps for the purpose of forcing a liquid, chemically prepared, into the vessels above. The principal ingredient, besides water, is sulphate of copper. From these vessels two systems of tubing are carried downwards to the ground, and continued along the surface forward to a distance of a couple of hundred yards, in a direction at right angles to the front of the rectangular structure already mentioned. Raised at a slight elevation from the ground, and placed at right angles to these tubes, lie the trees to be operated upon, with their thicker ends inwards; at intervals of 12 in. or 15 in. in this horizontal tubing is placed a series of taps, each connected by a short india-rubber tube to the end of a tree, to which it is secured by means of cramps and screws, and rendered water-tight by a sort of nozzle. By means of cocks at the upper end of the horizontal piping the solution in the vats is permitted to descend. The pressure exerted from above forces it into the pipes through the india-rubber tubing and into the trees, traversing them in the direction of their fibre. In a short time the sap and a portion of the chemical solution are seen to ooze slowly from the smaller end of the tree, when it falls into a sort of wooden gutter, inclined at such an angle as causes it to run back to a cistern near to where it had been originally prepared. After undergoing some filtration here, it is placed along with the yet unused liquid, and again performs the circuit of the vats above and trees below. The time necessary for the complete saturation of the trees varies from ten days to three weeks, according to their quality and age. In this way an application of the principles of hydrodynamics, combined with what is little more than a mechanical chemical knowledge, enables the manufacturer to provide poles for telegraphic purposes which will resist the action of the atmosphere for at least five times as long as the telegraph poles formerly in use.

CALENDAR OF MEETINGS.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....Royal Geographical, 8½. 1. Mr. R. B. Shaw, "Central Asia in 1872." 2. The late News of Discoveries made by Dr. Livingstone.

Tues. ...Colonial Institute, 8.

Wed.....**SOCIETY OF ARTS, 4.** Annual General Meeting.
Royal Society of Literature, 8¼.

Thurs...Antiquaries, 8½.
Royal Society Club, 6½. Annual Meeting.
Philosophical Club, 6.

Fri.......Royal United Service Institution, 8½. Captain J. B. O'Hea "Rifles and Rifling."
Quekett Club, 8.

Journal of the Society of Arts.

No. 1,023. Vol. XX.

FRIDAY, JUNE 28, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

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TECHNOLOGICAL EXAMINATIONS.

The Conference on this subject is appointed to take place, at 12 o'clock, on Saturday, the 20th of July, when His Royal Highness Prince Arthur, K.G., has consented to preside. The members of the Society, members of the City Companies, and of the Chambers of Commerce, merchants, manufacturers, and others interested in this movement, are invited to attend.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

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ANNUAL GENERAL MEETING.

The Annual General Meeting, for receiving the report from the Council, and the Treasurers' Statement of Receipts, Payments, and Expenditure during the past year, and also for the Election of Officers, was held, in accordance with the Bye-laws, on Wednesday, the 26th of June, at four p.m., Seymour Teulon, Esq., Vice-Chairman of the Council, in the Chair.

The Secretary having read the notice convening the meeting, the minutes of the last Annual General Meeting, and of the subsequent Special General Meeting, were read and signed.

The Chairman then nominated Mr. William Botly and Mr. Christopher Cooke as scrutineers, and declared the ballot open.

The Secretary then read the following

REPORT.

Pursuant to the bye-laws of the Society, the Council now lay before the members, in General Meeting assembled, their Report of the Society's proceedings during the past year.

Ships' Life-Boats.

In 1870 the Council, under the advice of a Committee, offered the Society's gold medal for a ship's life-boat suitable for the mercantile marine. In answer to this offer there were sent in forty-four models in 1870. The committee entrusted with the examination of these models recommended the Council to renew the offer, and seek a further competition from builders. This was done, and nineteen competitors entered for the medal Under the terms of the competition it was laid down that before the medal was finally awarded the Council would require the selected candidates to build full-sized boats, in order that the same may be practically tested.

The Committee have selected two models for actual trial, one, a wooden boat, on a model sent in by Captain Nisbet, and one, an iron boat, on Francis's corrugated principle, by Messrs. Hamilton, of Liverpool; and they further gave an option to Messrs. Woolfe and Sons, to send for actual trial a boat on their model of the previous year, especially suitable for large passenger ships. The same option has been given to Mr. White, of Cowes, who had sent in models on the previous occasion.

The Committee further recommended that in lieu of one gold medal the Council should offer two gold medals, one for a wooden boat and one for an iron boat, and this the Council at once assented to. The actual trial of these boats is fixed to take place, under the superintendence of the Committee, in the Regent's Canal Docks, on the 31st of July, when members of the Society and their friends interested in the subject are invited to attend.

Channel Passage.

The members will recollect that on a former occasion the Council offered the Society's Medal for models of vessels of an improved character for this service, but the response was not such as to justify its award, a large proportion of the competitors appearing to act on the view that, unless new harbours, admitting of much larger boats, were constructed, it would be impossible to give that improved accommodation to the traveller which was needed. The Council nevertheless felt that, however valuable and desirable it might be that such great works should be constructed, taking into consideration the large outlay of capital required, and that it must be a long time before this could be accomplished, the Council again took up the subject, and appointed a Committee, consisting of Lord Henry G. Lennox, M.P., Chairman of the Council, Mr. F. A. Abel, F.R.S., Mr E. Chadwick, C.B., Captain Donnelly, R.E., Mr. Eborall, Captain Douglas Galton, C.B., F.R.S., Mr. S. Redgrave, Vice-Chairman of the Council, Mr. Grosvenor

Hodgkinson, M.P., Mr. J. S. Forbes, Mr. C. W. Merrifield, F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., Mr. E. J. Reed, C.B., Admiral the Right Honourable Lord Clarence Paget, K.C.B., Vice-Admiral Ryder, Capt. Robert Scott, R.N., Mr. Seymour Teulon, Vice-Chairman of the Council, Sir E. Watkin, and General Eardley-Wilmot, F.R.S., to consider and report "how far the existing means of crossing the Channel can be improved, and to take evidence thereon." This Committee has held many sittings, and the evidence taken before it has been published in the *Journal*. The Committee, as will be seen by their report (see page 661 of this *Journal*), are of opinion that, with existing harbours, the boats may be so improved in ventilation and in their fittings, and even enlarged, and the arrangements as to luggage so modified as to afford the traveller very much increased comfort and convenience. The Council refer the members for further information on this head to the report of the Committee.

India Committee.

The India Committee of the Society has pursued its labours. Several interesting subjects have been made matters of discussion at its conferences, but the Society has exercised no inconsiderable influence on the interests of our Eastern Empire by its co-operation. It has greatly promoted the new spirit which has been infused into the East India Association, by offering opportunities for its meetings in the hall of the Society. The Society of Arts has become the local centre for the efforts of the friends of India. The action which is being taken on the subject of money-orders for India, and for a consolidation of the submarine telegraph system, also tends in the same direction of usefulness. In continuing the labours of the Silk Supply Association by means of a Silk Supply Committee, the Council have had India particularly in view. It is hoped that not only will the culture of ordinary silk be promoted, but also that of other kindred products of India. Attention has lately been directed to the desirability of promoting intercourse with our Indian and other oriental visitors, by offering them opportunities for social intercourse; and the Society of Arts has been freely open to natives of India, and many of them attend its proceedings. The Society has set the example for the last three years of inviting to its conversazioni the natives of India present in London as visitors, traders, and students, and this has been productive of a very useful effect, and has been justly appreciated.

Ocean Telegraphs.

During the year this subject has occupied much of the consideration of the Council, and the members will have seen the announcements in the *Journal* of the action which the Council have been taking in this matter, together with the memorial which the Council have presented to the Prime Minister, urging on the government the great importance to Arts, Manufactures, and Commerce that these lines should be at once purchased by the government, and placed in connection with the inland telegraphs as part of the general postal system of the country. It is unnecessary here to recapitulate the facts and arguments leading to this conclusion; they are set forth fully in the memorial above referred to, and in an explanatory minute, both of which have appeared in the *Journal*. Lord Henry Lennox, M.P., Chairman of the Council, has given notice in the House of Commons that he will move the appointment of a Select Committee to investigate the subject.

National Training School for Music.

The Council have the satisfaction of reporting that the Provisional Committee of the Royal Albert-hall having commended to the care of the Corporation of the Hall the National Training School for Music, which had been for so long a time a cherished object of the Society, the Council of the Royal Albert Hall has confirmed the recommendation, and stated their willingness to grant accommodation in the Hall as soon as a responsible body of management for the National Training School for Music has been constituted, with whom they can make arrangements. The Council therefore hope in a short time to be able to report that the scheme has been launched. During the year the Council have been engaged in the preliminaries for inducing the counties of the United Kingdom to establish a system of public competitions in each county, with a view of selecting young persons of both sexes possessing musical talent which might be trained in the school, and the result has been very successful. Without seeking publicity, influential persons willing to aid the movement have been found to afford substantial assistance in respect of thirty English counties, three Irish, seven Scotch, and three Welsh counties, also in the colonies of New South Wales and Australia. Amongst the numerous supporters the following may be instanced:—On behalf of their respective dioceses, the Archbishops of Canterbury and York have expressed their intention to subscribe annually. Sir Titus Salt, Bart., will establish, with a donation of £1,000, a "Saltaire" scholarship for Yorkshire. The Mercers' Company of London will subscribe £50 a-year for a scholarship in London. Mr. Frank Morrison founds a scholarship of £50 a-year for five years for the county of Inverness. Mr. Hawkshaw, C.E., founds a scholarship of £25 a year, for five years, for Sussex. The Marquis and Marchioness of Westminster subscribe £15 a year on behalf of Cheshire. Mr. Minton Campbell founds a scholarship of £50 a year, for five years, for North Staffordshire, and among 120 other subscribers and supporters some of the most influential names will be found, which will be shortly made known. The members will thus see that the labours of the Council, which have been going on since 1865, are about to be crowned with success, and they repeat earnestly the statement in their report of 1871:—"The Council strongly urge the members to help them in this great national work. In former times, some two hundred years ago, the cultivation of music was far more general among the people of this country than at present. History shows us in those days both instrumental and vocal music were the common accomplishments of all with any pretension to a fair social position. No doubt political, religious, and social changes subsequently tended to discourage these habits, but whilst the causes which led to this discouragement have long since passed away, their influence has remained, and music is not so extensively cultivated as formerly." But little public encouragement or facilities are given to its study. Whilst painting and fine arts have long and with advantage had aid from the State, why should not music be similarly aided?

FOOD COMMITTEE.

This Committee has continued its labours during the session, and the information brought before it has been already published in the *Journal*. The Committee, in their reports, say:—

> During the past session attention has been mainly paid to the supply of meat, either desiccated, tinned, or more or less subjected to the action of cold as a preservative.
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> The Committee have not yet examined any meat which, having been once thoroughly dried, can be recommended for general use in this country as an article of food.* The meat becomes hard, and its juices either destroyed or permanently coagulated, so that no means hitherto adopted have been successful in restoring it to a palatable condition, or acquiring for it a nutritive value.
>
> Various specimens of tinned meats from Australia, Queensland, New Zealand, and Paraguay have been carefully tested by the Committee. There are still several points calling for improvement in the preparation of these meats, and much still remains to be done in the application of heat to prevent overcooking, and consequent insipidity and general deterioration as an article of food.
>
> The Committee, anxious to obtain definite information as to the use of these meats on a large scale, have issued a schedule of questions to various institutes, hospitals, asylums, and prisons, in order to obtain the result of the experience gained in such establishments. They have received upwards of 50 replies, and in 50 cases the meat, beef and mutton, has been more or less used, in one case to the extent of twenty tons; in only three cases had its use been discontinued. All agree in reporting that the meat, from whatever importer received, was in good condition as to preservation, an exceedingly small percentage of the tins being defective. With only three exceptions, it is uniformly considered to be economical as compared with the use of fresh meat; in one case the saving is estimated at £30 weekly, it being used alternately with English meat. The general average of economy in its use is variously estimated, ranging between 45 and 12 per cent., with an average of 25 per cent. In no case has it been used exclusively, or in such a way as to afford a thoroughly trustworthy basis to test its nutritive value, taking fresh English meat as a standard—a point of extreme importance which the Committee much wish to see definitively settled. In nearly every case reported on there is stated to be more or less prejudice against the use of these meats, either on the part of the inmates or servants of the various institutions, but in many instances this prejudice is said to be disappearing. As to the great importance of this source of supply, it may be sufficient to note that, while in 1866 the total quantity imported into the country amounted only to 16,050 lbs., valued at £321; in 1871 this had so enormously increased as to amount to 22,000,000 lbs., at a value of £550,000. The Committee still regard with much interest the various means proposed or adopted for utilising cold as an agent for preservation of food. These means may at present be stated to be incomplete, and needing much careful inquiry and experiment. The Committee have attempted, within their powers, to acquire further knowledge, both as to the temperature most suitable for the treatment, without injury to the nutritive value of meat, and also as to other conditions inseparable from the solution of the question before them, and notably as to the necessity of dry atmospheres for ensuring perfect success. Their experiments have, however, as yet been so limited as to afford no reliable data; but they hope that, as her Majesty's Commissioners of the Exhibition of 1873 have applied to them for assistance and co-operation in that part of the Exhibition which is to be devoted to the display of food products, they may be able, through their instrumentality, to do something towards determining this important section of their inquiries. In reply to the communication from her Majesty's Commissioners, the Committee have expressed their willingness to assist in procuring a proper representation of this division of the Exhibition. The Committee have also undertaken to furnish all the help in their power in arranging for and aiding in a series of experiments intended to secure an extended knowledge and better modes of cooking.
>
> Besides these inquiries relating directly to food preservation, the Committee are investigating the question of food supply in various parts of the country, especially of fish, and also have directed their attention to transit of meat by various improved railway vans."

In 1873, one of the divisions of the International Exhibition will include "Substances used as Food;" and at the request of Her Majesty's Commissioners, a committee of this Society has been appointed to take charge of one portion of the subject, viz., "Drysaltery, Grocery, and Preparations of Food," and this committee is now actively directing its attention to this branch, with a view to get together as complete a representation of it as possible.

IMPROVED CABS.

The very little improvement, if any, which has taken place in the vehicles for hire in the metropolis, has induced the Council to take advantage of the opportunity afforded by the International Exhibition of 1873, when carriages of all kinds are to be shown, to draw special attention to the very unsatisfactory condition of such vehicles. Under the advice of a committee the Council offer the following prizes :—

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* This does not apply to the preserved desiccated meats previously reported on

One Prize of £60 for the best improved Cab of any description.
Two Prizes of £20 each for the next two best.
Two Prizes of £10 each for the next two best.

The competing Cabs must be exhibited at the International Exhibition, to be held in South Kensington in 1873, and on their delivery at the Exhibition Building they must be certified to the satisfaction of the Judges as having been in regular use in the streets of London for three months previously. They must be delivered on or before the first Saturday in April.

The Council consider that the Cabs now in use in London are especially defective in the following particulars :—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.
2. The seats in the four-wheelers are too high, not commodiously made, and the space underneath is lost.
3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.
4. The arrangements for opening and closing the window in the Hansom.
5. The confined space and want of ventilation in the Hansom when the window is closed.
6. Imperfect locking of the wheels in four-wheelers.

The Council desire to point out, for the consideration of those likely to compete, that in Continental and some English towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

A suggestion for a cab, to be used either closed or open, has been brought before the Council, and a model submitted. The principle might be adapted to existing four-wheelers, but the Council do not prescribe this model or any special form of carriage ; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

Examinations.

The Chairman, in his address to the members at the opening of the session, directed attention to the probability that, after the present year, the Society would no longer continue to carry on the Examinations which it had established in 1856. The Society has witnessed the system taking a firm root in the country; the universities have taken it up, and the government Department of Science are now engaged in the work, and there is no longer any need for the Society to expend its funds in that direction. The Council, therefore, in December last, passed the following resolution, which was published in the *Journal:*—

> That the time has now arrived when the present system of examinations is no longer necessary, and that the encouragement of particular objects bearing especially on Arts, Manufactures, and Commerce, should be promoted by special means.

At the same time that the foregoing resolution was passed, the Council took into consideration a suggestion by Captain Donnelly, R.E., one of their body, for instituting a system of technological examinations, and having referred the question to a committee, adopted their report, as follows :—

> Your Committee, having considered the propositions submitted by Captain Donnelly, are of opinion that it would be of public advantage if the Society of Arts were to supplement the existing examinations of the Science and Art Department, by organising examinations in the science and technology of the various arts and manufactures of this country.
>
> 2. These examinations should be conducted by a Board of Examiners, capable of testing the practical knowledge and skill required in the application of the scientific principles involved in each art or manufacture.
>
> 3. Your Committee are of opinion that the scheme of examinations proposed by Captain Donnelly, and which is appended, may with advantage be adopted, with such modifications as may from time to time be found from experience desirable.
>
> 4. The Council should give notice annually of the subjects which would be taken up the following year. In making their selection, the Council may find it advantageous to include those Arts and Manufactures which are to be the subjects of the International Exhibitions of the year.
>
> 5. Your Committe recommend that communication should be opened with the various Guilds, Companies, Chambers of Commerce, and large manufacturers, with a view of obtaining their assistance in carrying out the scheme.
>
> 6. Your Committee would further recommend that a conference should be called in the Society's House at an early day, to which all parties likely to co-operate should be invited.

The details of these Examinations are now under the consideration of a Committee, and the Council will lay them before a public Conference in the Society's Rooms, to be held on the 20th July, when His Royal Highness Prince Arthur has consented to preside.

Review of School Drill.

The review of school drill having proved so successful on two occasions, the one in the Crystal Palace Grounds, and the other held last year in the presence of H.R H. Prince Arthur, in the Royal Horticultural Gardens, the Council have determined to repeat it. His Royal Highness the Prince of Wales has graciously assented to the request of the

Council, and will honour the Society by being present on the occasion, and will present the prize banners to the schools which have been successful in the drill competition. Capt. O'Hea, late of the 25th Regiment, has been entrusted by the Society with the duty of inspecting the drill of the schools, and reporting thereon, as a guide to them in the award of the banners. The day is not yet appointed for the review, but it is expected to take place in the last week of July, when it is hoped the members of the Society will show their appreciation of this important element in the training of the young by attending the display.

Cantor Lectures.

These Lectures have been highly successful, large audiences having been attracted to them. The first course consisted of lectures by C. Haughton Gill, Esq., "On the Manufacture and Refining of Sugar."

The second course was delivered by the Rev. Arthur Rigg, and consisted of six lectures on "Mechanism."

The third course was delivered by Professor F. Barff, M.A., and included seven lectures, "On Silicates, Silicides, Glass, and Glass Painting."

Mr. Gill's lectures have already appeared in the *Journal*. Mr. Rigg's and Professor Barff's will be printed during the course of the summer.

Medals.

The Council have this year awarded the Albert gold medal to Henry Bessemer, Esq., for "the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel." The members need scarcely to be reminded that this medal was established as a memorial of their former illustrious president, the Prince Consort, and the Council feel confident that, in their award of the medal to Mr. Bessemer, they have added to the list of recipients a name which will meet the approval of all.

For papers read during the session the Council have awarded the Society's silver medal as follows :—

To R. Johnstone, Esq., for his paper entitled "Observations on the Esparto Plant."
To Peter Lund Simmonds, Esq., for his paper "On Nuts and their uses."
To the Rev. H. Highton, M.A., for his paper entitled "Telegraphy without insulation, a cheap means of International Communication."

The Council have also awarded the Society's Silver Medal to Monsieur Dormoy, for his "Rotating Rabble, for use in the Common Puddling Furnace," an invention fully described in Mr. Paget's paper read before the Society. The invention deals with one of the largest and most important industries of the country.

One important part of commercial economy is the presentation of reports on its classified productions. The Society has continuously devoted itself for above a century to bring before the public new raw materials, and also reviews of the condition of branches of commerce, and the members will observe papers of this kind in each session, and they have been indebted to the labours of one of their body, Mr. P. L. Simmonds, for frequent contributions on such subjects. Such papers, being illustrated by numerous specimens, advantageously bring before the commercial community the real condition of their resources. A merchant or broker is naturally apt to confine his attention to such productions as are current in the market, and it is useful to remind him of others, which, though not used by us, are adopted elsewhere, or may at some time become available to ourselves. Jute, coir, and esparto, for instance, were, not so long ago, neglected products, and many now disregarded may become of commercial importance. In consideration of the utility of his labours in this department, the Council have thought it right to award a medal to Mr. Simmonds.

The scarcity of paper material has often engaged the attention of the Society, and on the late occasion of a paper on esparto culture by Mr. Robert Johnstone, the Council took advantage of the occasion to address the Ottoman Minister of Commerce, supplying the chief centres of commerce in that empire with copies of the paper. In bringing the subject under consideration of the Minister and commercial community, the object was to call attention to the desirability of cultivating esparto in suitable situations, or of developing local substitutes. The Council have reason to believe that practical results will be obtained. There is an objection to engage in the culture of esparto on account of the number of years during which capital must be locked up, but it has been proposed that broom fibre shall be employed, and Mr. S. O. Clarke, of Sokia, in Asia Minor, an English merchant, who has taken a deep interest in local improvement, is devoting practical attention to the subject. It is very desirable that the paper trade should co-operate in these efforts.

While watching over the introduction of new materials and manufactures, one part of the vocation of the Society has been to promote what is truly to be called national economy in the right application of existing resources, and in the prevention and reduction of waste of economic materials. In this respect the supply of fertilisers for our agriculture has become of the more importance, since the recent form of sanitary operations has been the means of rendering unavailable so much valuable material, and of promoting foreign importations at a great outlay.

The treatment of sewage has been discussed in valuable papers, by Mr. J. Bailey Denton and Major-General H. Y. D. Scott, C.B., and the Council trust they may have further communications from these writers on the continued practical application of these methods. Mr. A. A. Croll has laid before the Society an important contribution to the history of the progress of gas manufacture. To his energy and indomitable perseverance and intelligence not only is the public indebted very largely for an improved and cheapened supply of gas, but it must be remembered that, as Chairman of one of our Telegraph companies, he introduced the system of a cheap and uniform charge for messages, which in the hands of the government has now become an integral part of the postal system of the country.

SILK SUPPLY.

A short time since, the Council received a communication from the Silk Supply Association, suggesting that a union or amalgamation of that body and the Society of Arts would be likely to lead to advantageous action in reference to the objects for which the association was established, and it was further suggested that the best way of effecting this would be the forming a Silk Supply Committee of this Society, and taking on such Committee, in addition to those nominated by the Society, such members of the Silk Supply Association as should be arranged. Accordingly such a Committee has been nominated by the Council, to consist of Mr. A. Cassels (Chairman), Sir Daniel Cooper, Bart., Mr. Hyde Clarke, Mr. E. Chadwick, C.B., Mr. D. Chadwick, M.P., Mr. Thomas Dickins, and Mr. Cobb, the Honorary Secretary of the Association, with such other members of the Association as may be hereafter added thereto. It is confidently anticipated that this Committee will be the means of giving vitality to a useful organisation, and will be able to give valuable aid in obtaining and diffusing through the pages of the *Journal* important information, and wherein the interests of this large industry will be discussed and promoted. By such exertions the efforts of various foreign and colonial governments will be promoted, and further resources may be obtained by the encouragement of silk culture and silk manufacture.

MEMORIAL TABLETS.

No additional tablets have been affixed this year. The Council have, however, received a letter from Mr. Wm. Newmarch, a Member of the Society, to the effect that two friends of that gentleman, Mr. H. D. Pochin and Mr. Benjamin Whitworth, are willing to give £50, to be expended in the providing and affixing of twelve tablets. The offer has been accepted, and steps are now being taken for having the work done. The Council have much pleasure in making this announcement, and trust to see so worthy an example followed by others.

MEMORIAL WINDOW IN ST. PAUL'S CATHEDRAL.

The members have already been informed, through the pages of the *Journal*, that it is proposed that the Members of the Society should aid in the decoration of St. Paul's Cathedral by giving a stained glass window, as a memorial of the recovery of His Royal Highness the President from his dangerous illness, and a subscription has been set on foot for this purpose. The sum already subscribed is about £350, but it is estimated that £700 will be required, in order to obtain a memorial worthy of the occasion. The Council have been fortunate in securing one of the most conspicuous windows over the north transept entrance of the Cathedral for this object; it is therefore earnestly hoped that the Society may succeed in placing there a first-rate work of art, which will be regarded by posterity as a valuable ornament to our Metropolitan Cathedral, and which will at all times reflect credit on the Society of Arts. Members who have not subscribed are therefore solicited to come forward with their subscriptions, in order to complete this work in a manner worthy of the occasion and the noble edifice which is now in progress of decoration. A committee with reference to the design has been appointed, who are authorised to communicate with the Dean of St. Paul's on this matter.

MOSCOW POLYTECHNIC EXHIBITION.

In the autumn of last year, a deputation from the Moscow Committee conducting this Exhibition, consisting of Monsieur Philip Koroleff, Conseiller d'Etat Actuel, Director of the Moscow Agricultural Academy, and President of the Educational Department of the Exhibition; M. M. Lvoff; Nicholas Saenger, Secretary of the Society of Friends of Natural Science; and the Rev. Basil E. Popove, came to this country, with a view of enlisting the sympathies of manufacturers and others on behalf of it, and at an interview between them and the Council a London Committee was at once formed to bring the subject before the public, and make the advantages offered by the Exhibition known to those who might be likely to engage in it. The particulars of the Exhibition, its aim and object, have already appeared in the *Journal*, and it is therefore unnecessary to repeat them here. The members of the Society, however, will be glad to learn that, notwithstanding the short time which was at the disposal of the Committee, their labours have been successful, and that a considerable number of British firms have sent goods to Moscow, and among these will be found some of the foremost houses in this country. This Exhibition was opened with great ceremony on the 11th of this month, and it is a matter of much regret among the members of the Council and the London Committee that, owing to the many engagements with which at this time of the year they are occupied, it has been impossible for them to accept the invitation to be present at the ceremony. The Council trust that these Exhibitions may be the means of increased intercourse between the two nations, and of an extension of trade and commerce, and eventually lead to a removal of the many fiscal restrictions which now unfortunately exist.

District Museums.

The members will have seen with great satisfaction that a commencement of such museums has been made, one having been opened with great ceremony within the last few days by H.R.H. the Prince of Wales, in Bethnal-green. It has long been the desire of the Council that such establishments should be formed in the various districts of the metropolis, and that in Bethnal-green is due, in a great measure to the exertions of Sir Antonio Brady, one of the members of the Society, and formerly a member of the Council, who sought for and obtained the land for the site of the present museum, raising the purchase by subscription, to which the Society contributed £100.

Loan of the Society's Rooms.

The Council feel assured that the Members will be glad to learn that they have been able to lend their aid to other societies and bodies working with kindred objects to their own, and they have the pleasure to state that, amongst others, the following societies have held meetings in their rooms:—The Institution of Naval Architects, the British Association of Gas Managers, the East India Association, the Colonial Institute, the Victoria Institute, the Savoy Choral Society, the Aeronautical Society, the National Union for Promoting the Education of Girls, the British Medical Association, &c., &c.

Finance.

The Council congratulate the members upon the satisfactory position of the Society financially. It will be seen by a comparison of the Treasurers' statement, published in the last *Journal*, with the corresponding statement published last year, that several changes have been made in the disposition of the Society's funded property, which changes have been rendered necessary owing to the Indian government having called in the rupee notes, in which stock the bequest of the late Dr. Cantor was invested, together with other money belonging to the Society. The Cantor bequest, heretofore invested in rupee notes, has now been transferred to and invested in Bombay and Baroda, and in Oude and Rohilcund guaranteed Railway Debenture Stock. The Council, during the year, have invested £766 14s. in Reduced 3 per cent. Stock, that sum representing the moneys paid on account of life subscriptions during the years 18 8-9-70-71, also the donation by Mr. John Murray of £50 to form the nucleus of a building fund for the Society, together with £30 received in aid of an Endowment fund. The Council have placed to a deposit account with Messrs. Coutts and Co. the sum of £275, the subscriptions paid in aid of a thanksgiving memorial window for St. Paul's, and £70, which has been transferred from the London and Westminster Bank, the donation of Sir W. C. Trevelyan, to be awarded as a prize by the Society. The Treasurers have been enabled to meet all the extraordinary and general claims during the year; and it will be seen that the assets of the Society are greater, and the liabilities less than at the corresponding period last year. The statement of receipts, payments, and expenditure during the year, as well as of assets and liabilities, has already been published in the *Journal*, as the bye-law directs. The Council desire to point out, in order to prevent misapprehension, that, although, by the accounts of the present year, the receipts on the part of the concerts appear to be much less than the amount expended, this is simply a cash account for the year; the receipts of last year and the balance in hand, as stated in the previous account, must be taken into consideration.

Members will doubtless have noticed with satisfaction that the Council have resolved to endeavour to raise an Endowment Fund for the Society, in extension of the special funds with which they have been already entrusted. By so doing they believe that they will largely promote the establishment of the Society on a permanent base, and enable it to carry on systematically the work of investigating the progressive discoveries of scientific men in their relation to industry, at the same time that its annual income will be left free to be applied to such public objects as have hitherto occupied the attention of the Society. The Council look for the hearty support and co-operation of members in the carrying out so important a proposition. In connection with this subject the Council have the pleasure to inform the members that Mr. Thomas Twining, one of the Vice-Presidents of the Society, has most liberally offered to contribute £50 a-year for three years, to aid in the commencement of systematic action on the part of the Society such as is contemplated, if a sufficient Endowment Fund can be obtained. It is hoped that other members of the Society will be willing to act in a similar manner, and thereby enable the Council to take advantage of Mr.

Twining's offer. It will be evident that the promoters of the objects of the Society, in the encouragement of Arts, Manufactures, and Commerce, must require considerable funds for their proper development. Very large sums have been, from time to time, raised through the Society's means for various purposes, but the permanent resources at its disposal are still inadequate to a full development of its useful action.

Candidates for Membership.

Some inconvenience having at times arisen from the regulation in the Bye-laws that in the form of proposal of a candidate for admission as a member of the Society, his recommendation must be signed by three members of the Society, "one of whom must have personal knowledge of the candidate," the Council propose to remedy this by making the following alteration, viz., these words be added to the existing Bye-law, "or the candidate shall be approved by the Council."

The Chairman thought the report was one of the very best that he had ever heard read at these annual meetings, and several very important matters were referred to in it. With regard to the improvement of the Channel communication, he thought that it ought to be possible to put the luggage on board the vessels other than by the barbarous method of slipping it down an inclined plane. There was also a delay of half an hour at Boulogne which was quite unnecessary, and might be obviated. It was caused by the time it took to transfer the luggage from the vessel to the Northern of France Railway, at the other end of the harbour. There would be no difficulty in continuing the line of rails of this company along the Quai Bonaparte. He was sorry to learn, as he had that day, that projected alterations and improvements were not to be carried out, on the plea that as a new harbour and various other new and extensive works have been proposed, they were unnecessary. With regard to the use of Australian meats the report showed that the introduction of them had proved a great national advantage. He hoped that the memorial window about to be erected in remembrance of the happy recovery of H.R.H. the Prince of Wales, our President, would be worthy of the Society. It was most important that, coming from the Society, it should be a first-rate work of art, worthy of the occasion and the Society's reputation. Only half the money had been subscribed, the other half he hoped would be forthcoming.

Professor Tennant said he thought that the attention of the Council, which had taken up the question of cabs, might be directed to the condition of the railway carriages, which were in a most dirty condition, especially the second-class ones. There was another matter which he hoped the Council would remonstrate about. The late Professor Faraday's medals, the Albert Medal of the Society amongst them, have been presented to the British Museum, and were exhibited to the public. The medals had, however, been removed to the medal-room, where it required an order, obtained with much pains and trouble, before they could be seen. He seconded the adoption of the report.

Lord Alfred Churchill, in supporting the motion, said that the proposition regarding the luggage at Boulogne referred to in the report might be easily carried out, and at no great cost.

Mr. George Saywell asked an explanation of the item in the assets "subscriptions uncollected," and wished to know if they were recoverable by law.

The Chairman said they were strictly recoverable.

Lord Clarence Paget also supported the motion, which was carried, and the report was adopted.

Professor Tennant moved that the best thanks of the meeting be given to Lord Henry Lennox, M.P., Chairman of Council, and the members of Council, for the services rendered during the year.

Mr. H. C. Saunders seconded the motion, which was carried unanimously.

Mr. Botly proposed, and **Mr. P. L. Simmonds** seconded, a vote of thanks to the officers of the Society, which was carried unanimously.

Lord Alfred Churchill proposed that the thanks of the meeting be given to Mr. Seymour Teulon for his able services in presiding over them that day.

The motion having been duly seconded, was passed by acclamation.

The ballot having remained open one hour, and the Scrutineers having reported, the Chairman declared that the following members had been elected to fill the several offices. The names in *Italics* are those of members who have not, during the past year, filled the offices to which they have been elected:—

COUNCIL.

PRESIDENT.

H.R.H. the Prince of Wales, K.G.

VICE-PRESIDENTS.

F. A. Abel, F.R.S.
Sir W. H. Bodkin (Assist. Judge)
Thomas Brassey, M.P.
Edwin Chadwick, C.B.
Lord Chancellor, F.R.S.
Henry Cole, C.B.
Sir Daniel Cooper, Bart.
Right Hon. W. F. Cowper-Temple, M.P.
Lord De l'Isle and Dudley
Capt. Douglas Galton, C.B., F.R.S.
The Earl Granville, K.G., F.R.S.
William Hawes, F.G.S.
Lord Henry G. Lennox, M.P.
Sir John Lubbock, Bart., M.P.
Right Hon. Sir John S. Pakington, Bart., M.P.
Major-Gen. Sir Henry Rawlinson, K.C.B.
Samuel Redgrave
Rev. W. Rogers, M.A.
Seymour Teulon
Thomas Twining

ORDINARY MEMBERS OF COUNCIL.

G. C. T. Bartley
Henry Bessemer
Andrew Cassels
Lord Alfred Churchill
Hyde Clarke
Captain Donnelly, R.E.
Major-Gen. F. Eardley-Wilmot, R.A., F.R.S.
Vice-Admiral Erasmus Ommanney, C.B., F.R.S.
Admiral the Right Hon. Lord Clarence Paget, K.C.B.
Robt. Rawlinson, C.B.
Col. A. Strange, F.R.S.
E. Carleton Tufnell

TREASURERS.

Edwin Lawrence | *T. R. Tufnell*

AUDITORS.

Edward Brooke | *James T. Ware*

SECRETARY.

Peter Le Neve Foster

FINANCIAL OFFICER.

Samuel Thomas Davenport

TRUSTEE FOR SOANE MUSEUM.

Samuel Redgrave.

The Chairman proposed a vote of thanks to the scrutineers for their services, which was carried.

At the conclusion of the General Meeting a Special Meeting was held, when the following candidates were balloted for and duly elected members of the Society:—

Bower, Harold Lance, 8, Brown's-buildings, Liverpool; and New Brighton, Cheshire.
Brydon, John McKean, 39, Great Marlborough-street, W.
Carlton, James, Norbury-booths, Knutsford, Cheshire.
Carati, Antonio, 6, St. James's-street, S.W.
Carter, John, The Vale, King's-road, Chelsea, S.W.
Churchill, Charles, 28, Wilson-street, Finsbury, E.C.
Cordes, Thomas, Bryn-glas, Newport, Monmouthshire.
Crawshay, Robert T., Cyfartha-castle, Merthyr Tydvil.
Delmar, F. O. T., 17, St. Petersburgh-place, Bayswater, W.
Essery, Richard A., Hamilton-house, Ffynone, Swansea.
FitzWygram, Colonel, 4, Portland-place, W.
Garrett, Captain Newson D., R.A., East India United Service Club, 14, St. James's-square, S.W.
Greenhow-Relph, G. R., Beech-hill, Usk, Monmouthshire.
Higgins, William Henry, 31, St. Swithin's-lane, E.C.
Holland, John, 93, York-road, Lambeth, S.E.
Lapraik, John S., The Oaks, Acton, W.
Lay, William, 8, Surrey-street, Strand, W.C.
Levick, Frederick, 46, Belsize-park, N.W.
Neuberger, Siegfried Louis, 17, St. Mary Abbott's-terrace, Kensington, W.
Nevill, Richard, Felin Foel, Llanelly.
O'Leary, Purcell, A.M., M.D., 29, Abingdon-villas, Kensington, W.
Perry, F., 172, Fenchurch-street, E.C.
Rehden George, 2, Great Tower-street, E.C.
Rich, George William, Alderwick-house, Hounslow, W.
Robertson, David, Union-grove, Dundee.
Rushton, William Lowes, 4, Ullet-lane, Prince's-park, Liverpool.
Streeter, Edwin William, 37, Conduit-street, Bond-street, W.
Vyver, P. F. A., 13, Royal-square, Jersey.
Williams, B. Lyon, Nightingale-grove, Shirley-road, Southampton.

And as Honorary Corresponding Members,

Healy, Rev. Joseph W., L.L.D., President of Straight University, New Orleans, U.S. America.
Pascual, His Excellency Don Agustin, Calle de Cervantes, No. 13, Madrid.

CHANNEL PASSAGE.

The Committee, consisting of Lord Henry G. Lennox, M.P., Chairman of the Council, Mr. F. A. Abel, F.R.S., Mr. E. Chadwick, C.B., Captain Donnelly, R.E., Mr. Eborall, Mr. J. S. Forbes, Captain Douglas Galton, C.B., F.R.S., Mr. Grosvenor Hodgkinson, M.P., Mr. C. W. Merrifield, F.R.S., Vice-Admiral Ommanney, C.B., F.R.S., Admiral the Right Hon. Lord Clarence Paget, K.C.B., Mr. S. Redgrave, Vice-Chairman of Council, Mr. E. J. Reed, C.B., Vice-Admiral Ryder, Captain Robert Scott, R.N., Mr. Seymour Teulon, Vice-Chairman of the Council, Sir Ed. Watkin, and General Eardley-Wilmot, F.R.S., have made the following

REPORT.

1. Your Committee were appointed to "consider and report how far the existing means of crossing the Channel can be improved, and to take evidence thereon." It will be observed that the scope of your Committee's labours is of a limited character, and does not embrace the consideration of the schemes for improved harbours and the very much larger vessels which have been brought before the public, involving a heavy outlay of capital, and a long delay, before they can be brought into operation. The duty of your Committee was to consider whether the best use is being made of existing means, what improvements are feasible, or, in other words, whether the public are getting all they may fairly expect.

2. The South Eastern and the London, Chatham, and Dover Railway Companies have furnished your Committee with drawings and sections of their boats; and Mr. Grosvenor Hodgkinson, the chairman of the latter company, and Mr. Eborall, the manager of the former, as members of the Committee, have supplied valuable and interesting information relating to the nature of the traffic and the manner of conducting it. Mr. Eborall's evidence has already appeared in the *Journal*. The following gentlemen have also given evidence before the Committee:—Mr. Henry Cole, C.B., Captain Dicey, Mr. White (of Cowes), Mr. Bessemer, Mr. E. J. Reed, C.B., and Mr. H. Liggins, and their evidence has been printed in the *Journal*. Your Committee have also received valuable information from Admiral Schomberg and Captain Dent, in reference to the Holyhead and Dublin boats. Captain Scott, R.N., a member of your Committee, has furnished a sketch plan for re-modelling the cabins of the existing boats, so as to get the benefit of a deck-house and ventilation, and avoiding at the same time the objections which are by some thought to exist to this form of cabin as likely to interfere with the navigation of the boats in stormy weather.

3. Your Committee are of opinion that, although no large measure of improvement can be effected in the Channel passage unless with vessels of much greater size, which would involve, in the first instance, considerable improvements in the French harbours of Calais and Boulogne, and subsequently the extension of the low-water pier at Folkestone, still much improvement may be made in the existing mode of conducting the traffic.

Improvement in Existing Vessels.

(*a*) *Accommodation.*—Your Committee would point out that deck-cabins should be made, and the vessels covered, like the Irish boats, fore and aft, affording shelter and protection to the passengers in bad weather, provided this can be done without injuriously affecting the stability of the vessels.

(*b*) *Ventilation.*—The ventilation of the cabins should be improved. The plan of ventilation, adopted largely in French government transports as well as in public buildings in France, by which the foul air is sucked downwards through numerous openings near the floor, and fresh air is introduced from above, or high up, appears to be especially suitable for the cabins of steam packets, as the foul air from the basins, instead of rising to the mouths and nostrils, would be immediately drawn downwards. It would be easy, at a very small expense of power, to work the necessary fans. The pipes would be out of sight under the seats, and the air holes so numerous and small, both above and below, as to create no perceptible draught.

(*c*) *Cabin Fittings.*—The cabin fittings should be made more commodious; and the steward's-room and pantries be placed where they would less incommode the passengers with their unsavoury odours.

(*d*) *Fish, Fruit, and Vegetable Traffic.*—Your Committee further point out the great inconvenience which the fish, fruit, and vegetable traffic entails upon the passengers, and they suggest that improved arrangements should be made for this class of traffic.

(*e*) *Landing Places.*—Suitable covered landing-places should be constructed where passengers can embark and disembark, and where the tickets might be taken under shelter.

(*f*) *Latrines.*—The whole of the urinal and water-closet arrangements are very insufficient, and require careful consideration.

(*g*) *Luggage.*—Your Committee desire to draw attention to the mode of dealing with the passengers' luggage, which is of the rudest description, every single piece being removed by hand from the railway vans, shot down a plank into the vessel, then stacked on the deck, to be again removed piece by piece on the vessel's arrival in the port, and carried by the hands of numerous porters to be packed in waggons for carriage to the railway vans. This involves loss of time, and great injury to the luggage. There appears no valid reason why, if the rails were as they should be, continued on the quays to the landing-place, the luggage should not at starting be so packed in boxes or crates as to admit of being, on arrival of the railway van, let down by cranes into the vessel, and by similar appliances replaced in the railway vans on the other side of the Channel.

(*h*) *Overcrowding.*—Your Committee desire to call attention to the occasional overcrowding which takes place, to the very great inconvenience of the passengers.

Note.—The South-Eastern Railway Company have had their favourite ship, the *Albert Edward*, covered on the fore and after part, after the manner of the Holyhead vessels, and are endeavouring to provide improved ventilation in the cabins.

Further Improvements in New Boats, about Fifty Feet Longer than the Existing Boats.

(*a*) *Size of Vessels.*—It has been stated that the smallness of the existing vessels does not admit of that amount of improvement in the accommodation on board which the passengers demand. Admitting these difficulties, the Committee are still of opinion that more might have been done to remedy the evils so long complained of, and they have pointed out above the various improvements they refer to. It has, however, been given in evidence before your Committee that the existing harbours at Dover and Boulogne will, without any alteration whatever, allow the use of boats fifty feet longer than those at present in use for a tidal service, requiring no greater draft of water. This being so, it is obvious that very much better accommodation for the passengers could thus be given, and your Committee recommend it to the serious attention of the companies whether any new vessels which they may lay down should not be of a larger class than those now running. The South-Eastern Railway Company has furnished the Committee with a plan for a steam-ship of the increased length recommended.

(*b*) *Bowsprits and Cutwaters, &c.*—The Committee point out that in the construction of new vessels considerable capacity may be gained by getting rid of the old-fashioned projecting cutwaters and over-hanging sterns, and confining the structure of the vessel as far as possible within the perpendiculars. The stem should be upright, and the bowsprit should be done away with, by which great advantage would be gained in the management and swinging of the vessels in confined harbours, such as Folkestone and the French ports. Most of the ocean steamers are now built in this fashion, bowsprits are given up entirely, although they are provided with a great deal of sail power; in fact, a vessel might be built sufficiently long to include the space now occupied by the overhanging bow and projecting bowsprit.

(*c*) *Bilge-keels.*—In designing new vessels, it must not be lost sight of that it has been stated on competent authority that while bilge-keels are most efficacious in limiting the angle of roll in the new men of war to which they have been fitted, no ill effects on speed or turning power have been experienced.

By order,

P. Le Neve Foster, *Secretary.*

CANTOR LECTURES.

MECHANISM.

By the Rev. Arthur Rigg, M.A.

Lecture II.—Delivered Monday, February 12th, 1872.

All machinery can be reduced to a classified list of elementary combinations in mechanism, the character of any portion being assigned to it from its general features, and not from any minute detail. For instance, all those pieces of mechanism in which motion is mainly communicated from piece to piece by what is called "rolling contact," where the principal moving parts are in actual contact and roll one upon another, should be classified under such division as that of "rolling."

The next division might include those contrivances by which one moving part in actual contact with another communicates motion through a process of "sliding." Cams and screws communicate motion by "sliding." The archimedean drill, generally used for light work, is an example of this kind of communicated motion.

Another mode of communicating motion results from the wrapping or folding of cords or chains over bodies, rigid, and generally circular, although they may be of any form; straps or bands over wheels are of this class. Again, there are numbers of contrivances in which motion is transmitted from piece to piece by means of bent or straight rods and bars. Very perplexing, though very useful motions, result from these. The grouping of them is distinguished by the name of "links." There are contrivances which depend chiefly upon the folding over, again and again, of cords or straps; to the class comprehending these the name communication of motion by "reduplication" is given. It is illustrated in the case of double and treble sets of pulleys.

Another is the transmission of motion by means of an intervening fluid. Sir William Armstrong's hydraulic machine, with its accumulator, is an example. Motion communicated by an intervening fluid has been adapted to facilitate telegraphic delivery in London. Telegrams received in Telegraph-street are put into little cylindrical "carpet-bags," which are placed in tubes and moved forward by air at high pressure, and so shot to the post-office at Charing-cross, or to such places as the tubes are laid. The messages are taken out of the carpet-bags, put into envelopes, and sent to their destination. The speaking tubes in this building and in offices are examples of motion communicated by fluids.

Under each of these six heads there may be arranged three and even more classes of motion. A tabular view of these divisional characteristics of modes of communicating motion, and a classification in reference to the relations of direction and the ratios of the velocities, may be useful for future reference:—

Division.	Character.
A	Motion communicated by Rolling.
B	Sliding.
C	Wrapping.
D	Links.
E	Reduplication.
F	Fluid.

Of each there are at least three classes:—

Class	Directional relation.	Velocity ratio.
1	constant	constant.
2	constant	varying.
3	varying	constant or varying

On Monday last, after the lecture was over, a gentleman remarked, "You said that mechanicians, as distinguished from mechanics, thought nothing about plummer-blocks and anti-friction curves." He asked, what is an anti-friction curve? An anti-friction curve has nothing to do with pure mechanism, but it has to do with the workshop, and it may be permitted, although beside the exact title of these lectures, to produce an anti-friction pen for the purpose of forming an anti-friction curve. Some years ago—a great many years ago—there was a discussion in the mathematical papers respecting the curve of least friction for rotating shafts. At the lower end of a vertical shaft the friction upon the bearing is a proportional part of the pressure. The question was how should that bearing be formed, and the mode in which it should be formed is given by this pen. Any skilled mechanic may make the pen. It is a piece of brass wire 6 inches long, freely movable about a pin put into a piece of wood, 2 in. long, and $\frac{3}{4}$ in. broad, and $\frac{1}{4}$ in. thick. There is bent over the wire a small piece of steel brought down so as to allow ink to be inserted between the two jaws; the ink will therefore flow as from a pen. The mode in which the pen is used is this. Supposing a bearing to be of a certain size in the lower diameter, and of a known dimension in the upper, the question is, to ascertain the curve to be formed between those two diameters. At right angles to a straight line, set off the two radii at their proper distance apart. Parallel to this straight line place a straight edge. Against this edge, where it crosses the larger radius, place the wood to which the wire of the pen is attached. Slide the steel pen along the wire until it is at the extremity of the radius. Then adjust the straight edge, and draw the wood along it until the pen crosses the extremity of the shorter radius. The path of the pen describes what is called an anti-friction curve, and the bearing of a shaft made with that vertical section is the one of least friction.

To return to the tabular characteristics of mechanism. It has perhaps been truly said that if there were no exceptions there need be no rules. There are before you, in illustration of this, two pieces of mechanism which cannot be arranged under the tabulated heads.

One is called Atwood's machine—a machine designed about the close of the last century, and to which we are indebted for our knowledge of the influence of gravity on falling bodies. The free motion of falling bodies becomes so rapid that the velocity cannot be observed. Mr. Atwood suggested and carried out the idea that if, whilst permitting gravity to exercise its full and usual influence, that influence could be distributed through a balanced mass, then, although the velocity were retarded, yet the law of that velocity would remain, and might be ascertained.

The arrangement of mechanism by which he accomplished this is here. Two equal weights are attached to the ends of a very flexible silk cord, about twelve feet ong.

This cord being laid over a pulley, the weights being equal, they might be placed in any position, and would so remain. Mr. Atwood reasoned, that if he could reduce to the smallest possible quantity the friction on the bearings of the pulley, he might determine the laws of falling bodies. Thus to reduce it, led to the contrivance of placing the bearings of the pulley upon the rims of four other pulleys—in fact, as far as possible, he converted a sliding into a rolling contact.

The silken cord was placed with one of the equal weights near the ground and the other near the pulley. A small and known weight being placed upon the upper one, caused a motion in the mass of the two connected weights, and dependent upon the relations of the small weight and the mass so the velocity of descent was retarded. By means of a vertical scale the rate of descent could be observed, and the laws of gravity be thence deduced.*

As a piece of mechanism, this instrument cannot well be placed under any of the heads specified in the table.

Here is another illustration of a machine which cannot be classed. It is one in which we are all interested, because by means of it coals are prepared for London free from slack. A waggon of coals as brought out of the pit, is not ready for special sale, and the question is how are those coals to be screened and made fit for the market, such a market at any rate as you have in London. The manner in which the slack is to be separated is not our business at present; we have simply to do with the motion, not the separation. On the table is a model of a railway waggon into which the larger lumps will be shot. Here is another into which what we may call the first class of slack will be shot, and here is another into which will be shot the dust, or that which is really little better than dust, out of which artificial fuel is made. This waggon of mixed coal direct from the pit is run into the apparatus. Observe the motion on the withdrawal of the hand from the break. The apparatus gently rotates—the coals are slid and not thrown on the screens, and the work being done the apparatus returns to its original position. To accomplish these reverse actions no special contrivance of mechanism is required. It is done by a change in the centre of gravity of the moving machinery, consequent upon the discharge of the coals from the pit waggon. When the coals are in the waggon the centre of gravity is at one side of the horizontal axis, and so causes the motion by which the mixed coals are discharged. Then the centre of gravity is at the other side, and so causes the apparatus to return to its original position. Such mechanism cannot be placed in one of the tabulated divisions.

The subject of the lecture more especially intended for this evening is on the communication of motion by rolling contact. The necessity for getting shafts to rotate so that one should cause the other to move must have arisen in very early days. You remember even so recently as Jewish times we read that "Two women should be grinding at the mill," so that it seemed to need two people to cause one shaft to rotate, for the mill-stone was driven by two people. To fold a cord round one shaft and then round another so as to communicate a motion, would not be a difficult matter, but to bring these shafts into a relation that needed no cords at all, that would then have seemed to be the perfection of mechanism. We have an example here*

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* The following illustration of a mode of using Atwood's machine for the purpose named in the lecture may be of interest to some readers.

Let M be the mass of one weight,
And $M + m$,, ,, the other ,,
,, R ,, resistance, friction, &c., of the machine.

Now the Moving Force = Mass multiplied by acceleration; expressed algebraically thus: $P = M.f$.

Therefore in the experiment $\left(M + \overline{M + m} + R\right) f = m.g$ (1) where (g) is the required force of gravity.

Again, if we take a second similar experiment with other masses.

Then $(M^1 + \overline{M^1 + m^1} + R)\, f^1 = m^1.\, g$ .... (2) combining equations (1) and (2).

$$g = \left\{\frac{2\,(M - M^1) + (m - m^1)}{m.f^1 - m^1.f}\right\} f.f^1 \quad \text{..........} \quad (3)$$

In this equation all is known except f and f^1, and by Atwood's machine these can be obtained thus:—First arrange M and $M + m$ on the machine, and allow the heavier to fall from one point to another at a known distance from the starting-point. Observe most carefully and accurately the time occupied by its motion.

Then, by a well-known law, viz.:—

$$s = \frac{1}{2} f.\, t^2$$

$$\text{And therefore } f = \frac{2s}{t^2}$$

Now, from this experiment, s and t are known, and therefore f can be found.

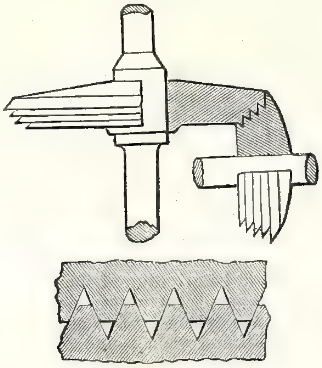
Similarly, f^1 can be found; therefore, in (3), all is known except (g).

Therefore, (g) can be found, and it is found to be = 32·2 feet.

* On the table were two plain broad wheels of wood. The one was rotated in a vertical plane by being placed on a wooden axle in a horizontal plane. The other wheel was also on a horizontal axle which was guided in a vertical slide above the former axle, and consequently the circumference of this latter wheel was always in contact with that of the lower wheel.

of such rolling contact. On these two wheels there are no teeth, but they roll on one another only. It would be very desirable to dispense with teeth, but it is quite clear that mechanics have not yet attained to such perfection that two wheels shall truly roll with regard to each other whilst acting on shafts in fixed bearings. The one wheel here on the upper shaft drops, and so contact of the circumferences is preserved. This was one contrivance to keep up contact. It is found in the blower we have so constantly in use where one wheel is held by a spring against the other. In another case, one wheel is covered with leather in order to secure a rolling contact. Other modes, prior to the introduction of teeth, have been adopted in order to preserve this rolling contact. Perhaps none is better than that of covering each of the rollers with brushes of hair. We are thus led to the origin of teeth upon wheels. We all know that teeth are generally placed across the wheel in the way you see here, so that the contact is secured. Some persons have adopted the suggestion of what may be called teeth running in a direction parallel to the plane of the wheel. This is the case in Robertson's friction gearing, a plan much adopted for the communication of motion by means of pulleys, grooved parallel to the face of the pulley. Wheels used as described are generally called "pullies." In ordinary cases, teeth run parallel to the shaft; in this case, at right angles to the shaft. For the purpose of throwing in and out of gear the latter are safe, and free from the objection which the ordinary teeth have, namely, the great liability to be broken if a sudden strain comes upon them. These wheels are still manufactured by the Patent Gearing Company at Glasgow, and to them we are indebted for the model before you, of which Fig. 1 is a diagram.

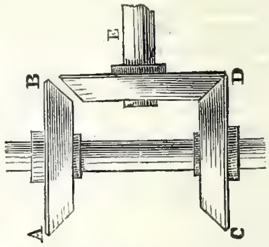
Fig. 1



In other cases, one pulley is put into a swing frame. The upper pulley in this model sliding in a groove, is then merely hung upon a hinged-frame, which allows weight to be borne by it, and so increase is given to the pressure upon the lower pulley. That is another contrivance for getting this motion by rolling contact. Others are formed by loading the axles with weights. These practices, however, have been abandoned where the communication of power is concerned, and toothed-wheels have taken their place. All other plans but teeth are objectionable, because they fail to communicate or keep up a true velocity ratio, and still fail where definite relations of motion must be established. If it is essential that motion should take place in the ratio of one to twelve, or one to twenty, no mode of pure rolling can accomplish it, but if it is simply essential to secure rolling contact for the purpose of high velocity and for the purpose of converting high velocity into power, it has of late years been most successfully accomplished by Mr. Ramsbottom, at Crewe.

We are much indebted to the authorities at Crewe for the machinery now on the table. Heavy weights are at Crewe lifted by the agency of a cord travelling at a very high velocity. Here are pieces of the cord used for that purpose. One, an old piece, has done its work, and the other, a new piece, had it not been cut off, would have had to do its work. It is a cotton cord, made very pliable, and caused to move at the rate of 5,000 feet a minute, and, as 5,280 feet are a mile, we may say it travels at the rate of a mile a minute. This speed is converted into power, and that is done by pure rolling contact. It is accomplished thus. At the top of the vertical part of a crane there is a pulley on a shaft which passes down through the crane in a vertical direction, and the pulley being driven communicates motion to this vertical shaft. Let us for the present rest content with the fact that we have a vertical shaft rotating rapidly. The mode in which that motion is communicated is this. That grooved pulley on the table is at the top of the shaft. It is one of the actual pullies. The high velocity cord does not pass round this pulley—it is simply pressed against it by means of two other grooved pullies, one on each side, and thus is caused to bear upon a portion of the grooved circumference. You may judge, therefore, that assuming there was no loss of motion, the rim of the pulley fixed upon the vertical shaft would travel at the rate of a circumferential velocity of a mile per minute. Of course there is a certain amount of slip which reduces this velocity. Now let us see what is done by this motion. Remember we deal with it only as a question of rolling contact, independent of the teeth of wheels, to show what can be done by rolling contact only. This shaft with the pulley at the top descends to the lower part of the crane, and there it comes upon the gearing now on the table. You have then a descending shaft. At the end of that descending shaft is a cone pulley which is made of pasteboard. It consists of two cast-iron faces with pieces or sheets of pasteboard strongly clamped between them, and that is turned in a lathe to the shape required. On one casting there are two cone wheels, with such a distance between the surfaces that they only just do not touch this pasteboard one when it is placed as in the figure between them. Suppose that E (Fig. 2) is the vertical shaft and the bevel wheel upon it is the pasteboard one. The bevel wheels, AB and CD, are upon a horizontal shaft, which is capable of an end-long motion. If the wheel CD be in contact with the rotating wheel, motion will be communicated to the horizontal shaft in one direction. Give now the end-long motion that shall bring AB into contact, then the horizontal shaft will be caused to rotate in the other direction. There is a handle, by the motion of which either of the two cone pullies may be brought into contact with the pasteboard one, and therefore, whatever motion is being given to the pasteboard one, can be communicated to one of the two. The actual gearing of one of these cranes is on the table. As a piece of mechanism it might have been made of wood, but as a piece of machinery it is made of cast-iron, and it has been sent from Crewe for the purpose of this evening's lecture. This card-board pulley is driven direct, being keyed upon the vertical

Fig. 2.



shaft, and therefore rotating with a very high velocity. When contact is made with the pulley on one side of it, the horizontal shaft rotates, and with it a worm-wheel at the end. If the contact is made with the second cone the worm-wheel is driven in the other direction. That is sufficient for our present purpose. With the machine, of which a part is here, large driving-wheels of locomotives and heavy pieces of machinery are lifted and moved from place to place; by similar arrangements even locomotives themselves are raised.

The exact velocity of these pullies can be given. The speed of the cord passing round the top pulley is 5,000 feet per minute, and the pulley itself makes 1,958 rotations per minute. Therefore the cone below also makes 1,958 rotations, and as it is not quite of the same diameter of the other, but rather larger, upon the law of reduction of these pulleys the pulley on the horizontal shaft makes 2,238 rotations per minute. Therefore the worm at the end moves at the rate of 2,238 rotations per minute, and then by the worm arrangement a very rapid reduction takes place until the wheels, by means of which loads are raised and carried from place to place, move with a circumferential velocity of only 79 feet per minute, so that the velocity of one mile is reduced to 79 feet as a question of travelling, for the smaller class of these cranes travel along lines, and so convey from place to place the heavy weights they may have lifted. It is also reduced to about 79 feet as a question of lifting, the two motions being kept distinct. This illustration will be sufficient for an example of the communication of motion by rolling contact where there are no teeth.

Although "rolling contact" is the especial purpose of this evening, yet it will be essential to say a few words in reference to a machine, of which an elementary portion is before you. The Registrar-General, with great kindness—a kindness which has met us on every hand in reference to illustrations for these lectures—has supplied these parts of the calculating machine made by Messrs. Scheutz, of Stockholm, for the Department at Somerset-house.

Before describing the simple and durable apparatus, it may be well to explain the objects contemplated by those who have given their minds to the construction of calculating machines.

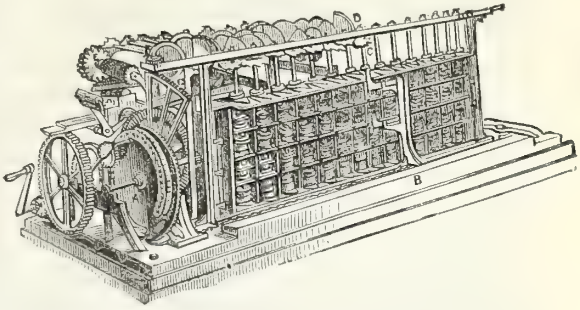
Perhaps Mr. Babbage was the first to direct attention to a peculiar mathematical relationship existing in almost all tables of numbers in sequence. He had observed that, if a consecutive series of these numbers were taken, and each subtracted from the next higher number, a deduced table of smaller numbers could be obtained. Performing a similar operation of subtraction upon the lines in this second table, a third table of still smaller figures resulted. Proceeding thus, he found that generally there resulted a series of the same, or nearly the same, numbers. For example, take the squares of the first nine digits; these squares are:—

Square Numbers	1	4	9	16	25	36	49	64	81
First Differences	3	5	7	9	11	13	15	17	
Second Differences	2	2	2	2	2	2	2		

If, now, mechanism were so contrived that the lower line was constantly added to the one above, and this (the second line), so increased, were added to the first, a series of figures would be obtained which, in the illustration given, would constitute a series of square numbers.

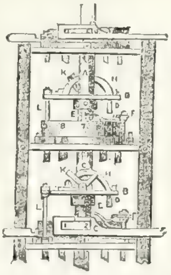
Such was the foundation of the scheme which Mr. Babbage laid as that on which to rear the superstructure of a calculating machine. Mr. Babbage's views, so far as they have received "body, form, and fashion," are now in the Museum at South Kensington. Two gentlemen—one a Mr. Scheutz, of Stockholm, the other a gentleman of England—partly from the published intentions and views of Mr. Babbage, and partly following out their own ideas, devised mechanism to do the work of calculation. Two machines on the plan of Messrs. Scheutz and his son have been made. One is at the Observatory at Albany, in America, the other at Somerset House.

FIG. 3.



The wood cut, Fig. 3, represents the general appearance of the machine. In each of the small recesses at the front is a wheel, or ring, or what may more correctly be called slice, about half an inch deep, of a metal cylinder, resting, as it were, in a groove, and having ten short pieces or legs projecting below. The woodcut (Fig. 4) may serve to show the general arrangement in two of the small recesses. These cylinder slices are not attached to the vertical shafts which pass through each recess. Attached, however, to the shafts are contrivances which not only are carried round with the shaft, but have upon them pins or studs capable of a vertical motion. This pin can be seen at G, between K and H, in the lower recess of Fig 4.

FIG. 4.



It may be observed that as the shaft rotates, a projecting trigger or pin D will be tripped up by the inclined plane E, attached to the lower cylinder-slice. Thus tripped up, the pin G, previously referred to, will be lifted out of the bell-crank K H. This bell-crank is loaded at K, and that end, therefore, falls. The consequence is that the pin G is supported upon the other arm H of the bell-crank, when the trigger D has passed over the inclined plane E and so held between what we have called the legs of the upper cylinder-slice. So long, therefore, as the shaft moves the cylinder will be moved. The rotation, however, brings the bell-crank into contact with a small inclined plane, not visible in Fig. A, and tripping up the end K of the bell-crank releases G, which falls down, and so discontinues the rotation of the cylinder-slice. This reliance upon the influence of gravity is a peculiar feature in this mechanism, and is not found in other machines dealing with calculations. It will be observed that around the cylinder slices, or rings, the figures from 0 to 9 are engraved. Any one of these figures may be brought by the hand or by the mechanism into the front vertical line, they are then regarded as the figures which are to enter into the calculations.*

The lecturer, by enlarged working models, explained the action of other parts of the machine so far as related to the calculating mechanism. The combined action of these parts conveyed to the upper line of the machine, shown in fig. 3, the various additions indicated by the laws of differences as previously illustrated.

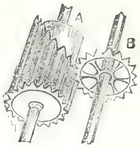
It will be observed that hitherto no mechanism has been described for the operation of carrying. For example—if the two lines $\frac{362}{473}$ were to be added, the figures indicated would be 735 instead of 835. Messrs. Scheuts had, therefore, to provide for this carrying. In fig. 3, it will be observed there is an upright marked B, this is called a Traveller. By a mangle wheel arrangement at the left-hand side of the figure, and a chain, acted upon by a toothed wheel, into the links of which the teeth enter, this Traveller passes in front of the recesses. It will be observed that the Traveller has two projecting arms. By means of these arms *he* is enabled to advance one figure on any wheel where the mechanism indicates that such an advance must be made. A similar traveller at the back does the same for the rows of wheels not operated upon by the front one. Thus, after each complete revolution of the wheel-work, the upper row of figures indicates the successive lines in the series being calculated.

It remains to state briefly how the figures thus made apparent are to be transferred to the type wheels and so impressed, either upon stereo-metal or upon a matrix of paper pulp, from which type-metal casts may be taken.

To say that it is done by a series of stepped cams something similar to the snail cam, by which the number of strokes made by the hammer of a clock is determined, would be a brief but not very sufficient explanation. This much must, however, suffice for the present, and those who wish for further information can obtain it on reference to the patent of Messrs. Scheutz.

Now that the mechanism of calculating machines is before us, it may be well to direct attention to that of arithmetical machines. These are for performing the ordinary operations of addition, substraction, multiplication, and division, and not for the calculations of series by a law of differences. The one now produced is simple in construction, compact in arrangement, and satisfactory in use. Similar ones are made by Mr. Thomas, of Colmar, and are used in many parts of Europe and England.

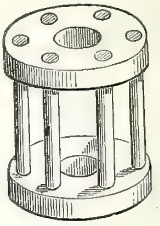
Fig. 5.



Exclusive of the progressive parts, which are similar to those of counting, or numbering, or paging machinery, there is a very ingenious and simple arrangement for committing to the machinery any number that the operator may desire. By directing small pointers to the figures on which an operation, say, of multiplication, is to be performed, and turning a handle, these figures appear in the machine. The mechanism for this is what we must now look at. The pointer to which reference has been made moves a small-toothed wheel along a square bar or shaft B. In gear with this wheel are teeth on a cylinder or pinion A. Ten of such long teeth surround about half of the cylinder. If, therefore, the cylinder A made one revolution, the wheel B would be advanced ten teeth. Now, an inspection of fig. 5 will show that a portion of each tooth is cut off, so that the position of the wheel B upon the small squared shaft determines the number of teeth it may be advanced, and therefore enables any figure to be introduced into the machine. Although between the small shafts, A and B, the communication of motion is by cylinders of circular section, yet the amount of motion communicated is variable, being dependent upon the position of the wheel on B.

We now return to the question of rolling curves. If one curve is to cause another to rotate, it is easy to see that the curves must have corresponding surfaces. Early mechanicians adopted a plan of which there is an example here, viz., driving pins round the edge of the wheel, and these pins worked between pins on the face of the other wheel, and thus continuous motion was obtained in shafts at right angles to each other. That motion was required because it was needful in early days to utilise the power of water for the purpose of grinding corn. The water fell vertically, and the water-wheel, therefore, moved vertically, but the millstones were required to rotate horizontally. The question, therefore, was how can we with a vertical fall of water get a horizontal motion. It was got by pins driven into the face of the wheels; such wheels exist to this day in Dutch clocks. They were much increased, extended, and enlarged as machinery advanced. Ultimately, they formed what are called trundle or lantern-wheels. Fig. 6 is an example of a trundle or lantern-wheel. In mill machinery, the round staves are made of a tough hard wood, firmly fixed at each end. In light machinery, the staves are of steel wire, and fixed only at one end.

Fig. 6.



The reason why wheels in mill machinery were made so broad, in all respects so heavy, and to our eyes so inconvenient and clusmy, arose from the fact that the shafts were wooden ones, generally square—capped at the end with an iron hoop—an iron pin being driven into the wood for a bearing. Millwrights then had not means for completing these wooden shafts with that care which an English development of the "tool-making" faculty has given us, and which we so successfully apply to iron shafts. There are drawings here of one of these earlier wheels, with its shaft and wedges, and of a modern wheel, with its turned wrought-iron shaft and key-way, from which you will at once see the difficulties which beset mechanics in the last century. It was needful that the wheels should revolve truly with one another, but this was very difficult with wooden wheels, wooden shafts, and wooden pin-teeth. Remember that it was not until Sweaton's time (A.D. 1769) that cast-iron teeth were used for wheels.

Another difficulty with a square wooden shaft was to make the wheel "run" truly. About 16 wedges were used, driven in on opposite sides, but, with all the driving, the wheel could not be made to run true. An inspection of Fig. 7 will satisfy anyone of the difficulties alluded to. Now, however, with Mr. Whitworth's gauges for shafts, wheels can be fixed so as to run true. That was one of the earlier difficulties, and when removed there was no difficulty in disposing of these thick heavy lantern-wheels, and machinists began to adopt mathematically correct teeth, as well as true circular shafts and circular holes. There is no difficulty in making clear, without the aid of mathematics, the principles upon which these teeth should be constructed. There are diagrams on the wall intended for the purpose, but the subject belongs more properly to the next lecture.

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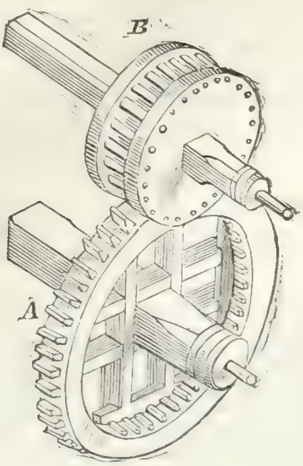
* For the use of this and future woodcuts, the Society of Arts is indebted to Messrs. Churchill and Sons, the publishers of "The Elements of Natural Philosophy," by Messrs. Brooke and Bird.

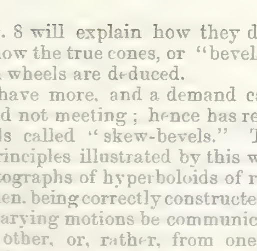
[For the use of this and future wood cuts the Society of Arts is indebted to Messrs. Longmans, the publishers of Willis's "Principles of Mechanism" and Goodeve's "Elements of Mechanism."]

Fig. 7.



But it was not only to shafts rotating at right-angles to each other, as in the grinding of corn by water-wheels, that motion had to be communicated through rolling contact. As machinery extended, the directions of shafts to be thus driven became more and more varied. Hence, for two shafts neither parallel nor at right-angles, but meeting, mechanicians were required to provide a contrivance. Fig. 8 will explain how they did this, and it also suggests how the true cones, or "bevels" as they are called, for such wheels are deduced.

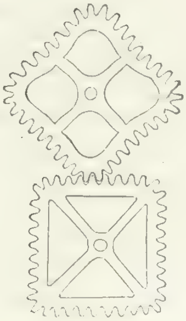
Fig. 8.



Much will have more, and a demand came for shafts not parallel and not meeting; hence has resulted a large class of wheels called "skew-bevels." These are derived from principles illustrated by this working mode and these photographs of hyperboloids of revolution.

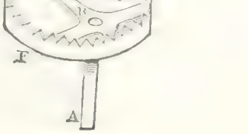
The teeth, then, being correctly constructed, the question was how can varying motions be communicated from one wheel to the other, or, rather, from one shaft to the other. It can be done by taking different curves, for it is the fact that, given one curve, another can always be found that will roll by a tooth arrangement in contact with it. Lobe wheels, and wheels formed upon the rims of squares, will work in gear with other lobe and square wheels. Here is an example, and it will be found that these wheels work as truly together as if they were circular. Here is another form, a heart, or cam, or lobe-shaped tooth-wheel, for which we are indebted to the authorities at South Kensington, and these rotate as truthfully as if the teeth were formed upon the rim of a circular wheel. A variable motion, therefore, has been obtained from a uniform one, for, although one of these shafts rotates uniformly, yet the velocity of the other shaft is not uniform. There are many cases in which such variable velocity is required, in none more than in arranging the velocities with which the tool or work travels in different machines. The mechanism for accomplishing that is devised in various ways. As an example of communication by rolling contact, it has been done by elliptical wheels.

Fig. 9.



The history of elliptical wheels is very curious; and if there are any here who are interested in mechanism apart from mechanics, the thoughtful study of all that is written about what is called "planetary mechanism" in "Rees's Cyclopædia" will repay the time given to it. The wonders of those orreries, contrived at the latter part of the last century, are quite sufficient to excite the astonishment of mechanicians at the present day. Here is one of the plates in Rees's "Cyclopædia," viz., one—under "Planetary Mechanism," showing an orrery moved by a small handle, but containing an immense number of wheels, probably more than 100. These orreries are very curious indeed, and we are indebted to them for two very important constructions, one being the elliptical wheel, the other the crown wheel. Astronomers wished very much to communicate a clear idea of the motions of the heavenly bodies, and they attempted to do it by machinery, not the machinery we have, but by contrivances, although, in our eyes, clumsy, yet in those days very beautiful. The orbit of the earth being elliptical, their object was to get an elliptical motion. About the year 1695 an attempt was made by Huyghens to form what we now call crown wheels. He then called them contrate wheels, because the teeth were in the contrary position to the usual one. He attempted to get at the requisite elliptical path by taking a contrate wheel, fixing its axis out of the centre, and putting a pinion to drive it; the wheel, therefore, went round with a

Fig 10.



variable velocity. Fig. 10 illustrates this arrangement. D C is a long pinion, F the contrate wheel, A B the axis placed out of the centre of the wheel F. If, now, the pinion C D moves uniformly, the axis, A B, will have a variable velocity, moving most rapidly when the distance from B to the driving portion of the pinion is the least. Roemer, about 1710, thought to accomplish the same object by a very ingenious contrivance, which is to be found in the cabinets of the mechanically curious to this day. He took a cone, and knowing that an ellipse is a section of a cone, he thought he could not do better than take two cones, making one grooved, and putting teeth round the elliptical section of the other, so as to fit into the grooves. Thus he got a velocity which he took to be the best representation of the path of the earth round the sun. There is a model of it here. Then a gentleman, Dr. Desauglier, who was the first to deliver public lectures on science in London, came forward about the year 1744. He attempted to accomplish the same thing by taking two wheels of a true elliptical form, nailing a string to each, so that one pulled the other round.

Then Adam Walker tried to accomplish this variable motion by using epicycloidal inclined plane wheels, for a more particular description of which see the "Encyclopædia." Joseph Priestly, in 1801, accomplished the same by a contrivance which was very ingenious, and which may now be sometimes available. He did that which no mechanic who had a character to lose would venture to do—he made wheels of which the teeth were irregular, that is to say, he made a large wheel having more teeth on one half of it than on the other, and the teeth of both the wheel and the pinion being large, they worked together, though in a somewhat loose way, and thus one half of the wheel travelled more quickly than the other. By this means a pretty faithful representation of the path of the earth round the sun was obtained.

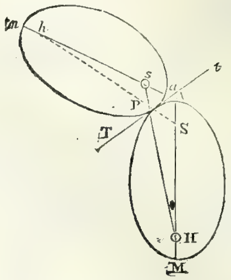
Then Pearson, about the year 1808, undertook to make, for the Royal Institution, one of the finest orreries, and one of the most extraordinary pieces of mechanism, probably made in that day. He not only introduced wheels such as have been described, but attempted to get various velocities and varying distances by means of elliptical wheels; and he, for the first time, introduced an epicycloidal train, of which more in a future lecture.

Those of you who are curious in the matter of "rolling contacts" will look with interest at a clock now in the Patent Museum at South Kensington. It was made by a man named Harrison, about the year 1715, at Barrow, in Lincolnshire. It is going to this day, and keeping good time. It strikes the hour, indicates the day of the month, and, with one exception, namely the escapement, all the wheels, all the teeth, and all the shafts are made of wood. The clock is well worth inspection. The same Harrison gained the reward of £20,000, which was offered by the Board of Longitude, for a nautical time-piece. The key of that clock is not a key—as we understand it—but is a pinion which drops into a wheel. The clock is made with a French-count wheel, and not a snail, such as is commonly used in modern English clocks.

Elliptical wheels are very good for rolling, so long as the driving wheel follows the driven one, but as soon as ever the reverse action takes place you will very soon see, by this specimen, that after a certain portion of the revolution is accomplished, they cease to roll in contact. Up to a certain point they roll very fairly, but as soon as the one ceases to gain on the other the rolling action ceases.

An inspection of Fig. 11 may explain this action; or what would give an experimental illustration might be more convincing. The latter may be had by cutting out two ellipses in cardboard, and placing them on a drawing-board. Put pins through them at H and S, the foci. Let the ellipse A P M be the driver. It will be found that when the driven ellipse *a* P *m* is in the position in which A and (*a*) coincide, and therefore M H S A and *a s h m* are in one straight line; then, because the driving ellipse A P M is retiring from the driven ellipse, the rolling contact is not preserved.

Fig. 11.

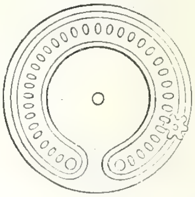


This difficulty was partially obviated by various devices, until now, in ellipses as in the more complicated forms of cam and lobe-wheels, the rims are prepared with teeth, and the theoretical rolling action is attained.

Messrs. Muir, of Manchester, use these elliptical wheels to obtain a quick return motion in their planing machines, &c. They have kindly sent the model on which they made their calculations, and you will see from it what is the property of an elliptical wheel. Each rotates about its focus, and these axes are such that the distance from the one to the other is always the same. It is quite clear that the distance must be constant, or the shafts could not be fixed. Two equal ellipses rotating as described, satisfy this condition Observe in connection with the rotation of these wheels that the driven ellipse travels with a varying velocity, although the rotation of the shaft of the driving one is constant. This varying velocity has been so arranged that when a machine is doing work the cutting instrument may be moved slowly. When the work is done, and the cutting instrument has to return in order to commence another cut, then the quick motion is imparted to it. Assume that in going forward it is doing its work, and in returning it is doing nothing. In the large model before you the cutting instrument comes back at three times the velocity with which it does its work. So that when there is nothing to do its industry is changed into running instead of labouring.

The class of rolling motions comprehended under the term "mangle wheels" must be noticed. This contrivance, illustrated in its most simple form in Fig. 12, is capable of preserving constant or variable velocity ratio with a varying directional relation. The principle alone can now be dealt with. The end of a shaft, on which is keyed a pinion, is guided in a groove, as shown in Fig. 12. It will be observed that this groove returns into the inner part of the wheel, and therefore, as the pinion is passed from the external to the internal teeth, the direction of motion of the wheel will be reversed. Now, as this groove may be of other than a true circular form, a varying velocity ratio can be communicated. These wheels sometimes fulfil very important offices in relation to the communication of motion by rolling contact.

Fig. 12.



ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

Sir,—The condition of England at the date of the Society's establishment, in 1754, must be borne in mind by all who would appreciate the object of the founders of our Society.

Civil commotion and foreign wars had lasted for 60 years, and had agitated the whole British nation. Internal communication was difficult, transport of goods was by pack-horses, the country had consumed its forest trees, coal was almost unknown as a fuel, the country was undrained, education neglected, art discouraged, food scarce, bread dear and bad, the fish supply a monopoly, and many of our chief manufactures were dependent on foreign countries for their supply of raw materials. To encourage art and industries, to promote agriculture, to improve the education of the people, and to increase the supply of food for both man and beast, were among the objects it sought to attain. Some of these objects it attained by the award of prizes for works of art and industry, as already referred to in my previous letter. In addition, it stimulated the collection of various descriptions of grass seeds, and distributed each variety separately, according to the locality or the conditions of soil in which it was to be sown, thereby greatly improving the pastures of the country and the supply of green and dry fodder for cattle. It inquired throughout Europe for green and root crops capable of cultivation in England, and of resisting the frosts of our winter, and thereby procured many new varieties of winter food for our cattle. It induced the planting of millions of timber trees of various kinds in the United Kingdom, and the mountain tops and hill sides of Scotland and Wales, and many parts of England now covered with timber were in those days barren and uncultivated wastes. It introduced the means and appliances then found best suited to the draining of land. It encouraged the reclamation of waste lands, thereby extending the area of our food production. It awarded prizes for, and encouraged the establishment of dairies and factories for the utilisation of farm produce, and thus added to the sources of and supplies of food for the people. It did not, however, limit its action to improving and increasing our food supplies by means of agriculture—it encouraged the extension and improvement of our coast fisheries, and spent many thousands of pounds in breaking up the monopoly of the fish supply to the cities of London and Westminster, by chartering vessels, and bringing in extensive supplies of fish to our markets. It also improved the land carriage of such supplies; and it promoted and encouraged attempts to cultivate shell-fish on both the Kent and Essex coasts.

In reference to the machinery used in agriculture, it is stated in the Minutes of our Society that the use of reaping and thrashing machines was being encouraged, and a reaping machine for corn, invented by Robert Ainslie, of Welnage, was in use as early as the autumn of 1764.

The cottages of the labourer and workmen's dwellings, as well as the laws under which sites for the erection of improved dwellings for the labouring classes are now obtainable, also received much attention, though at a [illegible] from the Society; and the country is, in part, indebted to our Society for the laws under which the government now grants loans of money for the erection of improved homes for the working classes, though, doubtless, the existence of such laws are chiefly due to the exertions of Sir Sidney Waterlow and others.

But food without money to pay for it is unattainable, and homes without the means of paying the rent are cold and cheerless habitations. To give food, comfort, and independence to the people, it is necessary that employment should be provided, and with that object, and to increase our manufacturing processes, our Society directed the attention of chemists to the manufacture of smalt and madder, the purification of fish oils, the production of substitutes for turpentine from pit coal; and of the botanist, both at home and abroad, to the cultivation of such roots and plants as were capable of affording the basis of new industries, or extending the commercial relations of England with her distant possessions or with foreign countries by developing new sources of supply of condiments and articles of luxury for the use and consumption of the more wealthy classes of the community. It sought to ease the labourer at the same time that it endeavoured to increase and cheapen production; it set up at its own cost and in the midst of much opposition the first saw-mills erected in England. It directed attention to the improvement of every kind of mechanical appliance used in industry, and obtained improved and more economic appliances for spinning and preparing thread for the weaver. It relieved the unfortunate slave in Ceylon from the drudgery of hulling rice for our consumption, by encouraging the introduction of mills and machinery suited to that purpose. It rewarded appliances for saving life both on land and at sea, and it has been the instrument through which many new industries have been created.

Before gas was common in every home, it introduced cocoa-nut oil; before telegraphs across the ocean existed, it rendered such possible by the introduction of gutta-percha; and only recently, by the approval it gave to the means of oxidising oil, invented by Mr. Walton, it laid the foundation of the manufacture of linoleum—a material which is now finding its way into every home. It is impossible to refer more in detail to the work done by our Society; those who desire to obtain further information upon the subject cannot do better than consult its "Transactions;" or a brief review of the past and present work of the Society will be found in a paper read before the Society by our Financial Officer, in 1869, and which is published in the *Journal*.

Is then, I would ask, a Society which has promoted charity, improved the education of the people, provided —and it is still providing—increased and cheaper supplies of food for the people, pointed out new directions for the creation of industries, helped to develop commerce, and added many sources of comfort to the homes of every class of the community worthy of a continued and increasing amount of support? I feel that it is, and that it will obtain it so soon as the public become more fully alive to the work that it has done and still desires to do with increased energy. When our Society was founded, correspondence was slow and costly; communities were shut off from each other by the difficulties of travel; there were no steam-engines, railways, or telegraphs. Societies were few in number, and dependent on the voluntary services of a few energetic men for their efficient working.

Since the development of the power of the steam-engine, and the introduction of the telegraph, and the power of the printing-press, everything has become changed. Scientific investigation has been carried on with enormous energy throughout Europe; discovery upon discovery has been made by which industry has been extended. Foreigners pour in upon us daily, for the purpose of establishing new industries in our midst, and increased energy and persistency, by means of paid labourers, must be given to the work if it is to be done, and there will then still remain more than enough for the largest body of volunteers to do. To secure the means of obtaining such paid service is the object of the endowment fund now sought to be raised.

Charity will ever be needed, but in proportion as the means of industry are increased so the necessity for charitable aid must necessarily be lessened. I cannot doubt that those who come forward to aid the Society of Arts with their money, by establishing for it a permanent fund, will reap their reward in the satisfaction of seeing, as Sir Rowland Hill has seen, thousands made happy by the means he has afforded to the working classes of earning an honest independence.—I am, &c.,

H. G. H.

CORRESPONDENCE.

THE WATER WE DRINK.

Sir,—None of the writers on this subject appear to have any better notion of the real nature and properties of our rivers, or the objects for which they were ordained, than James Brindley, the celebrated Duke of Bridgwater's canal engineer, whose idea was, when questioned before the Committee of the House of Commons, that rivers were created for the sole purpose of feeding navigable canals.

The more modern idea is that they are intended to afford water power for mills and factories, and, in addition, to receive the pestiferous waste from lead mills, woollen works, and such like; but the question of the supply of fresh-water fish and pure drinking water is never touched upon. It is true that our rivers are bound to receive the natural drainage of the valleys they pass through, but if freed from the impediment of innumerable dams and weirs, the powers of the chemistry of nature by means of organic and inorganic matters, as well as atmospheric agencies, would cause their waters to rush pure and undefiled from spring-head to embouchure. Even in their present miserably obstructed state, does any one in a boat on the river hesitate, when between town and town, to dip up a glassful of water and drink it? Certainly not; and yet medical science is constantly warning all persons from drinking river water as being unhealthy and sometimes dangerous, just as if our rivers had never been intended to supply fresh-water fish and pure drinking water. A more absurd position can scarcely be conceived.

Rome is planted on the banks of the Tiber, a muddy river for three parts of the year, and therefore cannot make use of its water, but the city is surrounded with mountains at the distance of five, ten, or fifteen miles, which, by means of aqueducts, afford an unlimited supply of the purest water, to an amount equal perhaps to twenty times that supplied to each inhabitant of London, and the Eternal City enjoys that abundance, flowing day and night to the present time, though many of those noble aqueducts are now in ruins.

When Christina of Sweden went to reside at Rome, she was shown of course the wonders of the city, and when admiring the two grand fountains in the Piazza di St. Pietro, she observed that they might be stopped now, as she was about to leave. The answer made was, "Please your majesty, they have been playing as you see them night and day for more than three hundred years."

The cost of clearing our rivers and their tributaries of all impediments to their course would be far less than that of artificially procuring a sufficient supply of pure water for the inhabitants of London and other principal towns, and that independently of great collateral advantages, such as diminished inundations, deepening the beds of the rivers, and clearing the mouths of the shoals by which they are all more or less obstructed, and many closed up.

There is not, however, much prospect of anything being done, at least for a long time to come, for there are several obstacles much in the way of public improvements. Vested rights, parochial divisions, and, last though not least, the patent laws, for unless something be devised that can be manufactured into a patent right, nothing is ever done.

The full treatment of this subject, however, would occupy far too much space for your columns, and I beg to refer the curious in such matters to the Abate Frisi's works on rivers and their management. He was hydraulic engineer and mathematician under the Tuscan Government during the present century.—I am, &c.,

Henry W. Reveley.

Reading.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-Gen. Scott, C.B., secretary.

His Royal Highness the Duke of Edinburgh presided on Friday, at Clarence-house, over a meeting of the General Purposes Committee, appointed by Her Majesty's Commissioners for the Exhibition of 1851, to carry out the current series of Annual International Exhibitions. There were also present His Royal Highness the Prince Christian, the Marquis of Ripon, the Marquis of Lansdowne, Sir Francis Sandford, Mr. Bowring, Mr. Cole, Dr. Playfair, Mr. Thring, and Major-General Scott (Secretary).

OPENING OF BETHNAL-GREEN BRANCH MUSEUM.

The ceremonial of opening the Bethnal-green Branch Museum, by His Royal Highness the Prince of Wales, on behalf of Her Majesty the Queen, took place on Monday, the 24th June. His Royal Highness, accompanied by Her Royal Highness the Princess of Wales, left Marlborough-house at 11·30 o'clock, attended by the Lord Chamberlain and the Household in Waiting. The carriage procession was formed in the following order:—

First Carriage.—Extra Equerry to His Royal Highness the Prince of Wales, Colonel Kingscote; Field Officer in Brigade Waiting, Colonel the Lord Abinger; Silver Stick in Waiting, Colonel Bateson; Equerry to His Royal Highness the Prince of Wales, Major-General Probyn, V.C., C.B.

Second Carriage.—Private Secretary to Her Royal Highness the Princess of Wales, Mr. Holzmann; Private Secretary to His Royal Highness the Prince of Wales, Mr. F. Knollys; Groom of the Bedchamber to His Royal Highness the Prince of Wales, Hon. A. T. Fitzmaurice; the Equerry in Waiting.

Third Carriage.—The Groom in Waiting, Colonel the Hon. A. Liddell; the Lord of the Bedchamber to His Royal Highness the Prince of Wales, the Marquis of Hamilton; the Treasurer and Comptroller to His Royal Highness the Prince of Wales, General the Right Hon. Sir W. Knollys, K.C.B.; the Woman of the Bedchamber to Her Royal Highness the Princess of Wales, the Hon. Mrs. Edward Coke.

Fourth Carriage.—The Lord in Waiting, the Lord Methuen; the Chamberlain to Her Royal Highness the Princess of Wales, the Lord Harris, G.C.S.I.; the Lady of the Bedchamber to Her Royal Highness the Princess of Wales, the Countess of Macclesfield; the Lady of the Bedchamber, the Countess of Caledon.

Fifth Carriage.—The Lord Chamberlain, the Viscount Sydney, G.C.B.; Her Royal Highness the Princess of Wales; His Royal Highness the Prince of Wales, K.G.

A captain's escort of the 1st Regiment of Life Guards accompanied their Royal Highnesses, who proceeded by the Mall, the Thames Embankment, Queen Victoria-street, Threadneedle-street, Bishopgate-street, and

Bethnal-green-road. At the entrance to the Museum was a detachment, with band, of the Grenadier Guards. A guard of honour of the 2nd Middlesex Tower Hamlets Volunteer Engineers was also stationed at the Museum.

The order of the proceedings inside the museum on the occasion was as follows:—Their Royal Highnesses were received by the Marquis of Ripon, K.G., Lord President, and by the Right Honourable W. E. Foster, M.P., Vice-President of the Council. A procession was then formed, and to a flourish of trumpets given by the State trumpeters it marched up the building. Upon the conclusion of the flourish the band of the Hon. Artillery Company, stationed in the East Gallery, played "God Save the Queen." The Bishop of London then offered up the following prayer:—

"Almighty and most merciful God, the author and source of all beauty, goodness, and truth, fulfil and perfect, we beseech Thee, the designs of those who have erected this fabric for Thy honour and glory, and for the moral and intellectual culture of Thy people. Grant that within these walls may ever be sought and found the knowledge which humbles while it elevates, and the tastes which purify while they adorn; and only those true pleasures which are unsullied by the stain of evil. Sanctify human science by the grace of heaven; imbue the creations of art with "the beauty of holiness;" and make each step in the discovery of truth a nearer approach to Thee, who art the Truth itself. Give peace in this our time, O Lord; and knit the hearts of all together in loyalty, unity, and Christian brotherhood, for Jesus Christ's sake. Amen.

The Hundredth Psalm was then sung by the children from about twenty local schools, assisted by choristers, and accompanied by drums and trumpets, all under the conductorship of Dr. Stainer.

The Marquis of Ripon, the Lord President, then read the following address to his Royal Highness:—

"May it please your Royal Highness—We, the Lords of the Committee of Council on Education, humbly beg leave to approach her Majesty, through you, her illustrious representative on this occasion, with the assurance of our devotion to her Majesty's Throne and Royal person.

"The interest which her Majesty has always shown in the advancement of education in science and in art is illustrated to-day by the presence of your Royal Highness and that of her Royal Highness the Princess of Wales, at the opening of this museum. This interest is fully appreciated by all ranks of her Majesty's subjects.

"The original idea of this museum may be said to have been derived from the Great Exhibition of 1851, from which so many other important works have sprung. At the third meeting of the Royal Commission for that undertaking your Royal Highness's lamented father proposed to arrange manufactures under the three heads of the Mineral, the Vegetable, and the Animal Kingdoms, and eventually the collections obtained from the Exhibition were thus divided:—Vegetable products were offered to the museum at Kew; minerals and mining products were offered to the museum in Jermyn-street; whilst the collection of animal products and food were deposited at the new museum at South Kensington.

"The question of separating the collections at South Kensington has been under consideration since 1865. It has been long felt that the accidental accumulation, in one spot, of heterogeneous collections, more or less distinct in character, was not convenient; and that the collections might be better developed separately, each one having its special objects and features.

"In 1865, when Lord Granville and Mr. Bruce were Lord President and Vice-President of the Council, the Lord President presided over a meeting to consider the question of the establishment of metropolitan district museums. The Duke of Buckingham, as Lord President, interested himself in the subject. After a time, and principally through the exertions of Sir Antonio Brady, the Rev. Septimus Hansard, Mr. Clabon, Dr. J. Millar, and others, the land on which we now stand was purchased through the public subscriptions of the neighbourhood, to be held in trust, on condition that a museum should be built on it and supported by the State, the necessary arrangements having been made by the Duke of Marlborough, as Lord President. This display of public spirit determined the site of the present museum.

"It has been established as a branch of the South Kensington Museum, and the collections of food and animal productions, with their allied industries, architectural models, sculpture, &c., have been transferred to it.

"We have, however, felt that the inhabitants of this district will naturally look for an opportunity of seeing here, from time to time, collections of fine art. Any doubts which may have been expressed as to the manne in which the Bethnal-green Branch Museum would be treated must be removed by what your Royal Highness sees in these galleries. This museum, rather than the South Kensington Museum itself, is for a year made the depository of the most valuable collection of art objects which have ever been lent to any institution by a single individual, and we feel sure that Sir Richard Wallace will be thanked by all classes, and especially those of the East of London, for his munificent liberality.

"It only remains for us to ask your Royal Highness to declare this museum open. For ourselves, we promise that no efforts on our part shall be spared to render this museum worthy of her Majesty's favour, of your Royal Highnesses' presence graciously afforded this day, and of the support of an enlightened public."

The Prince of Wales replied as follows:—My Lord—It is a source of great gratification to me that her Majesty the Queen has expressed the desire that I should represent her on the occasion of the opening of this museum. The history of its origin offers most interesting details of the gradual development of the views which led to the execution of the plan, of the difficulties which attended its progress, and of the perseverance which accomplished its final success. Her Majesty ever shared with my lamented father the philanthropic feelings which had for their object the promotion of the enjoyment of the people, and the more perfect knowledge of every art and science which could turn to their advantage. It affords the Princess of Wales and myself the most sincere pleasure to be thus associated with the Queen in the work of extending to so large a class of her subjects the advantages of a museum, and at the same time the means of improvement in their respective trades and occupations. It appears on competent evidence that whilst strength and solidity, neatness and finish, distinguish every production of the English workman, in the works of taste and art place must be given to his foreign competitor. It is to remedy this disadvantage that branch museums are designed, and to bring home to the dwellings of the working classes, for their instruction and imitation, the various collections of art and science which already exist in this country. In the address of the promoters of the Bethnal-green Museum to the Lord President of the Council of Education, in February, 1869, these objects are laid down in the clearest and most distinct language. That they will be carried out under the superintendence and by the hands of those able and earnest men who have devoted their time, their money, and their own collections towards the establishment of the Bethnal-green Museum, cannot be doubted. In conclusion, I feel that I should inadequately discharge the duties of the day if I did not tender Sir Richard Wallace the thanks of the promoters of the institution and my own for his munificent contributions. His philanthropy, as exhibited both in England and France, is too well known to need further eulogium from me. I trust he will be persuaded of the sense which we all entertain of those acts of generosity which are calculated to exercise so valuable an influence over the future destinies of this museum.

The Prince of Wales having declared the museum open, their Royal Highnesses and suite left the dais, and proceeded to inspect the fine art galleries, through which Sir Richard Wallace had the honour of conducting them. Having returned to the dais, the order of departure was the same as that of the arrival, the band of the Honourable Artillery Company, in the east gallery, playing "God bless the Prince of Wales" as their Royal Highnesses left.

Before finally departing, their Royal Highnesses partook, in a side gallery, of some refreshments, served by Messrs. Spiers and Pond, who have taken the contract for the supply of refreshments to the public who may visit the museum.

The whole of the line of the procession was gaily decorated with flags and mottoes, and if the display of bunting on the occasion is any test of the loyalty of the neighbourhood in which the museum stands, then Bethnal-green is loyal indeed.

Among those present were Lord Henry Lennox, M.P., Chairman, and the following members of the Council of the Society of Arts:—Mr. Andrew Cassells, Mr. Hyde Clarke, Mr. E. C. Tufnell, and Mr. J. A. Franklin.

GENERAL NOTES.

The Canal Cavour and Industrial Enterprise in Italy.—The completion of the new branch canal has given a fresh impetus to industrial enterprise in the province of Novara. A company recently formed at Milan have obtained a concession of motive power of two falls on the canal, near the railway station at Novara, and are now engaged in the erection of a vast establishment for spinning floss silk. The principal building is 98·20 metres in length and 67·80 metres wide, measured internally. The machinery is being principally supplied by Messrs. Greenwood and Batley and Messrs. Fairbairn, Kennedy, and Naylor, of Leeds. The shafting and driving gear by Neville and Co., of Venice, and Miani, Ventuzini, and Co., of Milan, whilst the boilers are by Süffert and Co., of Milan, to supply steam power in case of need, and during the annual clearing-out and repairs of the canal, which generally lasts for about a month.

Statistics of German Cotton Industry.—There has been an extraordinary progress in cotton spinning and weaving in Germany of late years. The consumption of raw cotton there amounted to but 185,772 centweights annual average during 1836-40. The yearly average between 1866 and 1870 was 1,685,124 centweights, and in yarn alone the average from 148,617 centweights reached a production of 1,348,099 centweights in 1870. Direct importation from the producing countries increases rapidly, but the last-named year affords no criterion, inasmuch as the Netherlands and Belgium then furnished a larger quota to Germany than Bremen, owing to the blockade. The importation of Indian cotton *viâ* Trieste has, from 89,586 centweights in 1868, risen to 183,453 through the opening of the Suez Canal. But, despite the perfection of machinery within the empire, the higher grades of yarns continue to come to a great extent from England, notwithstanding a raised import duty thereon; there is only a gradual decrease in this species of import observable as regards England; while it, on the other hand, assumes large proportions from Switzerland. The total amount of yarn consumed during the war year, 1870, was 1,617,715 centweights. The general tendency is that of independence, especially from England. This is the easier of accomplishment as direct steamship lines now ply from cotton ports to the Hanse Towns.

Employers and Workmen in Germany.—The *Chronique de l'Industrie* states that the principal constructors, as well as the founders and manufacturers of Germany, have held a meeting at Berlin to consider the measures that should be taken on the workman question, and that there was but one opinion amongst those who attended the meeting respecting the measures of repression to be taken in defence of their interests against the demands of their men.

New Quicksilver Assay.—The following description of a new method of assaying quicksilver ores, by A. Eschka, is taken from the *Berg-und hüttenmännische Zeitung*. The new assay may be used for cinnabar, mercuriferous Fahlerz, &c. The ore should be weighed in a balance turning with one milligramme. The quantity of ore for the assay varies according to its richness, as follows:—

	grammes.
Ore containing up to 1 per cent	10
,, 1 ,, 10 ,,	5
,, 10 ,, 30 ,,	2
,, over 30 ,,	1

The ore is introduced into a porcelain crucible, the edge of which has been ground flat, and mixed with about half its weight of clean iron filings, by means of a glass rod, and is then evenly covered with a layer of iron filings about $\frac{1}{4}$ to $\frac{3}{8}$ inch thick. A concave cover, made of fine gold, about 2 inches in diameter and 12 to 15 grammes in weight, is now placed on the crucible after having been carefully weighed; the concavity is filled with distilled water and the crucible placed on a triangle and heated for 10 minutes by a Bunsen burner or Argand spirit lamp, during which time the mercury is volatilized and deposits itself on the gold. The gold cover is then removed, the water poured off, and the mirror of mercury on the convex side washed with alcohol from a wash bottle. After being dried in the water bath the cover is allowed to cool thoroughly, and is then weighed in a balance turning with $\frac{1}{2}$ milligramme with 50 grammes in the pan. The increase of weight gives the quantity of quicksilver in the ore. During the weighing the cover is placed on an empty porcelain crucible. The quicksilver is then driven off by heating the cover gently in the flame of a Bunsen burner or a spirit lamp, in a place where there is a good draught, and the empty crucible and cover are subjected to a second weighing as a check. In order that the assay should succeed the following conditions must be fulfilled:—The cover must fit closely, so as to avoid loss of quicksilver, and must be deep enough to hold a sufficient quantity of water to keep it cool. The iron filings must be free from grease, which would prevent the proper formation of the mirror; the washing with alcohol must not be omitted, as it removes all the bituminous substances which spoil the mirror and assist the drying; drying in a water bath for two or three minutes; cooling in the exsiccator; weighing when fully cool. When assaying rich ores the alcohol used in washing the cover must be collected, as it may contain a little amalgam; it must be poured into the concavity of the cover, which will take up any little globules of quicksilver. The most exact results are obtained in the case of poor ores containing less than 10 per cent.

SCIENTIFIC MEETINGS FOR THE WEEK.

Mon.....Royal Institution, 2. General Monthly Meeting.
Royal United Service Institution, 8$\frac{1}{2}$. Captain Hozier, "The Breeding of Horses for Military Purposes."
Entomological, 7.
Asiatic, 3.

Wed.....International Prison Congress, 8. (In the Middle Temple Hall.) Opening Address by the Right Hon. Earl of Carnarvon.
Obstetrical, 8.

Fri.......Archæological Institute, 4.

Journal of the Society of Arts.

No. 1,024. Vol. XX.

FRIDAY, JULY 5, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

COUNCIL MEETING.

The Council, at the first meeting after the Annual Election, have chosen Major-General F. Eardley-Wilmot, R.A., F.R.S., as Chairman for the ensuing year.

The Council have re-appointed the following Committees:—Memorial Tablets, Ocean Telegraphs, Musical Education, Reduced Rates of Postage, Library, Finance, Drill, Food, Educational Organisation, Technological Examinations, Ships' Life Boats, India, Moscow Exhibition, School Rewards, Silk Supply, and Road Traction Experiments.

The Council of the Society having received a communicatson from her Majesty's Commissioners for the International Exhibition of 1873, to the effect that one of the most prominent features of the Exhibition next year will be the class of "Substances used as Food," under the following heads:—

(*a*) Agricultural products.
(*b*) Drysaltery, grocery, and preparations of food.
(*c*) Wines, spirits, beer and other drinks, and tobacco.
(*d*) Implements for drinking and the use of tobacco of all kinds;

together with raw materials used for all the above-mentioned objects, and the machinery belonging to each class, and expressing a desire on the part of Her Majesty's Commissioners to obtain the co-operation of the Food Committee of the Society of Arts in arranging for a complete representation of the above-named class, and in suggesting preparatory measures to be undertaken for scientific experiments in cooking, have thereupon appointed a Committee for this purpose, specially to deal with section (*b*), the other sections being in charge of separate Committees appointed by Her Majesty's Commissioners, such Committee to consist of all the members of the Society's Food Committee, with the addition of others specially conversant with the various matters included in this section.

TECHNOLOGICAL EXAMINATIONS.

The Conference on this subject is appointed to take place, at 12 o'clock, on Saturday, the 20th of July, when His Royal Highness PRINCE ARTHUR, K.G., has consented to preside. The members of the Society, members of the City Companies, and of the Chambers of Commerce, merchants, manufacturers, and others interested in this movement, are invited to attend. To this Conference the representatives of the Institutions in Union are invited, and the Annual Report of the Educational Officer will be laid before it.

IMPROVED CABS.

The Council of the Society of Arts offer the following Prizes:—

One Prize of £60 for the best improved Cab of any description.

Two Prizes of £20 each for the next two best.

Two Prizes of £10 each for the next two best.

The competing Cabs must be exhibited at the International Exhibition, to be held in South Kensington in 1873, and on their delivery at the Exhibition Building they must be certified to the satisfaction of the Judges as having been in regular use in the streets of London for three months previously. They must be delivered on or before the first Saturday in April.

The Council consider that the Cabs now in use in London are especially defective in the following particulars:—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.
2. The seats in the four-wheelers are too high, not commodiously made, and the space underneath is lost.
3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.
4. The arrangements for opening and closing the window in the Hansom.
5. The confined space and want of ventilation in the Hansom when the window is closed.
6. Imperfect locking of the wheels in four-wheelers.

The Council desire to point out, for the consideration of those likely to compete, that in Continental and some English towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

A suggestion for a cab, to be used either closed or open, has been brought before the Council, and a model submitted. The principle might be adapted to existing four-wheelers, but the Council do not prescribe this model or any special form of carriage; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges may report.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first published subscription list amounted to £351 3s. A further list will shortly be published.

SUBSCRIPTIONS.

The Lady-day subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

INDIA CONFERENCE.

A conference on "Engineering Education in India," was held on Friday afternoon, June 7th, Major-General Vaughan, C.B., in the chair.

The Chairman called upon Mr. Hyde Clarke to open the conference.

Mr. Hyde Clarke—Mr. Chairman and Gentlemen,—One quality that strikes practical observers of India is the great proficiency of its inhabitants in various branches of agriculture, of manufactures, and of commerce. There is, perhaps no more striking exemplification of that than the common plough, the Dacca muslins, and the hoondees or other commercial appliances by which the trade of India is kept up. Now, the plough of India, to an Englishman, presents itself under a very uninviting aspect. It is as rough as it can be. It is made of wood, with very little iron about it. But if we go and look at some of those specimens of Indian implements which we have at the present moment in the International Exhibition, they will, on careful examination, suggest admiration of the way in which the experience of the inhabitants of India has enabled them to apply their resources. As I have said, one of those ploughs is of the rudest construction, and yet, if you look at them, you will find in many of those implements all the elements of those improved implements of English agriculture of the progress in which we are so justly proud. You will find drills in various forms, and every necessary appliance for the economy of seed. When, too, you come to consider what is the nature of the country, and of the people in which and among whom these implements are to be applied, you will see that the very material of the construction is one particularly applicable. If, for instance, you are in that portion of the country which produces very little wood, which has no iron, and no minerals, and where the manure of the country is used up for fuel, it is evident that you cannot have those common resources which you possess in this island. The village blacksmith, who here does the ordinary repairs, and who is attached to every village, sometimes almost to every farm, is a man quite unknown in many districts of India. On the contrary, they are dependent on a travelling blacksmith, whose visits are only occasional. Under these circumstances, such a rude plough as I have been referring to is particularly valuable. If it meets with any accident it can be repaired without much trouble; but if you attempt to introduce the improved English implement you at once place the whole population in a difficulty.

These remarks apply not only to India, but to many other countries of the world in a similar position. In fact the agricultural implements and tools of India are so far superior to those of many other countries in the East, that they might be introduced with very great advantage; and for my own part I do not despair of the ancient influence of India being again successful in many other countries, and becoming a civilising agent for raising them to the level of its own advancement, because, after all, when we come to compare India with higher standards of advancement, India itself naturally falls behind. But India will not always be in this same position. While I have spoken of it in its position of advancement, I have done so with the necessary reservation that it is behind other countries. What is the cause of its advancement on one side, and what is the reason of its backward position on the other? The cause of advancement is one well recognised, viz., that everything in India is the result of thousands of years' experience of progress. Therefore, so far as the individual is concerned, we have the Indian ryot and the artisan of the town, who have in many cases reached the highest degree of progress which it is possible for an individual under the circumstances to attain. We have, however, to consider this, whether after all, when he has reached this degree of perfection, it is not possible for him to obtain something more. This fact certainly strikes us, that whatever are the natural capabilities of the ryots of India, certainly the condition of agriculture and manufactures is not comparable to that of this country or the highly advanced European and American countries. The fact is, that while the ryot and the influences relative to him in the scale have reached this pitch of perfection, it has been simply by individual exertion, and the collective power of the community has not been brought to bear. When you can apply this by means of public works, you alter the whole condition of the case. If, for instance, as strikes everyone in India, any district destitute of water should be supplied with water, you not only improve the means of cultivation, but you improve the means of communication, and you enable the materials to be brought which could not otherwise be made available, more particularly when you introduce improved and quick means of transport in another way, not simply by means of roads, because the roads are only available for short journeys, for a limited load, and for a low speed, but if you can introduce some tramway system, by which you can supply in some districts greater quantities of fuel, if you can bring to bear the coal or peat, or even a better supply of wood from districts which produce it, you enable mechanical processes to be carried out which before were impossible. You get a supply of fuel, a supply of metal, you get different building materials, different road materials, and you get likewise the application of mineral manures in aid of the local supply of vegetable or even animal manures. If you can arrive at such a state of affairs, you obtain a different class of artisans. You give a man appliances by means of which a larger trade can be carried on, and then you come to the point when you can replace the local implement by one of a higher character.

The object which I have had in making these remarks has been, on the one side, to acknowledge that capacity which the natives of India undoubtedly have, but, on the other, whilst we accept that, we must not carry it beyond its legitimate bounds; whilst at the same time I wish to impress upon you that the people of India have very much to learn, and from this country in particular. If India is to obtain development in every branch of its resources, it must be by a very great extension of public works of all kinds, works of irrigation, transportation, and of road and railway intercourse. So far as works of irrigation are concerned, in India is to be found all the experience which is necessary for their construction. There you find large works of ancient date, and there is no reason why India should not be self-sufficing in that respect. Whenever you come to the new mode of transport which has been introduced and extended in these parts of the world, India has to go to another school in which the population have to learn. In fact, everything for such purposes, whether with regard to the men, the plant, or the machinery, must be primarily obtained from this country, and to a considerable extent at all periods. So likewise with regard to all those processes of manufacture which are connected with mechanical undertakings. Why, in fact, should not the populations of India learn from this country? When we come to consider, we find that all the populations of Europe—I may say the populations of the world—have come to this land as the great school for political instruction, for industrial instruction, and for commercial instruction. It is on the model of the institutions practised in this country that the development of a great part of the world has been founded.

If, for instance, we take railways. The railways of France. Belgium, Germany, Italy. Spain. Turkey, Egypt, and likewise the countries in the New World, have been carried out in their beginning by Englishmen; and local schools of construction have been founded on English models, and by Englishmen, and to this day, in many cases. they remain under English superintendence and English instruction. It is, therefore, in the nature of things that India should follow that example. Nevertheless, we do find that there is a feeling amongst some persons in India that the people of India have really reached that point that they are self-supporting, and that they can do without any English assistance at all, and that it is but a right and proper act on their part to prevent any Englishmen from going into the country. It has ever been represented that it is a gross wrong on the natives of India that any Englishman should be employed in any engineering capacity; that all Englishmen should be as far as possible suppressed, and should be replaced by natives in every direction.

It is with reference mainly to that view of the subject that I wish to invite the consideration of the meeting. We hear a great deal about Indians, but the fact is there is no common native race. They are inhabitants of India of various populations, but there is no general mass in the sense or term of Indians. There is not the mass of "niggers" that the vulgar Englishman represents, and as surely there are not the available citizens of a model Indian republic, according to some native representations. There is a want of national cohesion, and we must therefore, in all considerations of this kind, discard all reference to nationality in the sense of European citizenship. It does not exist in India. India is a large quarter of the world, with various countries, with various climates, and populations of diverse origin and diverse habits.

Then, too, we must not deceive ourselves with regard to the capabilities of the individual natives of India. If we take the individual, we may find a man far superior to the average European, enabled to hold his own with the European of high standing; nevertheless, it must be patent to us that the populations of India in the mass do not hold their own against the population of England here, or those portions of the population that we send to India, even after we have made every allowance for the different circumstances. We may test this in a far better way, by putting aside for a moment reference to India itself, and comparing the condition of the English population with some of the highest populations of Europe. We know that as to the Germans, for instance, there is a far higher standard of education in Germany, there is a greater individual participation in instruction amongst many classes of the community and amongst the population at large; nevertheless, there can be no reasonable doubt that the political and even the industrial condition of Germany has not reached the same height as has been attained by the population of England. There is, in fact, in the English population a natural and a trained capacity for political and for industrial and commercial pursuits, from which other nations may learn very valuable lessons. There is this peculiarity of the English populations that I should wish to point out in reference to this subject; whether it is from indifferentism or what may be the natural cause which is operating on our population, it is certainly the fact that we are not so exclusively national as many other populations. If we go into a country, to a very great degree we are ready to attach ourselves to that country, and to identify ourselves with the interests of the population. If we look at it with reference to our own colonies, we may suppose that it arises in these cases from sympathy with people of our own blood; but it is an undoubted fact that if an Englishman goes to a colony, in two years he ceases to regard himself as exclusively belonging to the old country, and puts himself down as an Australian or a West Indian, or whatever it may be, and will postpone the interests of the old country to those of the new. The Englishman, too, who goes to India, feels an interest in India, and will stand up on all occasions to defend what he calls the interests of India. He is often more Indian than an Indian. Even on this subject we have to contend as much with the prepossessions of the English in India in favour of India as we have with the representatives of Indians themselves in behalf of the natives of India.

When we come to the question of railway and other large public works which have been carried out by Englishmen in different parts of the world, we find that, although, in the first instance, they naturally carry with them a staff from their own country suitable for the purpose, yet before long they employ the natives of the country to a far higher degree, and even in preference to a considerable extent to their own countrymen, at all events on a fair and equitable footing. This is an advantage which, as I have said, is a national characteristic. It enables the English in a country like India to assimilate themselves to a considerable degree to the interests of the population, though, as we know, in many cases they may take no interest in the pursuits of the populations, and they may be alien from the mode of thought and the pursuits of the great masses of India. However, so far as the general interests of any community are concerned, you will find the English on the spot, in whatever part of the world it may be, identifying themselves to a very great degree with the resident populations; and no one can say that, in any period of the history of the connection of the English with India, there has been a want of regard or attachment on the part of the English in India to the natives. Certain it is, that in individual cases there may be acts of neglect—there may be acts of brutality on the part of individual Englishmen towards natives, but on the whole, the feeling of the English community in India is one of great and high regard for the country, and a desire to advance its interests. One circumstance which has produced a considerable impression on public opinion with reference to the question of the management of public works, and the instruction and training of engineers and mechanics, has been the waste in the construction of Indian railways, The loss of capital reckoned directly is certainly very considerable. The opinion that states that the railways of India could have been constructed for one-half the amount which has been disbursed upon them, may not be true in figures, but is, perhaps, no exaggeration in the main. I do not speak with reference to any individual line, nor do I wish to bind myself to the gross amount; still, any such general statement does represent the very great degree of waste of material means that has taken place in the construction of these works.

On the other hand, it is true that, in balancing the accounts, no economic loss has been sustained. If we were to examine the whole operation—if we put on one side the number of millions that are as good as thrown into the ocean by totally wasted expenditure, on the other side we shall find that India has greatly and permanently benefited by not simply the formation of the railways and the results that are produced, but in a still greater degree by the new trades, the new modes of manufacture, the new arts, and the new systems of instruction which have been introduced through the formation of these public works. In my opinion, which I maintained long since, and which I see no reason to alter, that waste in great degree arises, not from the company system mainly, not from the adoption of private enterprise in preference to the construction of works under public guidance, but I believe it is attributable to the guarantees having been given to the railway companies of India. When these enterprises were first proposed, persons were willing to have made railways on the same conditions as in other countries, without guarantees. The guarantee system was scarcely known in connection with railways then, but the practice was to construct a railway as a commercial speculation. The Indian government unfortunately over-stood the market. When the railway companies were first proposed for India, there was a speculative period just like that which exists now, and it would have been very easy to have placed the shares of those companies. The government however stood out for terms, and the consequence was that, instead of the railways having been farmed in the ordinary way, the government was forced to give guarantees, the result of which has been that the whole commercial relations have been disturbed, and you have got rid of the real check which would have prevented waste of expenditure. You have had two causes at work to produce it—on the one side the recklessness of persons engaged in these operations, and on the other the want of any proper means of check. You have had some of the sharpest contractors in England, men interested in making as much money as they could, and having all the appliances at their disposal for the purpose overcoming obnoxious supervision, and you have set to watch over them those who have had no commercial training, and who were perfectly unaware of the difficulties with which they had to contend. They have succeeded in obtaining a good construction of the works which they overlooked, but they have been outwitted and out-manœuvred, and they have not prevented, on the whole, that waste which with more intelligence they might have had the means of avoiding.

This brings us to the question, what are the principles on which we ought to conduct and superintend public works in India generally? On the one hand we shall be led to demand high scientific acquirements in the officers entrusted with the operations, because we know that to constitute a thoroughly qualified engineer it is possible to unite a very high degree of scientific acquirements, and, on the other hand, when we come down to the base and root of the operations we find that, after all, they are mainly commercial operations. It is, therefore, the consideration of that state of the question—the commercial—which must guide us to a certain degree in any conclusions at which we may arrive. We may obtain from colleges in this country, or from colleges in Scotland or in India, a number of young men who have obtained by rote and by words a very high standard of scientific emquirement, and yet, at the same time, we shall have obtained men who, from the very circumstance of their being shut up in colleges during the period of their studies, have had no actual contact with the world, and are not therefore in a position to contend with men of lower acquirements but much sharper commercial practice.

We must have, for any purpose such as I have referred to, the construction of works or machinery, engineers, contractors, and workmen; and, however we regard it, the simple scientific part of it is far more subordinate than it is supposed to be. In India, however, as the engineer has to be put in charge of works where all the assistance which is available to him in a largely-peopled country like this, and with all the appliances of progress at hand are not available, he must have such degree of attainment as will enable him to deal to a greater or less extent with every variety of circumstances which may come under his notice. Still, one of his chief functions will be, after he has laid out his works, to watch that those works are properly carried out. Whether he has an English or a native contractor, it is necessary that he or the parties concerned with him shall have such a degree of sharpness in the knowledge of the value and cost of materials and of their application as will enable him to contend with persons who, as I have said, whether European or natives, have the sharpest motives to exert themselves, because they are influenced by the desire of profit. It is not necessary for me to dwell upon the various circumstances which are familiar to those who have to consider the condition of public works in India. New bridges have been built; they have been passed by government engineers, and after they have been paid for, in a very short time they have resolved themselves into their primeval elements, or, perhaps, rather into their artificial elements. Where bricks and stones have been put together, they have appeared to have an outside of mortar, but no cement of cohesion, and they have disappeared before traffic could even be brought upon them. It would be possible even to cite instances of large public works, where bridges have not disappeared by ones, or on a small scale, but where perhaps a dozen works of considerable size have been disturbed without the public having had the benefit of them. There must be something defective in the system of management of public works in India, when we find that such things can take place to a considerable extent. There must be something wrong when conductors and sub-conductors of works, and contractors and sub-contractors, can carry out such proceedings and make money by them, and when intelligent and able officers of the government, well trained and of high principle, can be subjected to such annoyance and disappointment.

Without entering into any consideration of these individual circumstances, or without attempting to place any blame upon officers of any one class, it does become us to consider whether the whole of this state of affairs does not arise from not availing ourselves so fully as we might of the real experience of our own country, but by attempting to give it the go-by, and starting schemes of schools, colleges, and departments, which have not worked in this country, and which, it is to be feared, will bring disappointment and disaster in their application to India. If we really are to obtain practical improvements and public works in India, it must be to a greater degree by taking advantage of what I may call the living sources of enterprise—of commercial experience of the country. Of course, commercial experience is not used here in the sense merely of a merchant, but with regard to those persons connected with the outlay for public works who have to regard the profit—the pounds, shillings, and pence—as well as that of the simple production or application.

I have already referred briefly to the circumstance that it has been claimed quite recently that the natives of India should have, as a right, the distribution amongst themselves of the taxation of India that may be applied for engineering employment or for government service in connection with the public works. I should like to hear a little about the rights of the natives of England in such matters. It has been by means of the natives of England that India has been supplied with these works, which are doing so much, whatever may be said, for the advancement of India, by promoting the intercourse between the various classes of its population which will lead to their real amalgamation. There should be some regard, therefore, for the rights of the natives of this country, who, having planted the vineyard, should assuredly be allowed to some degree to partake of the fruit. There is no necessity, as we may know by experience, to apply any artificial or preventive check to prevent too great a number of Englishmen being employed in India.

Under ordinary circumstances they cannot be so employed. An Englishman, being a stranger, placed under different circumstances from those in his own country, whether in India or in Brazil, must be paid at a higher rate, and cannot under equal conditions compete with the natives. The native will always have an advantage over him, and we shall find, if we give fair weight to the commercial considerations that I have referred to, we shall obtain in all cases positive value for the money we lay out, and the end will be that the English element will be used for the purpose of giving instruction, and the natives of the country will, in the course of time, be employed to a greater and greater extent, precisely as more and more Englishmen are employed. The principle I have endeavoured to maintain on several occasions has been that India should be allowed to avail herself to the fullest extent of the great advantages which she enjoys in connection with a country which has reached a high state of progress, which has an honest desire to promote the welfare of India, and by means of which alone the development and true advancement of India can be obtained.

Mr. E. Chadwick said that there could be no doubt that the administration was loose in principle which guaranteed payments without due security for results. He had no direct knowledge of Indian public works, and could only speak of them from the information of those who had. He knew, however, that formerly the education of the Royal Engineers in England was defective, as being too exclusively in abstract science—in science abstract from practicality, in respect to cohesion, density of substances, friction, &c. Some of their first bridges might have failed,—as had the iron bridges of the French Corps de Genie, from such defects. Others had been swept away by extraordinary torrents, such as did the like sometimes in this country. The royal engineer was placed under disadvantages in India, that he had not, as the civil engineer had at home, his bricks made for him; he must often make them himself, or teach the natives how to make them, and make his mortar too. He had not his trained contractors ready for him, nor his special official sub-officers—practised hands—but had to do everything himself. He was, too, commonly miserably scrimped for money and means, which the civil engineer in this country was not,—to meet unforeseen conditions of slippery foundations, and had often to see great waste of his work from its being left half finished, by the default of the superior financial administration in giving the money for completion according to estimates. With these difficulties taken fairly into account, the amount of success of the corps, and even their comparative economy, would be found to be honourable to them. Be their defaults what they might, however, it was an immense error to assume, as might be implied from the paper,—that there was either safety or efficiency, and economy, and security, against waste, in rule-of-thumbism or empiricism as against theoretical science. Had not iron railway bridges failed fatally in this country? Had not tunnels collapsed? Had not one railway viaduct, constructed by one President of the Civil Engineers, tumbled down in France? Had not there been great loss of life and property from the giving way of great reservoirs, for the more safe construction of which lessons might have been had from India? Had not railway tunnels collapsed? Had not a custom-house and a theatre in our time in London fallen down? The fall of a church tower built by a royal engineer in India excited a great sensation; the fall of a church tower in his own parish, built by an eminent architect, excited none. On the whole, if the works of officers of science—of the first abstract science—and of the desk, were all compared in their results with those of men of the rule-of-thumb, and, what was vaunted more, of men of the wheelbarrow, the failures of the latter, and of civilians in general in this country, would be found, he believed, to be largely preponderant. So frequent were the failures of one sort or another in London that he had proposed to the principal of a college of civil engineers at Putney that they should be made the subject of regular study by the pupils, for whom they should be made the subject of *post-mortem* examinations, and of clinical lectures, as it were, on the spot; and this was begun, and would have been continued had the college continued. As to waste, he could, as respects sanitary works, speak directly from his official dealing with them all over the country, and from having been driven, for the sake of the people, to require, as far as might be, that three towns and three houses should be drained at an expense heretofore incurred for one. It was a matter of history that George Stephenson had estimated for the sewage of Carlisle at seventy thousand pounds, which Mr. Robert Rawlinson better executed for twenty. Robert Stephenson, with others, estimated for a metropolitan sewer, the Victoria-street Sewer, at sixteen thousand pounds, and it cost upwards of one hundred and twenty thousand pounds, and was now little better than an extended cesspool. Had the redrainage of the fifteen hundred miles of streets and thoroughfares of the metropolis, on the principles of the self-cleansing sewers, established by the first General Board of Health been duly carried out, the expense would not exceed a million-and-a-quarter. But the intercepting sewers alone had cost upwards of four millions, and the river had not been purified or the death-rate lowered. The General Board of Health had had to force a reduction of the estimates of one President of Engineers by more than one-half. This was necessary to be done for the sake of sanitary progress, the great impediment to which was expense and and waste; but it did, as was foreseen, excite great odium in Parliament as well as out. In all respects it was a thankless service. It was, however, in the spirit of an old rule for the Royal-Engineers, which should be required to be regularly applied, and made general. It was this—that the name of the officer who had devised a work should be engraved on a plate and affixed to the work, and on that plate should be stated the amount estimated, and the actual cost. It was our duty to give to India the practical science of the West, and especially to avoid transplanting the evil and the waste of the West, for the people were poor. In that view he had submitted a paper of warning, derived from his experience in sanitary works in England, which the Home Government had transmitted to the authorities in India, and directed their attention to it. Certainly there was now better education, better practical preparation and promise for the future of India, though vigilance should be sustained for performance. We had already done more for it than any other conquerors had done. We had given it railways; we had started the improvement of water communication; we had began model works of the storage and distribution of water by irrigation, which did the military engineers great credit. We had introduced tea and coffee, and indigo, and other cultures. We had made a commencement of telegraphic communication, and with due support the agitation commenced by the Council for lower telegraph rates and complete stations for the ocean cables, would save weeks and months of time, would speed its production and commerce, would bring it in closer relation with the home government, and speed and save, by more full and free communication, the growing waste of highly paid service by the long delays to which India was now subjected. We held that country now by a quarter of a million of war force. By holding it in peace from internecine wars we saved it the burthen of some three millions of war castes. The relief from that burthen should afford means for the improvements of its cities, and for the extension of well-devised productive works, with which our improved engineer officers, obtained by competition, would be most productively occupied for the advantage of India.

Colonel Wragge said that there was a new field now opening for civil engineers in India. It was evident that the whole system of railway construction could not be continued on the old plan. Taking into consideration the enormous increase of the cost of raw material and working expenses for permanent way, and the fuel for the locomotive, it would be found that, though we had constructed 10,000 miles of railway at an average cost of about £17,000, and that the interest had been about 3½ per cent., with the rise of prices the new lines about to be constructed would cost a much larger sum per mile, and would return less interest. Consequently, there would be a much greater demand on the nation to pay the guaranteed interest, and therefore he thought it would be beneficial if the government would turn its attention to the development of the native resources of India. There were large deposits of coal and iron known to exist, and though they were talked about, that was all. Some were in close proximity to railways, only requiring a small branch to lead to them. The iron had been much neglected, and one company, which was formed for working it, did not, he thought, get that assistance from the government which they ought. There were other deposits in Central India, which would need great assistance to develop, and he believed that mining engineers would find a very successful field for their operations, if government would only utilise the native resources. When it was considered that the advance in coal must necessitate a rise in the price of iron—for every 1s. per ton of coal represented an increase of from 17s. to 20s. per ton on iron—he did not see how the additional railways which India required could be constructed without utilising her native resources. The iron market was going up week by week, and it was understood that not sufficient coal could be brought into the market to smelt the iron, and even the iron ore had to be fetched from Spain. It did not seem likely that a small country like England could draw so largely upon its resources to supply a great extent of country like India without being considerably straitened at home, and therefore he hoped that not only the iron but also the coal and peat deposits of India would be utilised, for what she most wanted was cheap transport, and that could only be obtained by cheap fuel. Under the present system there were 4,000 miles of railway opened this year more than there were last, but the traffic receipts were £50,000 less, and if the scale of 1869 had been kept up, there would have been a million and a-half more receipts for traffic than there had been. That did not tend to show that cheap transport was provided.

Mr. Botly said he could quite agree with what had been said by Col. Wragge with regard to the cost of coal and iron, for a short time ago, when looking over an estate in Suffolk, he came to an enormous clink, which he was informed marked the spot where iron smelting had formerly been carried on when wood was cheap, but the trade had been driven to the north by the scarcity of fuel. It seemed a question now whether the expense of coal would not even drive it away from there. He had also seen in Sussex a plough with a wooden mould-board and turn-furrow, showing that they had been in use not many years since. Mr. Hyde Clarke was quite right also in insisting on the importance of there being a blacksmith in every village. Many of these were exceedingly good artisans, and he had known one able to modify a plough very cleverly, so as to adapt it to the particular character of the soil in which it had to be used. He concluded by moving a vote of thanks to Mr. Hyde Clarke.

The motion was seconded by **Col. Wragge**, and carried unanimously, the Chairman, in putting it, expressing his regret that the attendance was so limited.

Mr. Hyde Clarke said he had but little to reply to, because he had fully agreed with what Mr. Chadwick had said. He by no means proposed that the rule of thumb should be substituted for science, nor did he doubt what the consequences would be in this country or any other from men undertaking works which they were incompetent to perform. But what he did wish to point out was, that the officers who superintended the works should be really capable of understanding the commercial conditions with which they had to deal as well as the scientific. A picture had been drawn of the failure of works in this country, particular allusion having been made to Mr. Robert Stephenson, and no doubt the list could have been largely extended. But on the other hand he believed he could have pointed to instances in India much more gross. The cause of failure in each case had been the same, men had been called upon to do more than they were able to carry out. Mr. Robert Stephenson was one of the leading engineers of the day, and he was called upon to do all kinds of things which he had no proper time to consider. He did his best, no doubt, under the circumstances, but it was not very wonderful if his views were not confirmed by experience. In India the same causes had been at work; men who had had a special training, and had been engaged in special studies, were called upon suddenly to supervise works with which they had no acquaintance. For instance, men were appointed to superintend railway works who hardly knew what a railway was, and who came over to this country on special leave, or employed part of their time when they were on furlough in learning something about them. He was very nearly referring to the case which Mr. Chadwick mentioned, of a distinguished officer being sent to Italy to study the irrigation works there, and his report was of very great value, but at that time it would have been of far greater service to have communicated an account of the old works in India, as was done at a later period. With regard to the cost of railway construction, it was quite true, as Colonel Wragge had remarked, that iron was rising in price, but that was no new phenomenon, it had happened over and over again, and there were several very remarkable instances in the early history of railways in England, where men who had made a conscientious contract, found it entirely disturbed by the rise in materials and wages. These operations were periodical, and happened under natural economic laws, and India must pay the price of her railways the same as all other countries. It would not, however, follow that there must be any disastrous result, because Colonel Wragge had left out one important part of the question, viz., that while in England the rise was temporary, consequent on speculation, in India it was permanent. In India not only must all materials rise in price, but all upon which the price of materials depends. It might happen that, after iron works had been opened in India, an advance in wages might turn the balance in favour of England, as Mr. Botly had referred to the interchange of the position of the iron manufacture, which had left the south of England, and gone to the midlands and the north. These operations were always going on, and it was difficult to form any decisive judgment whether advantageous or dangerous consequences would result from a rise in prices. It was impossible to legislate for circumstances which were the consequence of natural economic laws. The only wise course, as Mr. Chadwick had said, was to carefully observe results, and take advantage of experience.

CANTOR LECTURES.

MECHANISM.

By the Rev. Arthur Rigg, M.A.

Lecture III.—Delivered Monday, February 19th, 1872.

If we refer to what may be deemed an ever present characteristic of continuous motion communicated by rolling, it will be seen in this, viz., that the curves used were of that class which returned into themselves. They are, in fact, completed curves, or portions of curves that may be completed, obeying a decided and a clearly expressed law of formation as well as relation to each other. And we may notice further, that the shafts or axles on which these rolling curves are fixed, rotate. There is no other motion transferred by pure rolling than such as is expressed by the word "rotation." Some may say that motion communicated to a straight rack is a case of rolling, and that is not rotation. Practically it is not rotation; theoretically it is; for a rack is a straight line, and in the theory of mechanism straight lines are assumed to be the circumferences of circles with centres at infinite distances, for straight lines are really circles with infinity for a radius. Further, if "rolling" mechanism be examined, it will be noticed that the driver and follower are so connected that the precise extent of motion of the driver is of necessity transferred to the follower. In perfect rolling contact there is no escape from that law. The angular velocity, or the velocity of the shafts, may vary, but the length of the path of a point in the circumference of one wheel must be exactly equal to the length of the path of a point in the circumference of the other wheel. Bear in mind that there is a distinction between the angular velocity or the velocity of the shafts and the extent of travel of a point in the circumference of a wheel keyed on a shaft.

Further, the pathway in which the motion may be said to be transmitted is always in the line joining the two centres of rotation. The curves in contact move, but the pathway of communicated motion does not move. Remember, we are speaking of *pure* rolling contact. In this example of two wheels in rolling contact, the pathway in which motion is communicated is a line joining the two centres. As soon as the touching parts of the circumferences have left that line, they have left the pathway of communicated motion and ceased to communicate motion from the driver to the follower. The point in the pathway where the contact takes place may move. It may vibrate, as it were, in a line joining the centres of motion of the shafts, as in elliptic and excentric wheels, or it may be fixed, as in circular wheels. But in all instances of pure rolling contact motion, equal lengths of the two contact surfaces cross that pathway in equal times.

Now, however, that motion is to be communicated by *sliding*, the relations between the moving pieces are very materially modified. Not only may the direction of the pathway in which the point of contact travels be ever varying, but the very idea of peripheries or circumferences rotating about the centres to which they are related, by some re-entering law of curvature, vanishes. In rolling contact motions there are always peripheries; in sliding contact motions one or both of those peripheries disappear.

Let us see, then, how this preliminary alteration of affairs affects the mechanician in the case of rolling circles, ellipses, and lobe-wheels—by lobe-wheels are meant wheels based upon such figures as squares, with curves and teeth upon them (see Fig. 9, Lecture II.), of which there are some very beautiful photographs on the wall, well worth close inspection. It is cause for regret that, so little is mechanism appreciated as a study in England, that neither private enterprise nor the authorities in scientific museums have either exhibited or are possessed of copies of the originals from which many of the numerous photographs of mechanism in this room have been taken.

In the case of rolling circles, ellipses, and lobe-wheels, the velocities communicated depend on the ratio into which the point of contact divides the line connecting the centres of motion. This principle is applicable in all motions of pure mechanism. And there is a second condition. The freedom, perfection, and accuracy with which motion can be transferred are dependent upon the permanence of the line of direction in which the contact surfaces convey it. If the line of direction by which the motion is communicated varies, then accuracy in regard to the relations of the motions ceases. If the point is always in the same position in this line, then the velocity ratio of the shafts is constant, that is if, for example, one shaft makes ten revolutions, the other will make twenty; but if that point moves, the proportion of ten to twenty, or constant velocity ratio, fails.

You will find in this model (subject to the irregularities attendant upon all practical illustrations of pure rolling mechanism) there is on each wheel a piece of coloured paper, and as the wheels are turned round you see that these pieces come together again as at the first. The velocity ratio between the two is therefore constant. That point does not move. If however, we take the case of these elliptical wheels (Fig. 11, Lecture II) and bring them into contact at one point, you will observe that whilst the communication of motion by the rolling of the ellipses is perfect, the space passed through in that circumference and this circumference is the same. Equal travels have taken place in these elliptical wheels as regards the circumferences, but variable velocities in the shafts on which the wheels are keyed. Take for example these elliptical wheels, and see how the velocities of the shafts vary. There is a circle representing a section of the shaft divided into thirty parts. At the present moment the pointer is pointing to zero. While the wheel has gone half round, the shaft ought, according to the ordinary law, to have completed one half of a rotation, but you will find it is not so. The shaft has passed through twenty portions of the circle, but the other half rotation of the wheel takes the shaft through only ten portions.

Now, in these elliptic wheels without teeth, so long as pure rolling takes place, however varied may be the velocities of the circumferences of the cylindrical shafts, the circumferences of the wheels passed are equal. There is no evasion of that law; but assume they are in such circumstances that they are unequal, then one of the surfaces must have slid past the other. A sliding motion has entered into the mechanism which was not provided for at all. Perfection of workmanship and indestructibility of material can alone prevent a partial sliding in the very best of illustrative rolling contacts. What therefore cannot be averted must be accepted. Hence we must recognise rolling contact motions in connection with the motions consequent upon sliding, and we must therefore endeavour, as far as possible, to enlist the *necessary* sliding contact motions to aid in the promotion of rolling contact motions, the object being to impose an immutable law upon two pieces where one causes the motion of the other. As, for instance, in the case of clock-hands; if the minute hand did not move by an invariable connection with the hour hand, the clock would be very delusive. Since there is to be an immutable law between the two pieces, therefore, the uncertainties of sliding must be eliminated, whilst the presence of sliding must be recognised.

Now, put a piece of wood upon this rolling circle, and a pin or tracing pencil on the other; let the circles roll as before, and the pin mark a line upon the wood. Cut the wood to this line, and instead of the wheels rolling let arms from the centres carry the pencil-traced curve and a pin against its edge. The pressing and *sliding* action of the curve on the pin will cause the shafts to move as the *rolling* of the wheels did. Mathematicians can show the identity of the motions, and that they are the same as though communicated at the point in the line joining the centres. Were it not so, the preordained law of velocity-ratio would be broken.

The condition to be satisfied is that the motion be communicated exactly at the required point, and at no other.

The mechanician, or rather the mathematician—for we are now entering into that province which is forbidden ground, since the problem in this phase belongs to the mathematician—must determine the shapes of curves which may replace these rolling circles, the circles being entirely taken away; which curves shall so move in sliding contact that the line of pressure shall always intersect the line joining the centres of motion in the same point, or in a point whose law has been previously ordained. In the case of those elliptical wheels there is a law, and the point is continually varying. In the case of the circular wheels there is another law, and the point is constant. Although now trenching rather more on the province of mathematics than was originally intended, the conclusions to be drawn are so essential to the perfection of mechanism that a description of the principles which govern these conclusions must here be introduced.

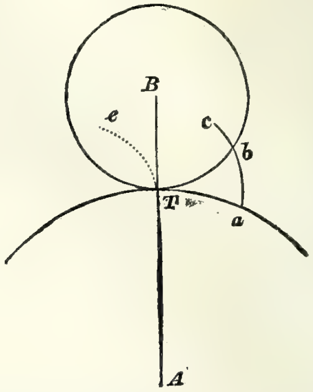
Let us see why to use pure rolling contact for the communication of power is little more than theory, but to use it for the communication of velocity is practice, as those who were here on Monday last can testify. We had then the case of pure rolling contact for raising heavy weights; and if any of you go into the room at the Arsenal at Woolwich where large timber is sawn, and ask to be taken below where the driving machinery is, you will see a large circular saw—to the best of my recollection four or five feet in diameter—the rotation of which is accomplished by pure rolling contact. The saw is supported upon a simple shaft resting on two bearings. It is driven by two cones pressing against it. The cones have leather surfaces, with which they grip the saw, causing it to rotate, and in this case a high velocity is accomplished by pure rolling contact, and is utilised in the cross-cutting of balks of timber.

Teeth on curves, or, as we usually call them, on wheels (although all curves can be made into wheels), are now the accepted mode for the communication of such motion as would take place if the rolling was perfect.

Let us see what should be the form of the teeth or curves, and how these teeth act and re-act upon each other.

There are four recognised modes in which a near approach may be made to a faithful reproduction of rolling contact by a process of sliding.

Fig. 13.

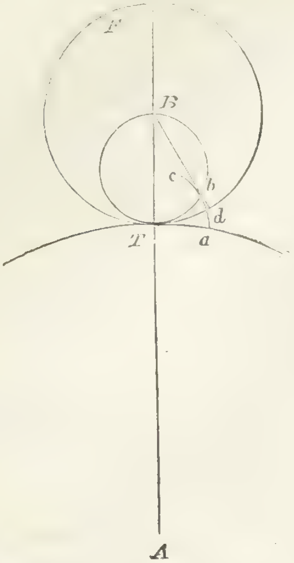


In Fig. 13, suppose that A and B are the centres of two shafts, then A B will be the line of which we have so frequently spoken as that in which is the pathway for the communication of motion from one wheel to the other. If the point, T, at which that motion is communicated from one to the other is invariable, then the relations between the velocities of the two shafts will also be invariable.

Suppose the circle and portions of circle to be the wheels keyed on the shafts, then one mode of determining the form of a contrivance for conveying motion from A to B by sliding, similar to that conveyed by rolling, is thus. Let there be at *b*, in the rim of the circle round B, a pencil-point, and suppose a sheet of paper to be gummed on the back of the wheel round A. Then, with the pencil point at *b* resting on the paper, and *b* being at *a*, and the circle round B be rolled freely like a wheel up the hill from (*a*) to T, then the pencil point will trace the line *abc*. Now, suppose a piece of wood to be shaped like *a b c*, and to be attached by an arm to move round A, and suppose an arm to be fastened to move round B, and to have a pin in it where the pencil, *b*, was. If, now, the arm with the curve (*a b c*) be placed so that *a* is at T, and if the arm with the pin *b* be placed so that *b* is also at T, then if the arm with (*a b c*) be moved, pressing forward the pin, *b*, it will be found that the pin will so slide up the curve, *a b c*, as to reach "by sliding" the exact point, *b*, which it would have reached, had the circular wheels "rolled" truly upon each other.

If, now, we increase the number of these curved arms and pins, or if we remove the rolling circles and put on others, which, not touching, carry curved arms and pins, then the one will be a wheel with the requisite number of teeth, each curved as (*a b c*) and the other will be a pin or lantern wheel, such as has been previously referred to. These pins are well and good for producing motion, but they are very much like a steam engine which looks very well and very pretty so long as it has no work to do, but as soon as you put it to work there is a breakdown. If you put work upon these pins on wheels they will very soon break down. Prior, however, to a rejection of a scheme of teeth and pins, which has some very commendable features, the mechanic endeavours to avail himself of the labours of the mathematician, by strengthening the pins by means of end framings. Thus the pin-wheel becomes a "lantern" or "trundle" wheel. (See Fig. 6, Lecture II.) It is, however, desirable to try if we can find some substitute for the pin, or some other contrivance. Hence the mechanic has again to apply to the mathematician. The mechanic says, "I want something stronger than a pin;" and the mathematician says, "then you must put a line there." He adopts a process which Fig. 14 may serve to illustrate, as a second stage of development.

Fig. 14.

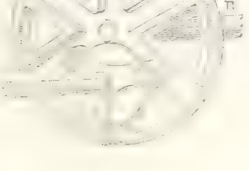


Assuming the explanation which has been given with the former figure, instead of the circle round B rolling as a wheel on that round A, let a circle whose diameter. T B, is the same as the radius of the former circle, B, roll up B T, the curve traced on the paper will be the one, (*a b c*). Putting the curve (*a b c*), as before, to an arm movable about A, the mathematician could easily show that if this arm has to produce the same effect upon the circle, F, as in the former case was produced upon the circle round B, it will be requisite to do away with the point or pin, and instead thereof to put a straight arm, (B *b d*). With such an arrangement the mathematician informs us that the sliding of the curve along or touching the straight arm (B *b d*), in the passage of the wheel on A from T to *a*, will communicate the same motion to the shaft, B, as though the two wheels on A and B, in Fig. 14, had rolled perfectly on each other.

Here (referring to a model) are two wheels constructed upon this principle, and it is easy to see that what are usually called teeth are, in the one wheel, radial straight lines, and in the other, the curve of which we have been speaking, the motion is free and satisfactory, and it possesses a peculiar property in reference to the numbers of arms and teeth, as this model illustrates.

Recognising, as all must do who consider a general audience, that mathematical demonstrations, however divested of technicalities and complexities, appear "dull, stale, flat, and unprofitable," no apology is needful for interrupting the sequence of reasoning on which the true forms of teeth on wheels have been developed. Let us do so to turn to this interesting model possessing peculiarities which these demonstrations explain.

Fig. 15.



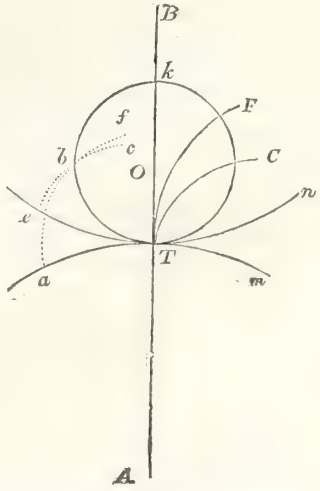
The wheel on the shaft B, Fig. 15, has on its face six radial grooves; on the shaft A is a smooth-faced pulley, having three pins at equal circumferential distances on a circle whose diameter is equal to the radius of the grooved pulley on B. On each of these pins is a small roller, fitting or nearly fitting the grooves. If now the shaft A be rotated, you may notice that each roller slides backwards and forwards in its diametrical pathway, and it is interesting to watch how equable is the motion and how neatly it is transferred to the grooved wheel and shaft B A, from roller after roller. The velocity ratios are such that A makes two revolutions whilst B makes one. Four radial grooves and two pins produce the same velocity ratios.

Two applications of this motion may be named. One is to compel a polished bead placed on the top of one of the pins to describe a straight line. This bead thus moving causes a reflected light, as that from a candle, to appear as a straight line. Thus from two or more lights are formed two or more straight lines. Hence the intensities of the lights can be compared, and the instrument becomes a photometer. Another use of this motion is to obtain what, by a misnomer, must be called "a parallel motion;" the end of a piston being attached to one of the pins will, of course, be guided in a rectilineal path.

It will be observed that the two methods already suggested for making available the principle of sliding to accomplish the results of pure rolling, are applicable only to wheels of the sizes for which the calculations have been made, and working in one direction only. It is very desirable that rotation in either direction may be communicated, and that either one wheel or the other may be the driver, and that they may run freely when geared with different sizes. If, then, the mathematician cannot provide for the mechanician and the mechanic some principle of more varied application, and enable him to use wheels with teeth made so that of an extended set any two may be put in working gear—if this cannot be done, the complexities of wheel-work would almost be a bar to the use of it.

These considerations led to a generalising of the principle hitherto described. In Fig. 16, (T *b k*) the circle which rolls upon (*a* T *m*) is taken of a diameter smaller than the radius T B. Let it roll on (*a* T *m*) from T to *m*, and describe the curve T C. Instead, now, of taking either a pin or a radial line, let the same circle (T *b k*), roll in the inside of (*n* T *c*), then will the point, T, describe the curve T F. If, now, these curves be the shapes attached respectively to the shafts, A and B, they will (mathe-

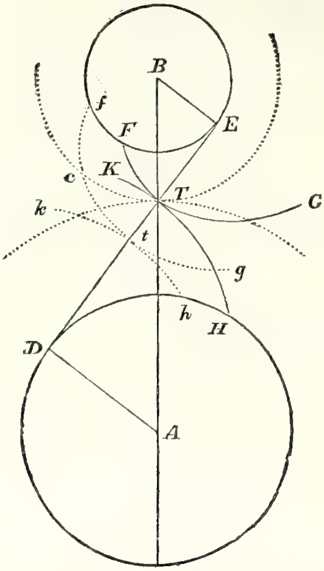
Fig. 16.



maticians tell us) communicate the required motions, even though the sizes of the wheels on A and B be variable. This gives that extensive generality to the construction which enables mechanics to keep wheel patterns and wheels within a moderate number.

The previous explanation of the principle upon which the most accurate system of teeth for a specific purpose can be formed, admits of only a slight deviation from perfect workmanship. There is another plan very generally adopted, which proceeds upon a different view of the relations between the driving and the driven wheel. Fig. 17 is intended to explain this method. The dotted circles touching at T represent what would be the circles if perfection of rolling were practicable. D H and E F represent other smaller circles or wheels. Through T draw, E T D a common tangent to D H and E F. Let us suppose T D to be a piece of string having a pencil at T, and we proceed to wrap T D round the rim of D H, the pencil would trace the curve, K T H. Transfer the pencil to the end, T, of E T, and wrap round the rim of E F, then will the curve F T G be traced. Teeth formed with these curves, and placed upon wheels fixed to the axles A and B, would cause these axles to move as though moved by the one dotted circle rolling on the other. Wheels formed upon the curve named in the first two methods (Figs. 13, 14) are said to have epicyclic teeth; those in the third method (Fig. 16) are called epicyclic and hypocyclic teeth; and those upon the last method (Fig. 17) are called involute teeth.

Fig. 17.



The explanation now given will to many appear deficient. For example, it is wanting in any attempt to show that the line in which these sliding surfaces transmit the motion is a line which always passes through the point T. To show this involves a property of the curves used, and, as mechanicians or mechanics only, we must accept the mathematician's statement that it does so. Should any one present desire to follow out the inquiry, he may refer to Professor Willis's "Principles of Mechanism," or to Professor Goodeve's "Elements of Mechanism," both published by Messrs. Longmans.

One difference between teeth formed upon the epicyclic and involute principles may however be stated. The action of epicyclic teeth when crossing the line of centres A B, and therefore when in the act of transferring motion, is always, at T, perpendicular to this line of centres, A B, whereas the action of involute teeth is always in the direction of the common tangent, as D T E, Fig. 17. Hence, owing to the great strain this oblique pressure puts upon the shafts to which the wheels are keyed, the latter (viz., involute teeth) are not adapted for the transmission of pressure or the communication of power. For modifying motion, or the simple communication of velocity, involute teeth are valuable. They have, too, this further advantage, the tooth of one wheel may be made to touch both back and front of the other. Suppose two wheels thus perfectly made, then, by a very slight increase of distance of the centres, there will be a sufficient space and clearance, and so that which is sometimes wrongly called "backlash," will be reduced to a minimum. Hence, too, with involute teeth, what the microscopist calls "loss of time," is not a serious inconvenience to these workers in a field of science where "time" is so valuable that none can be spared for the tolerance of what the mechanic generally considers to be necessary, safe, and inconsiderable.

Such being the principles which govern the formation of teeth in general use, and as wheels are employed in all extremes of varying velocity, an inquiry naturally arose at a very early date—what is the size of the smallest wheels in any system which shall ensure that a second tooth is coming into position before the acting or driving tooth has quit contact, and thus that jarring or shaking be obviated which occurs when there is a sudden transfer of the source of motion? Such, in fact, as may be illustrated by the periodic brightening of a gas-flame when the mechanism of a gasmeter is not well arranged and balanced. The mathematican answers the inquiry thus:—

The least numbers which can be safely employed

Of involute teeth are	25
„ epicyclic „	12
„ cylindric teeth, or pins	6

Pin-wheels, as deduced in Fig. 13, ought always to be followers and never drivers. The reason is very simple, and may be illustrated in this way. If you take a stick and draw it backwards, with the end resting on the ground, you can do so easily, but if you attempt to push the stick in front of you it is continually being shaken or stopped. In other words, if the stick be drawn towards the side on which it makes an acute angle, the following is smooth and easy. If the motion is towards the obtuse angle, such is not the case. It is the same with a pin in a wheel.

In Fig. 13, suppose B is driving A, then the pin would come in contact with the tooth (*c b a*), and in order to turn the wheel, A, it would have, as it were, to rise up the hill, from *b* to *a*, of this tooth. It would have to do with the tooth, practically, what you have to do with the stick when you push it forward over the rough ground, and the resistance so met would produce a constant jarring; whereas, if the pin slides down the tooth, as when A drives B, there is that sliding motion which is characteristic of toothed wheels, enabling the engineer to attain to perfection of rolling contact.

So much for the teeth of wheels. Those teeth slide on each other, and we have therefore a motion communicated by sliding only.

It is obvious that, whilst we have been forming these and similar curves, and taking portions of them for teeth, we may continue them, and it is possible we may find such continuations useful in their character of sliding surfaces. They re-appear in that character, and receive the name of cams. A cam consists, generally speaking, of a curved piece, which conveys motion to a pin or to another curved piece. Here is a curved piece, in which *a* is the centre of motion. Observe, the pin is connected with a bar which is capable of being slid between two parallel guide-pieces. If, now (referring to a model), this curved piece went round in that direction, it would raise the bar between the two guides, but if the curved piece came back again it would leave the bar at the point to which it had been raised. Place, however, a curved piece on the other side, and by that means the bar would be brought back. That is called a constrained cam. There is one on the table which forms a complete revolution, and, when turned round, makes an arm move backwards and forwards with a velocity-ratio determined according to any prescribed law, which may have been embodied in the form of the groove. The curved cam may drive a shaft, or it may move an arm, or the same cam may be applied in another way. If the curve forming a cam was passed round on a flat surface, it would form what is called a flat screw-wheel. It may also appear in another form, and this form is a very instructive one. Here is a piece of board, about the size of a page of the *Journal of the Society of Arts*. There is through the board a groove which passes as from the bottom left-hand corner of one column to the top right-hand corner of the same column. Let there be a pin in this groove, and let it be fixed on a bar constrained to move parallel to the lines on the page. Suppose the grooved wood to be slid for its whole length parallel to the binding of the volume, then will the end of the bar have travelled the breadth of a column of type. In this is a straight-line cam, and it is one of a very old form. It seems to have passed out of use for a long time, but has been re-introduced. If you put it round a cylinder it becomes a screw. In certain processes the screw is not conveniently available, and there are two cases known to many of you in which this flat or inclined plane cam is used for the purpose of generating screws—in the case of rifling guns, for instance. The rifling down the gun is a very long kind of screw, similar to the one on this old Chinese cotton gin, and that rifling is obtained by the use of this straight cam. In the fusee barrels of watches and clocks, the screw that takes the chain is also obtained from the straight cam. You have this same straight cam in the Archimedean drill.

As was said just now, motion is given to pins or bars by means of these cams. It is easy to see that if one pin is not of sufficient strength two may be put side by side, or three, or four, until at length you reach the form which ultimately developes into half a nut, and that half nut is used in Sir Joseph Whitworth's lathes, and is the mode by which the cutting tool is adjusted upon the lathe, the half nut being used because it can at any time be lifted out of gear so as to allow the slide-rest to go rapidly back. We may multiply or increase the length of this half nut and diminish the length of the screw, and we then reach the rack; for as the nut increases it extends into a rack, and the screw works upon the rack, causing it to travel. We may also curve the rack round a ring, as in Fig. 19, and then it becomes what we call a worm-wheel, and we get the ordinary worm-wheel motion. This mechanism, therefore, has altogether resulted from a straight slit in a board moving on a plane, simply by throwing the elementary parts upon curved surfaces. The screw may take two forms, so as to work either from right to left, or from left to right. In this piece the screw or worm is revolving on a shaft in a horizontal direction, and it communicates motion to a shaft at right angles to itself.

FIG. 18.

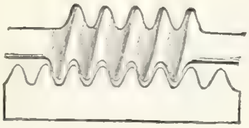
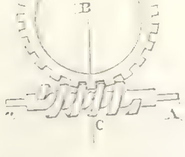


FIG. 19.



We found the same mechanism in that old Chinese churka, or cotton gin; it is very oddly made, and of very rude construction. In it are two screws, viz., a right-handed one gearing into a left-handed one, acting as if they were toothed wheels, and so causing two shafts to rotate parallel to each other.

This worm-wheel motion appears in a variety of forms, and it is generally employed in reducing speed; for one revolution of the shaft only allows one tooth of the wheel to pass. You may remember it in the crane kindly sent from Crewe. There was a very high velocity, which had ultimately to be very materially reduced; and the latter part of the reduction was by means of one of these worm wheels. This is therefore a mode of converting velocity into power. The perfection to which these screws have attained is very great; so great that practically what we have hitherto called "clearance" is dispensed with.

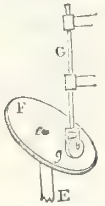
This is one of Mr. Whitworth's standard measuring instruments. We have a screw *perfectly* made, working in a nut *perfectly* made; that is, as perfect as hands can make them. There is a certain number of threads upon the screw, say 50 in an inch. If, therefore, this wheel, which is divided into 100 graduations, be keyed on the end of the screw, it would divide one inch into 100 times 50 parts, which would be 5,000; so that one of these divisions on the wheels would indicate $\frac{1}{5000}$ of an inch. The manufacture of the apparatus is so perfect that it is capable of dividing an inch into 10,000 parts. It is used for the purpose of determining gauges, and is a case of cam motion applied as a screw.

These cams are also employed in another way very different to that, and here is a Swedish machine intended to represent some of the phenomena of light, heat, and sound. It consists of three rows of levers, which at one end work in a series of cams on rollers, and by turning these cams the wave-like motion which you see is produced.

This is another very useful development of the same thing. Here you have the mode by which the thread is laid on the bobbins in cotton spinning. You will find the pin which originated the nut in this case is one only, but extended to a flat piece, and the grooves of the screw are so arranged that there is a return motion which gives a varying direction to a bar.

Here, again, is another which differs both in form and name. On turning a handle at E in Fig. 20, the upright bar, G, remains steady,* but by changing the angle of this plate, F, an up and down motion is produced. This is a cam acting parallel to its axis; it is called a "swash" plate.

FIG. 20.



In this machine, Fig. 21, are the arrangements by which gold and silver coins are weighed before being issued from the Mint. It is upon a much larger scale than the actual machines, and has been kindly lent by the

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* In the model the plate F could be moved about (*e*) and placed at right angles to E, or in a horizontal plane.

Master of the Mint. It may be well to preface any explanations of the cam contrivances in it, by a statement of the circumstances under which the machines are used.

In the process of coining, some of the coined pieces may be too heavy, and some too light. Such irregularities in weight must be within very narrow limits, and by means of mechanism, constructed as this large machine, it is determined which coins are too heavy or too light, and must not be allowed to pass into circulation, and which may so pass.

The coins are placed in heaps; they pass down a spout; and the machines take coin after coin, and give a verdict which consigns the coin to the public for use or to the crucible for remelting. The mechanism is self-acting, being driven by power derived from heat. The coins are weighed at the rate of about twenty per minute. In the Mint there are nineteen of these self-acting machines at work, capable therefore of weighing 22,800 coins per hour.

As an illustration of what is required from the mechanism, we may take the case of arrangements being made for weighing sovereigns:—

	Grains.
The legal weight of a sovereign is	123·2744
Less allowance	·2
Therefore the weight of one blank or counterpoise is	123·0744 (A)
Making a similar allowance of ·2 grains for excess, has led to the adoption of a weight consisting of a platinium wire, and called "the remedy," of	·4
	123·4744 (B)

All coins below the weight marked (A) are too light and must be rejected.

Again, all coins above the weight marked B, are too heavy, and must also be rejected. It will be observed that a coin heavier than the blank and "remedy" combined must be rejected. Hence one blank and one "remedy" wire constitute the weight on one side of the beam.

Mechanism similar to this is in use at some banks, and actuated by electricity. In one mechanistic respect it differs; for its judgment is only invited as to a coin being too light. The machines at the Mint are expert at keeping from the public coins too heavy. Therefore, where the Mint mechanism has three courses of decision open to it, the bank machines need only one.

Let us now turn to the mechanism,* and follow the operations in weighing these metal blanks, which are our representative sovereigns:—

It will be observed that at the lower end of D there are two slits, and at the lower end of E only one slit.

A horizontal bar, rigidly fixed to the vertically guided rod, N N, has its ends passed through the lower end of these two slits, consequently, if at any time the scale-beam is out of level, a depression of this vertical bar, N N, will restore the beam to the level.

L is a rocking bar attached to a horizontal slide, Y L Y. If this slide be moved from the reader's left hand towards his right it will be withdrawn from below the coin at M. If now it be moved from right to left, the coin will be advanced, and placed upon the scale pan, F. Beneath that scale-pan is a pair of nippers, marked Q, by the action of which the pendant, D, and consequently the beam, A A, can be held in any position.

Such is an outline of the contrivances attached to the "weighing." Let us now turn to another class of contrivances which have reference to the determination of the destiny of the coin being weighed. Passing one through and the other near the upper of the two slits in the pendant D, there may be seen in the general drawing two pieces marked respectively S S and T T. The one marked S S passes through the upper slot in D. The one marked T T passes outside the slot in D, and carries the chisel-shaped end T, which is so counterpoised that when free the right hand end preponderates. S is called an indicating finger; T is called an indicator. S may, when permitted by the mechanism, fall on the lower part of the slot in D, and so by a projecting piece (not shown) carry down with it the indicator, T.

If we now pass to the extreme left of the figure, a curved spout, having at its upper end a wide mouth, may be traced. It is lettered U, U. At the lower end of this spout and fixed to it may be seen three notched steps. The spout is free to move near its upper end about a horizontal axis perpendicular to the plane of the paper. Dependent upon the position of the lower extremity of the spout is decided into which of the three troughs

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* Through the kindness of Messrs Longmans, the Society of Arts are enabled to use these wood-cuts, which are taken from Ure's "Dictionary of Arts Manufactures, and Commerce."

Fig. 21.

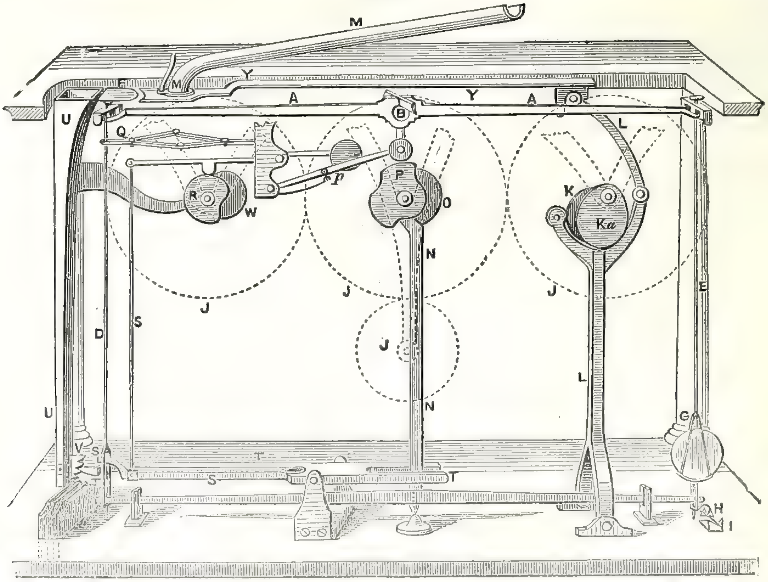
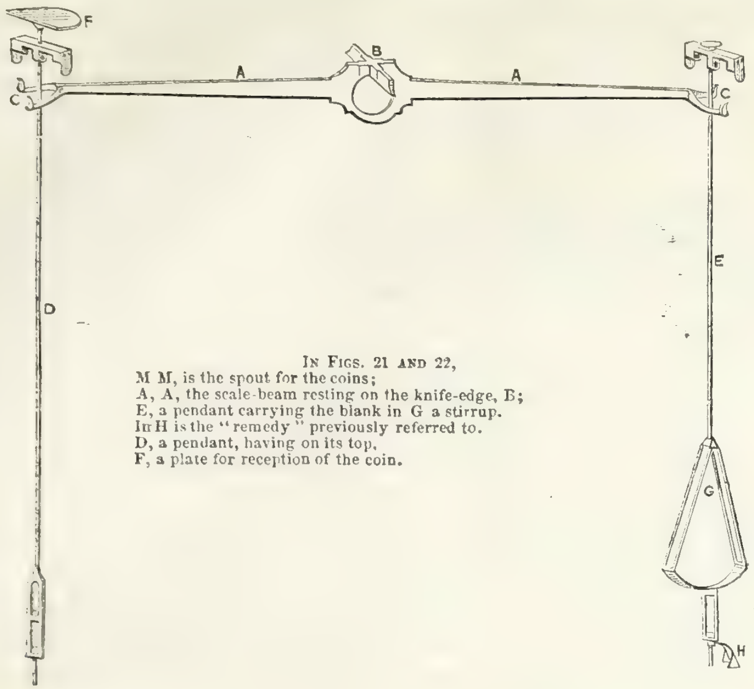


Fig. 22.



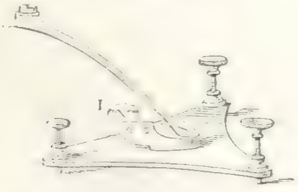
In Figs. 21 and 22,
M M, is the spout for the coins;
A, A, the scale-beam resting on the knife-edge, B;
E, a pendant carrying the blank in G a stirrup.
In H is the "remedy" previously referred to.
D, a pendant, having on its top,
F, a plate for reception of the coin.

(shown on the base-board of the machine) any coin passing down the spout may be discharged. These three troughs are the respective entrances to the vessels arranged to receive the light, the correct, and the heavy coins.

Having thus described the general construction of the essential parts of the weighing and distributing arrangements, we may turn our attention to the wheels and cams by which the whole of the previously described parts discharge their appointed duties, and in the required order.

J, J, J, J, are four small-toothed wheels, the three upper ones being of the same size. On the axes of each wheel are two cams, lettered K and K*a*, P and O, W and R. The cams have very varied portions of their circumferences struck with the same radius, and therefore when that portion of the circumference is upon the arm no motion is communicated. K and K*a* cause the bar, L, to rock, and thus one coin is placed on F, and slid off by the second coin put on in consequence of a second rocking. Assume that a coin is on F, and that it is too heavy, the scale beam will be depressed. This depression will have raised not only the blank counterpoise in G, but also "the remedy" in H. So important and sensitive is the action on "the remedy," that the bearings shown at I, Fig. 23, on which the small "remedy" wire rests must be truly horizontal. This is secured by the three levelling screws, as shown in Fig. 23, which is placed under H in Fig. 22. To return to the weighing. The action of the cam, P, releases a little weight which closes the nippers, Q, and holds the beam. The cam, R, then acts, and S falls upon the upper slit in D, carrying with it the chisel-shaped end, which is outside of the slit in D. The cam, W, now allows the spout U U, to fall, and, in the case assumed, the lower notch in V would rest upon the chisel end. (The drawing shows the middle notch so resting.) The destiny of the coin is now determined, and the scale beam may be restored to its proper level. This is accomplished by the cam O, which lowers the leveller attached to the vertical rod, N, N, the cam P having previously opened the nippers Q. This leveller, pressing upon the lower slots in the pendants D and E, restores the beam to horizontality. It will now be seen why the portion, S, S, which decides the drop of the spout is double, for the levelling of the beam at this stage does not disturb the chisel end in the notch.

Fig. 23.



The beam being levelled, the cam, P, again permits the nippers to close. The cam, K, advances the slide, Y, Y, and with it another coin. Thus the one on F is displaced—it falls into the spout, U, U, and being too heavy is guided into the receptacle for heavy coins. The cam W returns U U to its first position; the counterpoised end of T T causes the chisel-shaped end to rise, and the apparatus is restored ready for another operation.

The lecturer illustrated the description by weighing metal blanks, some of which were too heavy, others too light, and others correct, and said the instrument is produced as an example of the uses in mechanism of cams, affording, as they do, periods of rest or of impulsive action. These cams are found in many machines. They have also been employed in the form of tappets, for the sudden opening and closing of the valves of steam engines, where it was considered that the action of the excentric (another name for a particularly formed cam) was too gradual.

There are, however, few if any machines, in which cam actions have been more successfully employed than in the large one now before us. It is for the making of those wire combs called cards, used for laying the fibres of cotton parallel to each other. A consideration of this machine must be postponed for a future occasion.

ANNUAL INTERNATIONAL EXHIBITIONS

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

A Series of Facsimiles from ancient Roman utensils, lately discovered at Hildesheim, in Hanover, have been contributed within the last few weeks to the Reproduction Court of the east picture-gallery, by Christofle, of Paris. The shapes and applied ornament are exceedingly beautiful, and well worthy of attentive study by the art student.

In the same court are two copies of Hindu columns at Delhi, which, besides possessing a very elaborate carved character of considerable merit and beauty, are reproductions of the well-known K V T B Mosque, near modern Delhi, which is the best preserved record of the conquest of India by the Mahommedans in A.D. 1193. The mosque is composed of the stones of twenty-seven Hindu temples destroyed by the conquerors.

Evening Promenades.—On the occasion of the Evening Promenade, to be held on the 18th of July, a short sketch of the Progress of Electric Telegraphy will be given in the Royal Albert-hall, in addition to the usual promenade in the Picture Galleries of the Exhibition. Many members of the Literary and Scientific Societies, interested in this subject, have been invited.

General Purposes Committee.—His Royal Highness the Duke of Edinburgh presided, on July 3rd, at Clarence-house over a meeting of the General Purpeses Committee, appointed by her Majesty's Commissioners for the Exhibition of 1851 to carry out the current series of Annual International Exhibitions. There were also present His Royal Highness Prince Christian, the Marquis of Ripon, the Marquis of Lansdowne, Sir Francis Sandford, Mr. Bowring, Mr. Cole, Dr. Playfair, Mr. Thring, and Major-General Scott (secretary).

REPORTS OF THE FRENCH COMMISSIONERS ON THE INTERNATIONAL EXHIBITION OF 1871.

MM. Ozenne and Du Sommerard, the Commissaires-Généraux of France for the London International Exhibition, have presented their report to the Minister of Agriculture and Commerce.*

The volume opens with the official account of the interviews and correspondence relating to the scheme of these exhibitions, and to the space allotted and the rules observed by the French Commissioners in the Exhibition of 1871, and also a letter addressed by the French Commissioners to the British Commission in January, 1872, relative to the right of sale and removal of objects exhibited.

The second portion of the work contains special reports on the several great divisions of the Exhibition, that on Fine Arts being by M. Adolphe Viollet-le-Duc, architect; that on the Applications of Art and Industry, by M. A. Gruyer; on Ceramic Productions, by M. De Luynes, professor at the Conservatoire Des Arts et Metiers, of Paris; and that on Education, Inventions, and Scientific Discoveries, by M. Focillon, director of the Ecole Municipale Colbert.

There is no report on the woollen division.

The accounts and criticisms on the French portion of the Exhibition of 1871 will be read by many with interest; but those which refer to the English sections will undoubtedly attract most attention in this country. The reporters speak with perfect freedom, and, it may be added, impartiality; and while all that they say may not be accepted literally, there is much in the reports to cause English artists and artizans to think seriously on the subjects dealt with.

Of English painting in general M. Viollet-le-Duc, like all other French critics, remarks the general absence of unity of style, and an uncertainty in the execution. After some critical remarks on the works of our most eminent artists, the reporter says of the *genre* class of works that English artists have always achieved in this line a certain amount of success, but that, as in the modern English novel, the truth is often found side by side with caricature. In some of these works there are scenes which are treated with great cleverness, which attract and strike the observer at first by their power, but which afterwards repel. On the other hand M. Viollet-le-Duc admits that certain painters, whom he names, amongst others, exhibit great truth, energy of expression, and capabilities of execution, which seem to him to have been inspired by a profound study of the works of Rembrandt. Moderate praise is bestowed on the landscapes, while the marine pictures are pronounced as being generally treated in a superior manner.

Of the water-colour artists, the reporter declares that as able practicians they are still pre-eminent; but, like all other true critics and connoisseurs he entreats them to remain water-colour artists, and not to attempt to imitate the tones and the effects of oil painting. The grand advantage of water-colour drawing, he adds, is to be naturally clear, limpid, and fresh; this most precious quality should be preserved.

English glass painting receives fair praise at the hands of the reporter.

Statuary he regards as an exotic in England, and while speaking favorably of the work of a dozen English artists, he says that they do not form a school, that is to say, a centre of influence, originality, and education. The word originality seems strangely placed in the above sentence. The reporter adds, white marble seems out of place in these fogs, and unveiled figures seem to shiver under the pale sun of London. The English will never produce good sculpture until they are persuaded that the North requires a different mythology from that of Parnassus. English wood-carving, on the contrary, calls forth the reporter's warm admiration; it is often, he says, energetic, and seems to partake of the sap of the vigorous oak or the elm from which it is created.

Of all the ornamental manufactures shown by Great Britain, none call forth such severe strictures as the prize cups or racing plate, which are declared to possess almost all the faults that can possibly be combined in them. M. Viollet-le-Duc speaks well, however, of some of our superior goldsmith's work, and also of our enamelled and other church metal work.

Like all artists, M. Viollet-le-Duc expresses the highest admiration of the exquisite productions of India and the East generally, but deplores the dangers with which it is now menaced by the introduction of European ideas, which, he truly says, detracts from the originality of the work of the artists of those regions without aiding the development of their intelligence.

M. Viollet-le-Duc is naturally enough led in the conclusion of this report to some remarks on the Museums of South Kensington. He visited England in 1862, and like M. Mérimée, the reporter in the fine art portion of that Exhibition, he expressed in print some fears of the effect on France of the active and intelligent concurrence of that establishment. Now, after a second visit, his opinion is altered, and he declares that France has nothing to fear from the kind of teaching produced at South Kensington and in the schools connected with the department. The remarks are far too long for quotation here, and will doubtless be read by all who take a deep interest in the subject of art education, but the general tenor of the criticism will be evident from the following passages:—"It is in our opinion an utterly false idea, that of creating an 'industrial art.' There is no such thing as industrial art. Industry borrows the genius of art, dresses itself up in it, and ennobles itself, but it does not control or direct it; or, if it does, it denaturalises and corrupts it." Speaking of the magnificence and liberality of the South Kensington establishment, the reporter says:—"They compose from the collections a series of rare and precious models, but these treasures are wasted by interpretations which exhibit inability and want of discernment." He denounces the misapplication of productions of the old artists to uses to which they are totally unfit, and adds, "If this is what is called industrial art, it consists in a determined absence of method and forgetfulness of proportions and harmony."

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* Expositions Internationales Londres, 1871, &c., Rapports. Paris, Jules Claye, super-royal 8vo., 169 pages, 1872.

M. A. Gruyer, who is the reporter on the Applications of Art to Industry, in his opening remarks, gives his adhesion to the scheme of the present series of exhibitions, and against universal monster getherings, which he declares the Paris Exhibition of 1867 to have proved to be dangerous.

The reporter says very little of English industrial art till he arrives at the division of ceramic ware, when he at once frankly admits the immense progress which has been made in art, and attributes it in a great measure to the teaching and the influence of the South Kensington Museum. The Wedgwood ware, in its original form, is fairly estimated, and its defects, from an art point of view, well pointed out, but the modern forms of it, and especially the shades of colour, are seriously criticised. The grounds alone, says the reporter, have changed their tints, and not with advantage. The very pale blue—almost grey—of the old ware has been replaced by a cold, hard, deep blue; the greens are pale, and a greyish black, which weakens the contours, has been substituted for ebony black of former days. Thus, in the case of statuettes and vases, we have no more of those firmly tinted pâtes so propitious for modelling, and in simple bas-reliefs no more of those gentle transitions between the subjects and the ground. This fabrication, he adds, has grown old. Antiquity of the time of George III. no longer satisfies us. What pleases us of the 18th century is the period itself; as to its manner of viewing antiquity, it appears to us false.

Of other kinds of ware, M. Gruyer speaks in high praise. In 1851 he says the porcelain of Sèvres was the object of almost exclusive admiration; in the Exhibition of 1871, the English porcelain rivals the finest we (France) can produce. Thus, while we remain stationary, the English work, and work incessantly, and, less favoured than we are, wrest from nature, by re-doubled ardour and application, that which she seems to refuse to them. Science has revealed to them all the secrets of *pâte duce* and *pâte tendre*, of the preparation of oxide and the metallic composition of fluxes. The porcelain of Mr. Minton is generally happy in form and very fine in colour. The turquoise blues in particular is remarkable for the intensity of its hue. On these rich bodies swans of dazzling whiteness, storks, herons, red parrots, with green wings, branches of wild briar, rushes, eglantine, clematis, butterflies—all the colours which nature has been pleased to bestow upon us to charm and astonish the eye—are produced with a daring that is almost always successful. The artists who direct these decorations do not shun contrasts, however violent, and in that they follow the models of the East, which they have studied, and from which they derive their inspiration without reproducing them literally. The pieces of porcelain in pale green celadon, decorated with white enamelled figures modelled in the pâte, also deserve notice. I would point out also, on these same celadon grounds, black medallions, with very fine blue reliefs, and garlands of flowers and foliage also in relief.

The works of other potters are also mentioned with much admiration, and the remarks are summarised in the following paragraphs.

Generally, English porcelain-makers do not aim at large objects; they are right. They are in a good road of imitation. They take mostly their models wherever they find them, in ancient Chinese or Japanese ware, in Saxon, and above all in the French porcelain of the 18th century. Not that the English manufactures gives us old Saxon, or our old Sèvres; but they know now what they were worth, as regards delicacy and taste; they are fond of the forms; they seek to penetrate the spirit; they labour to extract the essences. Still the archaic forms are not without temptation for the English potters, but when they yield to the temptation they miss the mark. The statuettes in biscuit are abundant in the Exhibition, and sometimes it is at the sacrifice of ancient art that the English taste satisfies itself. This pâte, which is milky and soft in appearance ill suits the austere contour of the antique. The Greek or Roman spirit leaves a false impression in kaolin; the image of the renaissance is reflected therein but palely; the 17th century would recognise itself with a grimace. The imaginative works of the far East excepted, and, looking only to the history of western technologies, porcelain and the 18th centnry seem to have been made for each other. With this postulate we have only to mount to the sources, to take inspiration from the best models, and try and adapt them to our wants and our tastes.

Beyond the limit of the delicate and somewhat limited fabrication of porcelain, the English ceramists claim to be the the first potters in the world, and they are so in truth, and by far, by the importance of the works which they undertake, and are, moreover, in the way of becoming so by the quality of their productions, fair reservation being made for some exceptions which we claim for France.

The English potters, says M. Gruyer, have made enormous progress, and accomplished great things. They alone would prove the utility of an establishment so well provided, so magnificently endowed, as the South Kensington Museum. If France still possess ceramists who stand first, her ceramic industries, taken as a whole, are now surpassed. It is not the same with respect to the greater part of other applications of art to industry. France, though seeing her rivals growing up around her, is far from having found her masters. It remains with her to continue the arbiter of taste, but she must hasten to learn and to work. The efforts made by the English during the last twenty years have not, moreover, produced all that they might; and the reporter proceeds to explain what he considers to be the reason of this.

The exhibition itself, he says, gives evidence of the inherent faults which reside in the Kensington system. He considers the admixture of picture galleries and museums of sculpture with collections of decorated workmanship, however excellent in themselves, a great mistake, and as having prevented the Kensington Museum from producing all the results expected from it; and he blames his own countrymen for being inclined to follow much the same road. Art is bent under the yoke which we all submit to, that of money. We talk more of the market price of works of art than of æsthetic value. Applying the reasoning to France, he adds:—"Let us keep art pure in our museums, like a treasure which must be kept aloof from all profane contact. Let us bring back the dignity of art, and our decorative arts will recover their importance of themselves. Let us have our Kensington, but let us keep our Louvre; let us have our decorative arts, but let us preserve art independent and disinterested; let us perfect our professional education in drawing, but touch not our school of fine arts except to raise it and give it back its prerogatives. . . . . . . The essential thing is art itself—art regarded, I repeat, without any consideration of application or speculation. Make art grand and pure, and you will have in addition, and consequently, good and charming industrial arts. Have not all the great epochs of art left us admirable technologies?"

The special report on ceramic productions is by M. Victor de Luynes, professor at the Conservatoire des Arts et Metiers, and all who desire to know the history of modern ceramic art, and to comprehend the technicalities of the manufacture, should read this report with attention. This portion of the report concludes with the following scientific and commercial account of the feldspar and kaolinic stone of the Montebras mines, in the Department of the Creuse:—"The conglomerate feldspathic sand forms a long bed running in the north-eastern direction, and with an inclination of about 45° to the north-west. The bed is encased by granite of moderate hardness. Above, between the sand and the granite, is a stanniferous vein of from 60 to 90 centimetres, and containing oxide of tin and quartz, and red feldspar. The sand presents two varieties, specimens of which were shown at the Exhibition of 1871. The hard variety is a mixture, with fine grains of 70 to 80 per cent. of white arthose feldspar, and 20 to 30 per cent. of quartz, with a few specks of white mica; the other variety only differs from the former by the presence of a small per-centage of very white kaolin disseminated through the mass. This kaolin bakes white.

"The alkaline element, according to the analysis of M. Moissenet, of the Ecole des Mines, amounts to 5·86 per cent.; potash is the predominating element. The mine is so worked as to prevent any admixture of minerals with the stone, and the quantity at present available is from 18,000 to 20,000 tons. Two other specimens exhibited, which had been burnt, together with specimens of pottery in which the mineral had been employed, prove that it could be advantageously used in ceramic manufacture. This stone is sent from Montebras to Vierzon, and Limoges, at the cost of 6·1 to 7·50 francs for carriage. The ships which carry the china clay of Cornwall to Bordeaux might carry back this stone. The cost for Rochefort is 14·80 frs., and for Bordeaux, 14·18 frs. per ton.

"The first trials, made in the year 1869, in the porcelain works of Vierzon, were sufficiently satisfactory to induce many potteries in that part of the country to adopt it as raw material."

Of the British porcelain, Professor de Luynes says, that the first view of the china services produces a singular impression, from the uniformity of the decorations and their cold elegance. Here we see the taste for the correct pushed to its extreme limit, which does not exclude in certain cases perfection of manufacture. English porcelain may be regarded as composed of a fine faïence pâte, to which is added about 45 per cent. of phosphate of lime. It receives a soft plombiferous glaze, and lends itself to decoration almost as well as the *porcelaine tendre* of old Sèvres. The turquoise blue, so pale on hard porcelain, the rose Du Barry, which approaches violet on the same ware, are applied with advantage on the English porcelain, and form the principal part of the grounds in the articles exhibited. With respect to gold, M. Luynes wisely protests against the false mode often adopted of covering parts of vases, feet, handles, &c., with gold, thus taking away all character of china (a bad habit) which, unfortunately, Sèvres has been greatly guilty of herself. We may add, with some restrictions it must be admitted that amongst the English products are some of a very high order. M. de Luynes then notices the chief productions of the various exhibitions, and speaks in very high praise of much of the ware, its forms and decorations. The decorated tiles and slabs, the terra-cotta, and especially the brown stone ware of Vauxhall, &c., are all highly lauded.

The report on the two divisions of educational modes and materials, and scientific inventions, is by M. Focillon, the director of the Ecole Colbert, Paris. As regards the modes of teaching in the primary schools of France as well as of England, and most other matters connected with education, M. Focillon is a very severe critic, but his report is not fitted for extraction; it should be read in its entirety.

The English instruments for scientific education are noticed at length and with much praise.

In the report on scientific inventions, M. Focillon confines his remarks almost entirely to France, and refers his readers to the English reports for the rest.

Taken altogether, the volume of reports in question must be regarded as an important addition to the literature of international exhibitions.

EXHIBITIONS.

Proposed International Exhibitions.—A great exhibition is announced to be held in Philadelphia, in the year 1878, the centenary of the declaration of independence, to open on the 19th of April, the anniversary of the battle of Lexington, and close on the 19th of October, the day of the surrender of Lord Cornwallis. In the accounts given in the journals, it is stated that the last day for applications for space is fixed for the 4th of March, 1874, and that all the works of art and goods to be exhibited must be delivered in Philadelphia by the 1st of January, 1876. This last date must be a misprint, or the whole account looks like a hoax. A great exhibition is also spoken of at Calcutta; if there be any truth in this rumour it will doubtless soon be make known officially.

Copenhagen Exhibition.—The second great Scandinavian exhibition opened on the 13th ult., with considerable *éclat*, there being about six thousand persons present, and the city being hung with flags of all nations. The exhibition is situated in a park in which are a number of châlets, rustic and other pavilions, and Swedish and Norwegian monuments, surrounded by trees, grass, and water, making up a charming *ensemble*. There are cafés-restaurants both within the exhibition building and in the grounds, and the view from the exhibition is bounded by the fine trees of Tivoli Gardens, the great public promenade of Copenhagen. The King, accompanied by the Prince Royal, the Princess Royal, and the young Prince Valdemar, attended the ceremony of inauguration, and the royal party was received at the entrance by the principal Ministers, the Commission of the exhibition, the diplomatic corps, and the civil authorities. There was a profusion of music from three orchestras, supported by twelve hundred choristers.

The Paris Salon.—Those who have the ill-luck, or something else, to have their works excluded from public exhibition, are, naturally enough, inclined to find fault with the jury, and to look upon themselves as ill-used. This is the case with many persons this year, and the jury, in order if possible to meet the wishes of their *confreres*, have petitioned the government to allow a gallery to be set apart for the exhibition of the works refused. In answer to this appeal, M. Charles Blanc, Director of Beaux Arts, has replied that such an exhibition would be contrary to the spirit of the regulations by which all contributors agree to abide by the decision of the jury, and that the government, in granting such a request, would be assuming a power which it has already declined, leaving the jury perfectly free in its action. M. Blanc adds, moreover, that such an exhibition would be incomplete unless the whole of the rejected works, nearly 2,000, were to be shown; whereas the painters of all but 351 works have already acquiesced in the decisions, which means, probably, that they have taken home their works. Lastly, that such an exhibition would cause an outlay which has not been provided for in the budget. The main portion of M. Blanc's argument has been supported in advance by a former act of the government. Some few years since, the refused pictures were allowed to be exhibited in side galleries, and a more painful exhibition it would be difficult to imagine; nearly the whole of the rejected works were withdrawn, and the remainder proved pretty clearly that the painters of them had no ability, or experience, and no eye for the absurd. The jury, with M. Messionier at their head, have also proposed a free exhibition, to be permanent in itself, but no work to remain there more than three months, the price of admission to be half a franc on ordinary days, but the exhibition to be open gratis on Sundays and *fête* days. It is not believed in Paris that such a plan, which has already been tried more than once, would succeed. It is strange that the immense body of Paris artists have never been able to establish free societies for exhibition of the works of their members, like those which are so numerous, successful, and increasing in number in London.

PRINCE CONSORT MEMORIAL.

It will be within the memory of the majority of the members of our Society how deep and sad an interest the Society took in the proposition to raise a National Memorial to the Memory of His Royal Highness the Prince Consort, who had been for so many years President of the Society. Ten years have passed since the first steps were taken to raise a fund, and on Monday last the shrine, after a design by Mr. Gilbert Scott, R.A., which has been raised in Hyde-park, near to Kensington-gardens, directly in front and over-looking the Royal Albert Hall and Horticultural-gardens, was thrown open to the public, after a private inspection of the same by Her Most Gracious Majesty the Queen.

The figure of the Prince Consort is not yet in its place. The model, by Mr. Foley, was placed in position in July, 1870, and, after a few modifications, was approved of. Owing, however, to the artist's illness, its casting in bronze has been delayed, and it is probable that it will not be erected till another year has elapsed.

There is no necessity to enter into an account of how the memorial fund was raised; a reference to vols. 10 and 11 of the present series of the *Journal* will give all the particulars. Suffice it to say that a fund was started at the Mansion House by the then Lord Mayor (Cubitt), to which the Society of Arts gave 1,000 guineas, and which realised £35,000. In addition, the Society formed an organisation throughout the kingdom and the colonies, whereby a sum of £12,000 by small subscriptions was collected, and Parliament voted £50,000. The estimated cost of the design was £120,000.

The monument is elevated upon a lofty and wide-spreading pyramid of steps, from the upper platform of which rises a podium, or continuous pedestal surrounded by sculpture in alto-relievo, representing eminent artists of all ages of the world. The figures are about six feet high, arranged in historical groups in their several classes of Painting, Sculpture, Architecture, Poetry, and Music. On the level platform round which these groups cluster is erected the gorgeous canopy under which the statue is to rest. Four pillars of polished granite bear aloft the four main arches of the canopy. Each side is terminated by a gable, the tympanum of which contains a large picture in mosaic, its mouldings being richly decorated with carving, and inlaid with mosaic work, enamel, and polished gem-like stones, in accordance with the characteristics of a shrine. The intersecting roofs are covered with scales of metal richly enamelled and gilded, with crestings of gilt beaten metal in rich leaf-work. The structure is crowned by a lofty spire of "tabernacle work," in partially gilt and enamelled metal, terminating in the cross aforesaid, which reaches to the height of 180 feet above the ground.

The adornment of the podium with emblematic or representative figures in alto-relievo is among the most important of the distinct labours that have been subordinate to that of the designer. This task has been divided by two sculptors—Mr. Armstead and Mr. J. B. Philip—the former having illustrated painting, poetry, and music; while the latter has given a chronological history of the kindred arts of the sculpture and the architecture. The base of the shrine is a square, each corner of which has an oblong projection, with three sides or faces. Counting the four principal lengths, given by the sides of the square itself, there are sixteen unequal divisions. Mr. Philip has overcome the difficulty of a chronological sequence of costume, which, in the treatment of two subjects, might have led to a mingling of extreme antiquity and comparative modernism, by making his point of departure from the middle angle. His two histories read off in different directions, architecture running to the left and sculpture to the right. Starting from the north-west corner, there is Sennacherib, as the founder of the palace of Nimroud, and Nitocris with a model of a pyramid resting in her lap; King Cheops, Bezaleel stands for the building of the Tabernacle, and Hiram for the Temple. The first of the line of figures representing sculpture illustrates the origin of processes in different materials, as moulding, modelling, and carving; one holding a matrix, another a chisel and mallet, and a third the model of a small statue, supposed to be of terracotta. Then, in proper historical progress, come the sculptors of all ages, central positions being filled by Phidias, Michael Angelo, and Bernini, with a group consisting of Flaxman, Canova, and Canova's pupil, Thorwaldsen. The architects—proceeding to the left hand from the central point we have indicated—are, first, Chersiphron and Metagenes, father and son, who built the Temple of Diana; Apollodorus, the builder of Trajan's Column; William the Englishman, who built the choir of Canterbury; Johan de Chelles, the architect of Notre Dame; Robert de Coucy, who raised the beautiful cathedral of Rheims; and Giotto, with his bell-tower in the distance; Arnolfo di Lapo and Brunelleschi; William of Wykeham, holding his model of Winchester Cathedral; San Gallo, and the other architects of St. Peter's at Rome; Palladio, Vignola, and Thorpe, who is sometimes called John of Padua. Inigo Jones, Wren, Chambers, Vanburgh, Barry, Cockerell, and Pugin bring us down to recent days. The likeness of one living artist only has been introduced—the designer of the monument, Mr. Gilbert Scott. The painters, poets, and musicians are grouped by nations. In the centre of each of the four great groups are placed the great masters of the several arts. Thus Homer, with lyre in hand, has Dante with upturned face, lying at his feet on the right hand side, Shakespeare sitting below, Milton standing on the right hand of his chair, and Chaucer in the rear. Amongst the painters, Raphael, Michael Angelo, and Leonardo da Vinci form the centre group.

Besides the sculpture already described, there are, on the pedestals projecting from each of the four angles of the podium, groups of Agriculture, Manufactures, Commerce, and Engineering; the sculptors being respectively Mr. W. Calder Marshall, R.A., Mr. Henry Weekes, R.A., Mr. Thomas Thornycroft, and Mr. John Lawlor. Above these groups, against the pillars of the principal structure, and also in the angles of the gables, are statues which represent the sciences; and in the tabernacle work of the spire are figures of angels and of the Christian virtues. At the lower angles of the pyramid of steps are four large pedestals bearing groups which represent the four quarters of the globe—Europe, by the late Mr Macdowell, R.A.; Asia, by Mr. Foley, R.A.; Africa, by Mr. Reed; and America, by Mr. John Bell. The central portion of the monument is based upon a mass of concrete 60 feet square and 17 feet in thickness. Upon this are laid two continuous courses of thick stone landings, bedded in Portland cement; and on this platform is erected the sub-structure of massive brickwork upon which the monument is based.

The vault of the canopy is a combination of Mr. Skidmore's rich metal work and the glass mosaics of Messrs. Salviati and Co., of Venice, with which revived form of ornament the tympana, spandrels, and vaulting are adorned. The designs for the mosaics were prepared by Messrs. Clayton and Bell.

The dedicatory inscription, executed in mosaic, the letters being of blue glass with black edges, placed upon a ground of gold enamelled glass, is as follows:—

QUEEN VICTORIA AND HER PEOPLE
TO THE MEMORY OF ALBERT, PRINCE CONSORT,
AS A TRIBUTE OF THEIR GRATITUDE
FOR A LIFE DEVOTED TO THE PUBLIC GOOD.

CORRESPONDENCE.

ENDOWMENT FUND.

Sir,—It seems tolerably clear that the idea of an "Endowment Fund" is not favourably entertained by the Society at large nor by any considerable number of its members; the proposition has been prominently exhibited and zealously urged by the Council, warmly supported in the columns of the *Journal*, and now, by the adoption of the annual report at the last annual general meeting, it has been, by implication, formally approved by the Society at large, and yet the actual subscriptions towards the fund, as revealed by the financial statement, do not exceed altogether the sum of £30, a fact too significant to require comment; it is moreover noticeable that, according to the report of the proceedings of the annual meeting, neither the chairman nor any of the speakers made any allusion to the subject.

In this state of circumstances would it not be more becoming the dignity of the Council to acquiesce in the virtual decision of the Society, as indicated by its silence, and to withdraw the question from consideration.

The truth is, that faith in the justice, expediency, and efficiency of endowments is growing daily less, and is ready to vanish away.—I am, &c.,

J. B.

London, 1st July, 1872.

ON THE USE OF CHINA CLAY FOR STIFFENING AND WEIGHTING WOVEN FABRICS.

Sir,—If men can be found who, to increase their profits, will endanger the health of persons in their employ, it will be but a small matter to attempt improvement in the solitary case of dusty weaving sheds, while numerous trades are carried on, through false economy, in places ill-contrived, ill-built, and improperly ventilated.

Instead of interfering with the modern introduction of earthy matters into woven fabrics, for the sole purpose of deception, we should so construct all workshops, factories, and indeed all closed spaces where human beings are congregated in either large or small numbers, that no dust, effluvia, or foul air shall affect the respiratory organs of the persons therein confined.

This desirable object is readily to be obtained, but only by reversing the prevailing mode of ventilation, and that is by drawing the foul air, dust, and effluvia downwards through a perforated or grated floor, and admitting fresh air from without through perforated ceilings or cornices.

The costly attempt by the late Dr. Read to ventilate the Westminster Palace, notwithstanding very expensive alterations, has been a total failure, because the doctor set out upon the false plan of upward ventilation, through perforated floors, and thereby forcing all the effluvia from street dirt, shoe-leather, heated human beings, and dust to pass upwards, right into the mouth and nostrils of all persons assembled therein.

If, as in the case before us, weaving-sheds are necessarily dusty, they may be made perfectly healthy by perforating the floors, or constructing them of close grating, and forcing a downward draught by means of a chimney and small fire outside, an air-shaft and fans, or any other more appropriate device.

Shortly before the adoption of amorphous phosphorous in making common matches, I published the plan of downward ventilation, through the floor of the workroom, a proceeding that would have entirely prevented that terrible disease of the poor match-makers, the caries of the lower jaw.—I am, &c.,

Henry W. Reveley.

Reading.

AUSTRALIAN MEAT.

Sir,—In answer to your correspondent "E. F. D. C.," inquiring which is the best method of preserving animal food, I cannot do better than draw his attention to an article in this month's number of the *Food Journal*, an extract from which I enclose for insertion. The subject has been brought prominently before the members of the Society on two or three occasions. I have attended several public and private meetings of gentlemen interested in the question of our food supplies, when many kinds of meat have been submitted to inspection. The palm has invariably been given to that preserved by Mr. Richard Jones's process. With regard to the equivalent in Australian meat of ordinary English without bone, I must refer your correspondent to the analysis. It will be seen that nothing whatever is lost, so that were this process adopted by the Australians the whole of the original constituents of the meat (excepting the water lost in cooking) would be available for food. With regard to the best way of preparing Australian meat, this so entirely depends on the way it is preserved that no rule can be laid down, unless it be the general one of warming it up with vegetables, making a sort of Irish stew of the whole mass, and thus disguising its overcooked character; whereas that preserved by Mr. R. Jones's plan can be cut in slices and partaken of in this country, being similar in every respect to an English joint of meat.—I am, &c.,

A Member.

London, June 25th, 1872.

"Taking the various methods as a whole, there seems to be as yet nothing better than the vacuum process, and it is to the results of our examination of a set of samples of meat preserved by a new modification of this plan to which we desire to direct attention. These specimens have been transmitted to us by Mr. Richard Jones, and were preserved under his vacuum method by Messrs. Forbes and Co., of London and Aberdeen. By Mr. Jones's process the meat is put into tins and entirely soldered up, except a small tube, which is about the size of a quill, and is soldered into the top of the tin. This tube is placed in connection with a vacuum-chamber, and the air exhausted. The cooking is then commenced, and, without entering into details, we have simply to say the principle involved is the production of a vacuum before beginning to cook, and the maintaining of the same during the time that the operation is in progress. The special feature claimed for the system is that 'poultry, game, fish, and whole joints of beef and mutton can be as readily preserved with as without bone, so obviating the hitherto unsatisfactory appearance of preserved meat.' Having thus given the *rationale* of the process, we will proceed to the results of the examination of samples.

"No. 1 was a roasted sirloin of beef preserved entire. Before opening the package, the tin was observed to have the battered appearance produced by the external pressure of the air, which is always indicative of a perfect vacuum in such tins, and without which no package of preserved meat should ever find a purchaser. On opening, the meat was found to be devoid of the usual shrivelled appearance, and, in fact, presented the characteristics of a joint of meat cooked the day before, and served cold in any ordinary household. Upon cutting into the joint there was no appearance of over-cooking and stringiness; it came off in good slices, and was even somewhat ruddy in the centre. It was remarked by our friends who were present at the trial, that the flavour was not at all like the common tinned beef. A portion from the inner part of the joint was cut off for analysis, with the following result:—

Water	69·337
*Muscular fibre, coagulated albumen, &c.	17·653
*Soluble organic salts	2·790
Fat	6·710
Mineral matter	3·510
	100·000

"No. 2 was a partridge roasted whole, which presented no trace of a shrivelled or discoloured appearance, and stood carving in the ordinary way without tearing into shreds. The flavour was exceedingly fresh and agreeable; the only objection made to it by some of the party was, that it was not sufficiently "high" for their palates.

"No. 3 was a section of cod boiled in one piece. This was an exceedingly happy specimen of food preservation. It was so firm in consistence, and so perfect in flavour, that no one would have imagined that it had not been cooked the same morning. It possessed, as one of the company remarked, that peculiar liveliness of flavour which cold fish only retains for a limited period after cooking.

"It was not thought necessary to submit either the game or fish to analysis.

"Looking to the results of our experiments, we cannot but think that the method of preservation in tins has at last reached perfection in this process, for the development of which we were informed that a company has recently been formed with every prospect of success. When it gets into working order, there is little doubt but that this meat will head the market until such time as some happy inventors can produce a reliable plan of importing raw meat from our colonies in a sound state."

EXPLOSIVE AGENTS APPLIED TO INDUSTRIAL PURPOSES.

At the last ordinary meeting of the session of the Institution of Civil Engineers, 1871-2, held May 14th, 1872, Mr. T. Hawksley, President, in the chair, a paper was read giving an account of "Explosive Agents Applied to Industrial Purposes," by Mr. F. A. Abel, F.R.S.

The nature and properties of gunpowder, and its special advantages and defects as an explosive agent for industrial purposes, were first briefly reviewed. The application of chlorate of potash to the production of mixtures more violent than gunpowder was discussed, their general susceptibility to explosion by friction or blows was pointed out, and some comparatively safe compounds of this class, such as Horsley's powder, and a substance called Tutonite, were specially noticed. The salts of an organic acid, called picric acid, now produced in large quantities by the action of nitric acid on the well-known antiseptic, carbolic acid, were described as endowed with explosive properties, and as furnishing very powerful agents when mixed with chlorate of potash or saltpetre. Of these the "poudre picrate," or mixture of picrate of potash and chlorate of potash, was the most violent, but was far too dangerous, on account of the readiness with which it exploded by friction, to permit of its technical application. A mixture of picrate of ammonia and saltpetre, designated "picric powder" by the author, was described as certainly not more dangerous to manufacture and to use than gunpowder; considerable quantities had been produced with the ordinary appliances of gunpowder-works, and the material had received safe and successful employment as a violently explosive charge for shells.

Numerous other products of the action of nitric acid upon organic substances, endowed with explosive properties, were stated to exist, but only two of them—nitro-glycerine and gun-cotton—had hitherto received practical application, and these two constituted, at the present time, the chief rivals of gunpowder in many of its most important uses. Attempts were made to apply gun-cotton immediately after its discovery in 1846, and long before its properties were understood; but nitro-glycerine, which was discovered in 1847, had continued a chemical curiosity for sixteen years, its manufacture and application having been developed during the last nine years.

The early history of gun-cotton was briefly referred to, and it was shown that, even in the first days of its production and application, important results were arrived at, though the too hasty attempts to utilise it led to its speedy abandonment, as a highly dangerous material, by all but the Austrians. The improvements effected by Baron von Lenk in the application as well as in the manufacture of gun-cotton, which first became public in 1863, led to a resumption of the employment of this agent in England, and to its careful study by a special government committee and others. The advantages of the Austrian gun-cotton, as a mining, quarrying, and engineering agent, were pointed out, as also the considerable improvements in point of power, economy, safety, and convenience in use, in facility and uniformity of production, which had been effected by the reduction of gun-cotton fibre to a finely-divided condition, and its subsequent conversion into highly compressed homogeneous masses. The rigidity of the charges of gun-cotton, and their subsequent occasional tendency to become jammed in irregularly-shaped blast holes were, however, shown to be occasional sources of accident; and the necessity for strongly confining gun-cotton, in order to develop its full explosive force, was a defect which existed until recently, and had for a time rendered the material decidedly inferior to nitro-glycerine.

An account was next given of the successful manner in which Mr. Alfred Nobel had developed the practical application of nitro-glycerine. His discovery that the explosion of this liquid could be brought about through the agency of a detonation, and its successful manufacture, combined to furnish the industrial world with the most powerful explosive agent hitherto susceptible of application, and which agent, from its high specific gravity and insolubility in water, presented the special advantage, that it could be used in positions where water could not be excluded. The poisonous nature of the substance constituted an objectionable quality, and some uncertainty occasionally attended its employment, but its principal defects arose from the fact of its being a liquid, and from the comparatively high pressure at which it froze. The majority of the numerous fearful accidents which had occurred during the transport and handling of nitro-glycerine appeared to be caused by the accidental leakage of the liquid from receptacles in which it was confined. The liability of such leakages to escape observation, and to lead to accidental explosions, which would be transmitted to the confined nitro-glycerine, and the reckless manner in which the frozen nitro-glycerine had been frequently dealt with, in consequence of its apparently inert condition, had been fruitful sources of disaster, which had rendered the liquid, in its pure condition, a very unsafe material for employment as a mining agent. But Mr. Nobel had succeeded in applying nitro-glycerine in a simple manner, by which its defects, arising out of the liquid nature of the material, were remedied. He mixed nitro-glycerine with a porous and finely-divided silicious earth, and thus obtained a solid but plastic preparation, which could be conveniently handled and converted into charges of suitable dimensions, susceptible of application like any other solid explosive agent, and capable of detonation quite as readily as the pure nitro-glycerine. This mixture, called dynamite,

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* Containing 3·74 nitrogen.

and of which one or two varieties were prepared by Nobel, was stated to be one of the safest, most convenient, and most powerful blasting and mining agents. As now manufactured in the form of compressed charges, it retained as much as 75 per cent. of nitro-glycerine, without exhibiting any tendency to a separation of the liquid during transport and storage.

Several other nitro-glycerine preparations of more recent production were referred to, all of which might be regarded as modifications of dynamite. In some of them, such as Horsley's mining powder, dualine, and glyoxiline, solid explosive compounds or mixtures were employed instead of porous silica, as the absorbents of nitro-glycerine; in others, as in litho-fracteur, the silicious earth and nitro-glycerine contained in dynamite were in part replaced by semi-explosive substances—for example, by gunpowder constituents. None of these newer preparations contained so high a proportion of nitro-glycerine as dynamite, and although some of them, such as litho-fracteur, might vie with it in regard to safety, it was scarcely possible that the substitution of other explosive substances for a proportion of nitro-glycerine in the mixture could result in the production of an equally powerful explosive agent.

When it was found, by recent experiments, that gun-cotton in the compressed form could be exploded by detonation like nitro-glycerine and its preparations, that substance proved to be quite analogous to them in its behaviour, though the pure nitro-glycerine still remained somewhat the strongest explosive agent. The suddenness of the explosion developed by detonation permitted of the application of compressed gun-cotton and nitro-glycerine preparations to purposes of destruction without any confinement, and thus operations could be expeditiously and effectually carried out with comparatively small quantities of these materials, which could only be accomplished by exorbitantly large charges of gunpowder. The rapid demolition of military works, bridges, &c., the breaking up of boulders, large masses of rock, guns, or castings or forgings, were quoted as operations of this class.

The author pointed out some of the causes of the great difficulty experienced in arriving at anything approaching a precise estimate of the relative power and effect of different explosive agents. Taking dynamite as the type of the practically useful nitro-glycerine preparations, and as certainly one of the strongest, experience had shown it and compressed gun-cotton to be about on an equality in point of power, and to exhibit in their most advantageous applications a strength which was estimated at six times that of powder. The plastic nature of dynamite, and its power of resisting penetration by moisture, gave it advantages over compressed gun-cotton, as it could be used in wet blast-holes, and as very irregular holes, or holes terminating in fissures, could be more conveniently and heavily charged with it than with gun-cotton. On the other hand, the readiness with which dynamite froze, and its inertness unless thawed or fired by special arrangements, and the unpleasant effects experienced occasionally by those using it, were inconveniences not shared by gun-cotton. The advantages presented by these materials in their general application as blasting agents were shown to consist chiefly in saving of time and labour, especially in tunnelling or in blasting in hard rock. They were also susceptible of advantageous employment as auxiliaries to gunpowder, in the rapid removal of large masses of rock, or of submerged wrecks; the violent explosive agent being first used to produce extensive rending and shattering effects, and the superior displacing effect of powder being afterwards brought to bear. It was pointed out that gunpowder could not be satisfactorily replaced by these violent explosive agents in some kinds of work, where its comparatively gradual action was a specially valuable feature.

In conclusion, after referring to some recent interesting experiments of Dr. Sprengel, on the application of readily oxidisable and other powerfully oxidising liquids in the production of violently detonating mixtures, the author showed that, even in the application of gunpowder to industrial purposes, some decided advance had lately been made, for its violent explosion could be developed, like that of all other explosive mixtures and compounds, through the agency of a detonation, whereby its action might be considerably intensified, and its application to some important classes of work, *e.g.*, in submarine operations, greatly facilitated.

GENERAL NOTES.

The International Prison Congress was opened on Wednesday by the Earl of Carnarvon, its president, who delivered an address in the Hall of the Middle Temple.

"Et Cætera."—A new monthly magazine of general literature, under this title, is to make its appearance on the 1st of August next; it is intended to be of a very comprehensive nature, and will embrace fiction, politics, science, biography, &c.

Chamber of Commerce for Luton.—The Luton straw hat and bonnet manufacturers have decided upon having a Chamber of Commerce. The chamber, however, will not be confined to persons engaged in the staple trade of the district, but merchants, general traders, &c., being principals, are to be also admitted. Union has at length been thought desirable by the manufacturers, for the protection of their interests, more especially as an intimation was given them by the Great Northern and Midland Railway, at the commencement of the present month, that the transit of goods from Luton to the metropolis would be raised from 10d. to 1s. per box from the 1st of June. Hitherto an anomaly has existed in the trade with regard to the transport of straw goods from Luton, for whilst the customers of the large provincial towns, as also foreign buyers, would have to pay carriage, the metropolitan houses would have theirs conveyed to them at the cost of the sellers. Now it has been resolved in a meeting here, that after the 1st of June all customers shall be placed upon the same footing, and that the manufacturers will cease any longer to favour London buyers in this respect. At the same meeting a protest was entered against the increase in the transit by the railways, as being not in keeping with the liberal policy of railways generally of the present day; and it was at this meeting that a Chamber of Commerce was decided upon. Some 70,000 are engaged in the straw hat and bonnet trade, and that there should be a body to watch the interests of such a branch of manufacture, and be an intermediate channel of communication, no one will be inclined to doubt. The matter was mooted by Mr. Gunn, of the firm of Gunn and Davis, in George-street, and met with general approval, a committee having been thereupon appointed to draw up rules, &c., for the government of the chamber, and to invite the co-operation of the manufacturers of the neighbouring towns, Dunstable, St. Alban's, &c.

SCIENTIFIC MEETINGS FOR THE WEEK.

Tues. ...East India Association, 8. (At the House of the Society of Arts.) Mr. F. W. Chesson on "The best means of Educating English Opinion on Indian Affairs."

Wed.... Royal Literary Fund, 3.
Charity Organisation Society (Strand Branch), 3. (At the House of the Society of Arts.)

Thurs...International Prison Congress, 11. (At the House of the Society of Arts.)

Fri...... Geologists' Association, 8. 1. Mr. Alfred Bell "On Corbicula fluminalis, its associates and distribution in Britain." 2. Rev. John Gunn "On the Dip of the Chalk of Norfolk, and the Remains of Old Land Surfaces called the 'Stone-bed.'"
Quekett Club, 8.
International Prison Congress, 11. (At the House of the Society of Arts.)

Sat.......Royal Botanic, 3¾.
College of Preceptors, 8.

Journal of the Society of Arts.

No. 1,025. Vol. XX.

FRIDAY, JULY 12, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Conference on this subject is appointed to take place, at 12 o'clock, on Saturday, the 20th of July, when His Royal Highness Prince Arthur, K.G., has consented to preside. The members of the Society, members of the City Companies, and of the Chambers of Commerce, merchants, manufacturers, and others interested in this movement, are invited to attend. To this Conference the representatives of the Institutions in Union are invited, and the Annual Report of the Educational Officer will be laid before it.

DRILL REVIEW

His Royal Highness the Prince of Wales has named Thursday, the 25th of July, as the day for the review of school drill, which has been announced to take place in the Royal Horticultural Gardens. His Royal Highness will graciously honour the review with his presence, and will afterwards present, in the Albert Hall, the prize banners to the schools successful in the competition. The united bands of the schools will, after the review, perform a selection of music in the hall.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first published subscription list amounted to £351 3s. A further list will shortly be published.

IMPROVED CABS.

The Council of the Society of Arts offer the following Prizes:—

One Prize of £60 for the best improved Cab of any description.

Two Prizes of £20 each for the next two best.

Two Prizes of £10 each for the next two best.

The competing Cabs must be exhibited at the International Exhibition, to be held in South Kensington in 1873, and on their delivery at the Exhibition Building they must be certified to the satisfaction of the Judges as having been in regular use in the streets of London, or other city or town in the United Kingdom, for three months previously. They must be delivered on or before the first Saturday in April.

The Council consider that the Cabs now in use in London are especially defective in the following particulars:—

1. Want of room, both as regards the four-wheelers as well as the Hansoms.
2. The seats in the four-wheelers are too high, not commodiously made, and the space underneath is lost.
3. Difficulty of getting in and out of the Hansom, by reason of the height of the step as well as the interference of the large wheels.
4. The arrangements for opening and closing the window in the Hansom.
5. The confined space and want of ventilation in the Hansom when the window is closed.
6. Imperfect locking of the wheels in four-wheelers.

The Council desire to point out, for the consideration of those likely to compete, that in Continental and some English towns there is to be found a very convenient class of open carriages, termed Victorias, as well as carriages which admit of being opened or closed at the option of the passenger.

A suggestion for a cab, to be used either closed or open, has been brought before the Council, and a model submitted. The principle might be adapted to existing four-wheelers, but the Council do not prescribe this model or any special form of carriage; they are content to point out some of the more obvious defects in the existing carriages, and to draw attention to what has been found convenient in other towns, leaving it entirely open for competitors to effect improvement in any way they may think best, whether by improvements on existing forms and contrivances, or by entirely novel forms and arrangements.

The Council reserve to themselves the right of withholding all or any of the above prizes, as the judges may report.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

MECHANISM.

By the Rev. Arthur Rigg, M.A.

Lecture IV.—Delivered Monday, Feb. 26th, 1872.

Hitherto the communication of motion from one piece to another in mechanism, has been considered as taking place only by direct contact of the pieces. The laws which govern the ratio of the velocities of the driver and follower were either obviously impressed upon the driver, as in the case of circular wheels rotating about fixed shafts, or of cams acting upon simple rollers, or sometimes, but less frequently, the law was impressed upon the combined action of the driver and the follower, as in the case of elliptical and lobe wheels, and sometimes cams acting upon cams. Whatever might be the law, the driver and follower must, in accordance with the principles hither announced, be placed in communication by means of rigid bodies moving about centres or sliding in grooves. Such communication necessarily narrows the range of primary motion. The space within which rigid bodies alone can act thus, places a very great restriction on facilities for the transference of motion. Suppose it was requisite (and the case is a very common one) to convey a fractional part of an existing primary motion to one place, leaving a large amount of unutilised motion remaining. There must then be called into play a truly perplexing array of wheels, cams, and bars, rolling, oscillating, and sliding, in order beneficially to employ the remaining surplus motion.

Valuable to mechanics and engineers as may have been the deductions of the mechanician and mathematician in relation to the communication of motion by contact, the field of their operations must have been seriously contracted, from a simple incompetency to employ the heavy cumbersome means by which alone this mode could be utilised. Let any one enter a workshop or factory, where steam or water is a source of motion, and those things which first arrest his attention are not wheels, cams, and rods—they are not the rolling and sliding of material substances, each in mechanical contact with the other—but they are the straps, the cords, and the chains which are united in what is usually called *wrapping* gear. Take, for example, the sheds or rooms in which the weaving of cloth is carried on. They are generally on the basement floor, in consequence of the heavy weight of the number of looms placed close to each other. Curious as are other sights which varying manufacturing processes present, it may be questioned whether anything in the manufacturing line is more perplexingly curious than the strap-gearing, the, to the eye, endlessness of interlacing by which, in these sheds, motion is transferred from a supply-shaft to the recipient shafts of the respective looms. Speaking generally there are from one hundred to two hundred, or more, of these looms in the same shed, so closely packed that those who attend to them have but narrow space in which to move. To give motion to the parts of these looms with which the mechanician is concerned, there are apparently from 200 to 400 straps coming from shafts generally near the ceiling. All straps are in rapid motion, and the labyrinth of these moving bands is so bewildering, and the hopelessness of penetrating with the eye through this labyrinth to the end of the sheds in which the looms are placed is so very great that there arises in the mind of an unaccustomed spectator a sense of fear rather than of respect for the skill which, from apparent chaos, brings perfect order. And further, in this same shed there is a whir of wheels, a click of gathering ratchets, a din of beams, and sharp raps at brief intervals, now driving and now stopping the shuttles. There are material elements of varied forms seemingly endowed with life and action, each in its own sphere, disporting itself as though chaos and order were for once agreed. In the midst of these sounds and scenes the uninitiated is lost in wonder; the moving straps which cause this babel of mechanic tongues are themselves perfectly silent. Each strap is doing—what England expects every man to do—its allotted duty in its appointed way, too busy to meddle with its neighbour's concerns; and from straps such as these, thus simply constructed and sufficient for the purpose, mechanicians can now obtain from one moving shaft, without the cumbersome mechanism and contrivance which motions by contacts require, as great a variety of motions as plants obtain of flowers and fruits from the same garden soil.

For example, through the agency of straps, or of those wrapping connectors which partake somewhat of the character of straps, motion can be accelerated, as in spindles, lathes, and circular saws. It can be retarded, as in the descent of clock weights; it can cause tools to advance, as in planing and shaping machinery, or retrograde, as in empty kibbles descending mine shafts; it may be made to pause, as in punching and shearing machinery; it can remain at rest, as in the striking mechanism of a clock which remains at rest for an hour; or it may cause a combination of reciprocation, acceleration, and retardation as in mule-spinning.

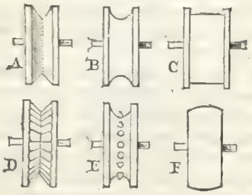
It is not only by means of straps and bands that we can communicate motion to a distance. There are many cases in which that can be done by the aid of physical and chemical laws, just in the same way as sliding contact was, by the mechanician's ingenuity and contrivance, brought to assist rolling contact, which it seemed entirely to destroy. On these aids from physical and chemical laws the mechanician is dependant for distinct motions. For example, in the relays of telegraphs and blocking of railways, electricity and magnestism are employed. In the delivery of parcels by the Pneumatic Company, blasts of wind are used; in the motion of ships, steam is employed; in the motion of projectiles, gunpowder and gun-cotton are used; in the semaphore, light is employed; and in the conveyance of sound, air is employed.

Interesting as it is to follow the ingenuities by which the contriving minds of thoughtful men have put in harness such mighty powers, and made them obedient to their will, yet duty requires that these must not now engage attention. One brief sentence at parting with some of the noblest triumphs of the human mind over the visible and invisible colossal powers of nature.

'Twas a sight not to be forgotten when Mr. James Nasmyth, with a delicacy of touch that would barely crush a soap bubble, caused his newly-invented steam-hammer to gently tap an egg in a wine glass; to drive fine needles into wood, and then come down with a blow that shivered a block of oak, as though torn into splinters by a lightning flash; and all this within the space of one minute, and without any really personal effort.

Wrapping connectors are of various forms and different materials, and within limited distances are the most convenient mode for transferring motion. The purpose for which each is to be employed determines the material of the wrapper used. Stated generally—and the statement, though general, admits of but few exceptions—where the object is the transmission of motion with a view to obtain power, flat straps are used, and when that motion is very slow then flat chains may be employed. Where the object is to communicate velocity or to work up to velocity, then round bands or cords may take the place of flat straps or chains. The mode in which these straps are generally used is by means of what are called pulleys—not pulleys as we commonly understand the word. It is to be regretted that in mechanism, as in other departments, the same name is given to articles of very different character. Pulleys are really, as we are now speaking of them, simply wheels with or without rims. There are specimens on the diagram lettered A, B, C, D, E and F. These, of which sections are given in Fig. 24, have all at one time or other been employed; they are but a selection from a very numerous class. It is really extraordinary to note how prejudice or profit prompts opinions, for in pullies the less satisfactory forms have sometimes displaced the more satisfactory ones. The selected six contain some peculiarities worth studying, for amongst them are to be found features which were once thought valuable, but would not now be employed.

Fig. 24.



A and B are smooth-grooved pulleys.

Sometimes the groove is sharp or pointed, as at A. At other times the sloping sides are rounded into each other, as at B. Those who were present at a former lecture may remember that attention was directed to the form of the sides of a large grooved pulley from the works at Crewe. The form of that groove, and the angle of inclination of the sloping sides in relation to the diameter of the rope, and the purpose for which the system was used, were then pointed out. Such a pulley would convey an amount of power, for the object of a pulley thus formed in the groove is to enable the cord which presses into the groove to drive the shaft to which the pulley is keyed. By the wedging of the cord between the sloping sides this is accomplished, and for this reason the slope of the sides and the diameter of the cord should be related. Other pulleys are arranged merely to guide the cord, and are not keyed on any shaft which must necessarily be driven by it. The groove in that case is formed as at B.*

In the case of A (Fig. 24), it is essential that the cord should assume, by the force of tension and compression in the groove, something of an angular character, although only momentarily. The elasticity of the cord prevents it retaining the angular form, which is impressed upon it that the wheel may be driven. It was once thought essential, in order that a pulley might be driven by a cord, that the pulley should be roughened, or have spikes put in, as at E. The object was that the rope might lay hold of these, and so drag the pulley round. Many can remember the day when it was generally believed that railway trains could never run on smooth rails, and some of you may know that rails were laid down which were either adapted for toothed wheels, or roughened by some other means. So here, it was thought that a cord could never drive a shaft through the agency of a pulley without some means of holding. Sometimes the pulley was grooved or serrated, as at D (Fig. 24), the rope laying hold on the serrated groove dragged the pulley round. Sometimes Y-shaped iron projections were fastened on the pulley, thus presenting lodgments for the links of chains, by means of which the pulley could be dragged round. Other plans for holding the chain links were also used.

C and F (Fig. 24) are types of pulleys now in use. Those hitherto considered have been used with cords or chains. C and F are forms intended for straps. Until recent years all straps were formed of leather, latterly straps formed of gutta percha and canvass have been introduced. Although it was found that the adhesion of the strap to the pulley gave sufficient driving-power, and so enabled mechanics to dispense with the contrivances previously named, yet it was considered that unless plans were adopted to hold the strap on the pulley it would not remain; and at the time referred to pulleys were supposed to retain the driving-band by such artificial means. Therefore pulleys, similar to C, with high edges or deep rims, were used, and the band was supposed to run between the edges or rims. Very serious difficulties encompassed this apparently simple and necessary appendage. Any mechanic who attempts it will find, that although he thus provides a way and a guide for the strap, yet the strap may be said to have "a will and a way of its own." He may persevere, and he may answer as one did when told that all facts were against a novel theory he had broached—"Then so much the worse for the facts." So here. Perseverance in a wrong opinion, however plausibly supported, cannot convert "wrong" into "right." The strap will rise up and run on these upper edges, or fray itself to pieces in the corners by attempting to rise, and so be destroyed.

Mechanics lost both time and temper in trying to keep that band in its place. It would not stop. Yet if we let the band alone it will stop where we want it to stop. It will not obey our dictation if we say you shall stop, but if we give it liberty to run off it never does. Off that plain pulley, F, (Fig. 24), it never goes at all, but between those two walls on C it will not and cannot be bound. If anybody wants to destroy their bands, let them put guides upon such pullies as this; the destruction will soon be complete.

There is a peculiar and unexpected requirement here. A band always seeks the highest point upon the wheel, and those who take up mechanism or who take up physical science, or who take up any branch of Nature's laws, will find it their wisest plan to learn what Nature says should be done, and to seek to impress that upon what they wish to be done. We may just as well attempt to make water run up a hill as attempt to make a band run on a flat between confined walls. The proper method is to observe how a band behaves itself, and you will find it always tries to get to the highest point, in that respect imitating some of ourselves. Here (referring to a model) is a band running over a double cone, and about six feet lower down it runs over a cylindried drum by which it it driven. On turning the lower drum the strap rises to the highest point of the cone. Why is that? You see it is now positively running on the edge formed by a junction of the bases of the two cones. There is no provision made to keep it there; indeed, the provision rather is that it should go down the hill, which we might think would be the easier to do; but it prefers going up and stopping at the top. The reason (now that we know the fact) is very simple—like many other facts that are easily explained when we know them. It was not so easy to anticipate it. The explanation may be given with the aid of this diagram. Fig. 25 is a rounded or coned pulley, very much distorted, in order to make the cause of the phenomenon more distinct. When a band is stretched between two pulleys, if there is any irregularity, however small it be, in the pulley or in the density of the band—we will assume it here to be in the pulley—then the line of the strap at C (Fig. 25) is clearly moving, owing to its position on the pulley, at a higher velocity than the line at *c*, and not only is it moving at a higher velocity, but that edge alone is conveying the power that is to be conveyed. The driving power is transmitted simply along the edge C D, because that edge is stretched and the edge (*c*, *d*) is not stretched. The consequence is that the edge C D of the band touches the pulley, and the edge *c d* does not. Therefore, touching the pulley, it drives it, and the band being there most stretched is taken into the position shown by the dotted lines; hence this portion of the band falls upon the larger diameter of the pulley, and is carried in a plane at right angles to the rotating shaft. A few revolutions of the shaft thus causes the edge of the band C to reach the upper or larger diameter as at S. Ultimately, the middle of the band transmits the pressure. It may not be the mathematical middle, but it is the middle, as regards density and elasticity; and although it may oscillate to one side or the other of the upper line, S, it is again driven back. It oscillates about the middle, owing entirely to the difference between the degree on which the outside and inside edges are stretched. Therefore, we have no need whatever to do anything to keep bands in their places, except give them a high point in the pulley to ride upon, and there they always stop.

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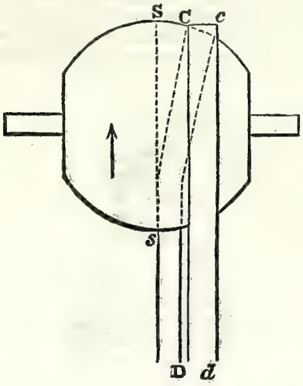
* Many such formed pulleys are seen along the railways, guiding the cord or wire from the signal-post to the semaphore.

Fig. 25.



Another point about these bands is their great rigidity. Hence a question of some consequence arises, namely, that the pullies should be of large diameters, and not too near each other. Nothing is more injurious to the band itself, and nothing involves a greater loss of power than attempting to bend a rigid band round a small pulley.

So far, then, for bands and cords. Chains, however, are also used for these purposes. Chains, bands, and cords, as generally used, transfer a motion not regularly, that is to say, they do not transmit it with a definite and decided law, because there is a certain amount of sliding and slipping, and it becomes a very serious question if it is possible to arrange a flexible connector between a moving shaft and one to be moved, which shall transmit a velocity ratio identical with that which can be transferred by rolling and sliding contact. There are wheels with what may be called teeth upon them, not teeth in the sense of toothed-wheels driving other toothed-wheels, but teeth for a particular purpose, and chains made with links of a particular character, so that each link of the chain is held by a tooth of the wheel. The consequence is, that supposing another similar wheel engaged in driving this one, then the velocity ratio of those wheels would be preserved throughout the whole of the course. Thus the chain becomes, in fact, a flexible wheel with internal teeth, driving another wheel in the same direction, as it would if it was a circular wheel with internal teeth. There are other chains which hook upon hooks similar to those on the flanged pulley E, Fig. 24. A contrivance like this was used in the first mowing machine. Here are other forms of driving chains, this is one used in watches, chronometers, and clocks—chains that may be bent in one direction but not in any other.

The use of wrapping connectors is very old; it was one of the earliest modes adopted for driving machinery, and here is one of those lathes which has given the name to the tool we now have, though our present lathe bears no more resemblance to it than do substances that never were like each other. Although in a course of lectures on mechanism so universally useful a machine as a lathe could not avoid notice, yet the primitive form of the instrument seems to have been "improved out of existence."

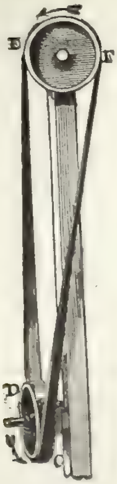
In Clerkenwell, however, the original lathe is still in use, and the construction of one is this:—A long lath, or elastic branch of a tree, is put over a beam, one end being held firm; at the other end, therefore, is an elasticity similar to that in a bow. A cord from the end of the lath passes round a piece of wood roughly shaped cylindrically with a hatchet, thence it passes to a treadle, which, in the one before you, is nailed to the floor by a piece of common shoe leather. The whole tool is thus complete, and motion is given by pressing the treadle. When the pressure is withdrawn the spring of the lath takes the cord back again, and so a backward and forward motion is obtained. Whatever may be the amount of time occupied in turning one way, there is an equal loss of time in turning backwards. Whilst so returning the workman withdraws the tool, replacing it as the work comes forward again. Therefore half the time of the man is lost, while the work goes backwards. There are two trades, and perhaps only two, in which this antiquated lath-lathe cannot be dispensed with. No mechanism has yet enabled the artisan to replace what we should call the rough-and-ready varying travel of that lathe. The two trades in which it is used are the watch-case makers and that of making brass water or steam taps. On looking at the case of a watch you will find in the rim one or two hinges. These hinges are stops to the turning tool. Hence very short arcs of circles have at times to be turned or "milled," too short and too varied to permit of special adjustments. Hence, chucks for segment-turning are not available.

No doubt mechanism might be invented, but the time lost in setting the mechanism would be more than the time now occupied in doing the work. Therefore, a man skilled at the trade—and one man told me he had been working at one of these lathes 30 years—can turn half-an-inch, or two or three inches, or not a quarter of an inch, of a circumference of 8 or 9 inches.

Emerson, for whom a mechanic ought to have great respect, suggests another mode of retaining cords in pullies, that knots should be put upon the cords in order that the pulley might be driven, and the cord instead of being smooth would be covered with knots, which would hold in the roughnesses of the pulley and so drag it round. As to the smooth pulley F, Fig. 24, here is Young's book, entitled "A Course of Lectures upon Natural Philosophy and the Mechanical Arts," delivered in the Royal Institution of Great Britain, and printed in 1807. Now, let us see what Young in that day wrote. He says (Vol. 2, page 183), "When a strap runs on a revolving cone, and is sufficiently tight, it advances towards the base of the cone and does not slide towards the point; for the edge of the strap nearest the base is driven more rapidly than the other, and the portion advancing towards the wheel is driven towards the base. Therefore, in order that a strap may remain on the middle of a wheel, it must consist of two portions of cones joined at their bases, and if rounded must be convex, not concave at its circumference." Thus we have in 1807 the true principle laid down, and yet, in 1872, the question is still occasionally discussed.

Straps are very peculiar in their behaviour. Not only are they disposed to stop on a pulley that is not level and reach the highest point, but they will do what sometimes mechanics try in vain to make them do; for if you observe the laws that govern them they will most willingly "drive" round corners. Nothing is more easy, and nothing is more difficult—if not done in the right way. Here is a pulley at the bottom of a shaft and one at the top, at right angles; as you see, there is no difficulty in making the strap turn this right-angled corner. There is nothing to hold it on, but it keeps its place. Yet, if the driving pulley be turned in the other direction the strap will not keep on. The principle is very simple, and applies to shafts oblique to one another as well as to shafts at right angles to one another. The mode of operation to secure the strap remaining on is this.—Ascertain the point where a perpendicular to the two shafts could be drawn. Draw a line in fact from one shaft to the other, at right angles to the two shafts. The upright, in Fig. 26, is clearly perpendicular to both shafts. Now, take from that perpendicular a distance for the top pulley equal to the radius of the lower pulley, and for the lower pulley a distance equal to the radius of the top pulley. The radii of the pullies are the portions involved. If the distance from the perpendicular to either pulley be too great, then you will observe that the point on the pulley where the strap enters is not in the plane of the other pulley. All that is needed to retain a strap in its position is that it should leave one pulley in the plane of the pulley on which it is to travel. It must be entering in the plane of the pulley to be moved. It may leave a pulley in any plane, but it may not enter in any plane.

Fig. 26.



In Fig. 26 the direction of the motion of the strap is shown by the arrows. Remembering the previous explanation, it will be noticed that the point E in the upper pulley projects or overhangs so far as to be in the plane, passing through the lower pulley D C. Therefore, when the strap is entering on the lower pulley, there is no tendency to run off. Again, the lower pulley D C is so placed that the point C is in the plane E F, and therefore the strap does not leave E F. Not only so, but a small deviation from the true planes may be permitted. For there is, as it were, a contest between the curvature or rounding, as in F, Fig. 24, of the pulley, and the tendency to run off. If, now, the direction of motion of the driving pulley be reversed, then the strap immediately falls off, in accordance with what the preceding reasoning led us to suspect. It is discreditable to a mechanic to hold straps or pulleys, or to use guide pulleys under many circumstances in which these are placed. Whoever does so may perhaps be a good mechanic, but he is a poor mechanician.

If straps have to be shifted on pullies it should be done when in motion. They are then easily moved, but not so when they are at rest, for there is all the force of their cohesion on the pulley, which causes them to drive it, but if they are moving the strap needs only to be guided, and the pressure of the hand at one side throws the strap to another part of the pulley immediately. That is the only mode of moving the straps with ease. For thus, in fact, the machinery moves the strap, and the workman guides or directs the machinery by his hand on the strap, as a coachman directs the horses by his hand on the reins.

Fig. 27

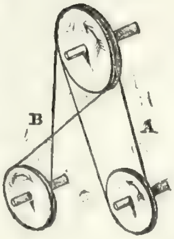
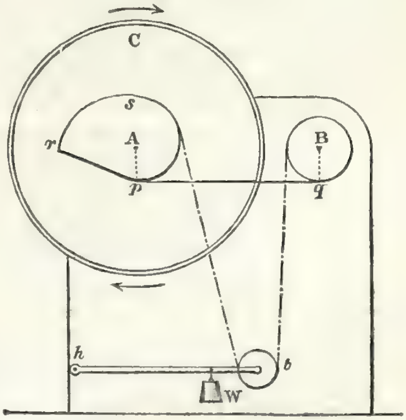


Fig. 27 is a diagram with cords showing how they may be arranged so as to cross each other as at B, or act direct as at A. The advantage of crossing is this, that a strap embraces more of the surfaces of the pullies. Nor is it with cords only that this crossing may be accomplished. The half-turn given to crossed straps in passing from pulley to pulley so accommodates itself to the construction that at B the straps pass without even touching each other.

Fig. 28.



Cam Pullies.—These are not generally used, but they have properties which might under many circumstances be utilized. Fig. 28 represents an arrangement by which the peculiar action of cams may be studied in their transference of motion to cords. C is a pulley driven in the direction of the arrows; *s r p* is a cam, around which is passed the cord. From *p* the cord passes to *q*, then round the pulley B and under the stretching pulley *b* to *s*, *r*, and *p*. W is a weight which by means of the arm *h b*—hinged at *h*—maintains the tension of the cord.

Assume that the cord is round the circumference of the circular pulley C, then the point *q*, in the line B *q*, will be moved uniformly round the centre B, and the directional relations and velocity ratios will be constant. Transfer the cord to the position shown in Fig. 28; then the motion imparted to B *q* will be a variable one. The travel of *q* evidently depends upon the length of cord passing off the cam, *s r p*. Now the cam may be fixed on any part of the face of the pulley C.

If it be so fixed that the centre of the pulley A is within the cam, then the directional relations of the motions of A and B will be constant, but the velocity ratios will be variable.

Let the centre A, and the cusp *r*, coincide, then in *q* there will be a period of rest. Hence whilst the directional relations are constant the velocity ratios are such that one has vanished and motion has become rest. This therefore is a transition stage.

Let now the centre A be without the cam, the point *q* will advance, pause, and then retrograde. Thus, with a cam pulley and a cord, we may, without any alteration in the mechanism, pass from directional relation and velocity ratio constant to directional relation and velocity ratio both varying.

One example of an application of a cam to produce a variable circular velocity in the slide-rest of a screw-cutting lathe may be given. Some years ago the connecting and other long rods in engines were "barrelled," that is, they were in longitudinal section curved, being of a larger diameter in the middle than at the ends. Upon the proportions of the varying diameters much of the beauty of the curve depended. Uniformity was secured thus:—The handle of the slide-rest was removed, and a cam (as *s r p*, fig. 28), or some other form, was fixed in the stead of the handle. A cord was passed round this cam, and one end tied to the end of the lathe-bed. As the slide-rest was advanced uniformly by the action of the change-wheels, the cord caused the cam to be moved at a varying rate. Having given the required data, it was then easy to form a cam which should give any predetermined curvature to the "barrelling."

Here is an apparatus containing two pullies of different diameters. It is an old-fashioned Chinese windlass, one of the oldest of wrapping contrivances. The object is to get a motion dependent on the diameters of the two pullies. You will find that a very large amount of cord passes, and a very small motion of the weight takes place. This arrangement has been chiefly regarded as an illustrative experiment until Weston's pulley blocks were adopted; then, by a peculiar contrivance, that which was nearly useless, owing to the large amount of cord needed and the small motion resulting, became useful, and is now frequently met with in the workshop. Here is a pair of large pullies by which the action can be seen. The peculiarity is that there are grooves cast in the rims of each of these two pullies, and the links of a chain drop into them, so that "slip" is destroyed. If the chain does not slip it is held in, and must force the pulley round. One man can lift heavy weights with great ease, leaving them suspended in any position without a counterprise. The weights are lowered by drawing the chain in the reverse direction.

There are various other arrangements of strap gearing, both for the reversing of motion and for producing variable motion, which have been kindly lent. Here is a machine for reversing motion, and producing different velocities. There are two spur or toothed wheels of different diameters, so as to give two speeds. One wheel is brought into use, causing the tool to do its work, and the other wheel causes the tool to run back at a much quicker speed, the reverse motion being obtained by changing the strap from the outside pulley at one side over a loose pulley in the centre on to a pulley at the other side, so that there is a period of rest between the two, preventing any jerk in the machinery. Here is another of the same principle, but without variable velocity. Here is one with two straps, one being crossed. Observe, there are four pullies—the two centre ones being loose on the shaft. The direction of the machine is determined by moving either the crossed or the other strap on to its correspondent outer pulley.

This subject of strap gearing is far from exhausted. We must, however, turn to a piece of mechanism which is as extraordinary as any ever invented. It is a machine for making cards. The cards which it makes consist of very fine pieces of wire bent and pushed through pieces of leather. They are used for the combing of cotton. Cotton fibre, before it is manufactured into thread, must all be laid in the same direction, and these cards do with the fibre what we with combs do with our hair.

Messrs. J. Thompson and Co., of Kendal, have kindly sent one of their machines, and a piece of the leather card it was making before being taken down. The machine is in working order, and, as it may remain in the rooms of the Society of Arts for a short time, those who are curious in the matter of cam-movements will have every opportunity of examining it.

This piece of leather, through which the bent wire is to be put, passes between two grooved rollers, and is led over a pulley, being stretched by a weight of twelve pounds. On the right hand of the machine is a light lantern-wheel, which carries a coil of wire. There are no toothed wheels; it is exclusively a cam-machine. Upon one short shaft are thirteen cams, each of which takes its part in a proper sequence in one rotation of the shaft. On the black board is a statement of the sequence of actions, and a few notes as to the character of the cams:—

Action of Cams in Cardmaking Machine.

Cams.	Duties.
1	grips the wire to be advanced.
2	advances the gripped wire.
3	holds firmly the advanced wire.
4	cuts the advanced wire to the required length.
7	actuates prickers of the leather.
8	withdraws prickers.
5	advances fingers to hold and bend the wire.
6	withdraws bending fingers.
9 10	cause the bent wire to enter the pricked holes.
13	raises front nippers and bends the wire.
11	releases the wire-holding pieces.
12	advances a skeleton stepped cam-wheel.

Notes on Cams in Card-making Machine.

1, 2, is a double cam; 1 grips the wire by a cylindrical contrivance; 2 advances it by a swash-plate.

4 not only operates on the cutting-blade, but causes the machinery to stop if the wire should be broken.

5, 6, 7, 8. These rotating cams act in combination with inclined planes which are rectilineal cams—and with springs.

The very fine wire, about the size of a full stop on a page of the *Journal*, passes through a small hole, above which is a pin that can be pressed down so as to hold the wire, and lifted up to release it. When the wire is gripped it is advanced as far as is needful, being adjusted for any required length by a set screw.

As soon as it is advanced, this piece lifts up, leaving the wire so advanced. Another piece now comes down and grips the wire. The piece which originally advanced it goes back and repeats the same operation. The piece that held it down after being advanced retains its hold until a couple of pieces like fingers, operated upon in the centre of the machine, come forward, and a third piece corresponding to them comes from above, so that the wire lies across the two underneath, and the third holds it above. It lies there freely. Whilst so lying another operation is performed. The wire is now lying in what may be called a loose grip, and a motion then takes place which pushing two fingers a little in advance, the wire is gripped firmly. Whilst thus held, as in a vice, two other fingers come forward and bend it. They bend it forward and then close in, causing the points of that wire nearly to touch each other. That, however, is not what is wanted, but the wire has a certain amount of elasticity, and the pressure of these fingers beyond what is required is just sufficient to overcome this excessive elasticity. These bending fingers then withdraw, the elasticity of the wire causes it to open so as to remain with its bent ends exactly opposite the two small holes which have been made in the leather at a previous stage by two prickers. The wire being passed through these two holes as a thread through the eye of a needle, two hooks rise up on the outside, close in, clip the wire, and bend it down, and you will find, on examining this card, that all the wires are bent exactly alike. When so bent, all the operating pieces withdraw, and the wire is left in the leather. Then it is that an action takes place which advances the leather ready for another operation. The processes are these. First, the wire is gripped in the way described by a piece falling upon it; the gripped wire is then advanced. Having been advanced, a piece drops and holds the advanced wire as in a second vice. Whilst so held a knife comes forward and cuts off the required length. These two fingers, previously described, hold the cut-off piece, which has been laid, as it were, upon them; they hold it balanced, projecting an equal length on each side. Whilst so held, a piece descends in front, and, in combination with the two fingers, grips the wire firmly; then two other fingers come forward. Whilst that is going on with the cut-off wire, two little prickers make holes in the leather, through which the wire is to be pushed. A cam withdraws these prickers, then the bending fingers begin to act; when they have bent the wire to the proper position, those bent fingers withdraw themselves and the holders insert the wire through the leather, the hooks in front coming up and bending the inserted wire. Now a wheel, such as few if any in this room have ever seen, called a skeleton wheel, moves. It is a kind of compound side cam stepped wheel, an outline of which has been traced on the board. It is gripped by two clams, and every time the wire is advanced this wheel causes the leather to be pushed sideways. The cams which work the machine are some of them single cams, some swash plates, and some compound cams. There is also one cam which has a very peculiar province. It has no part in the mechanism of the work, but it does this. There is a cam which cuts off the wire at the proper length with a little knife. Upon the wire rides a piece of light metal. This light metal rests as it were upon the wire, so that if the wire should break the light metal would fall down a quarter of an inch, and that falling of a quarter of an inch causes a small piece to rise up which stops the whole machine by throwing the strap wheel out of gear. If the piece of wire were to break, unless the machine were stopped work would go on, the leather being perforated and no wire inserted. It is essential, therefore, that the whole of the machinery should stop when the wire breaks. A similar contrivance causes the stoppage of large silk and cotton looms in case the shuttle thread be broken. Although the black board may have made some parts clear even to those at a distance, yet if a nearer inspection be desired, it can be had either now or in the course of the next ten days.

CORRESPONDENCE.

ASSAM AS A FIELD FOR PRIVATE ENTERPRISE.

Sir,—Having read in your *Journals* of 15th March and 5th April, papers by Mr. F. Campbell, on "Assam as a Field for Private Enterprise, with special regard to Tea Cultivation," and having been resident in that province myself for some years, I take the liberty of correcting a few misconceptions, and adding a few remarks, which may be interesting to some of your numerous readers.

Lower Assam. and the lower half of Central Assam, do not, in my opinion, present a desirable climate for European settlement. I found them decidedly unhealthy. But my experience of Upper Assam is quite the opposite. No doubt the soil of the former is very rich, and I believe there would be practically no limit to its productions, but it cannot compare with Upper Assam, say from Jorehaut to Suddya, or rather Saiqua Ghat, for Suddya is on the northern side of the river, and the land is very poor for many miles northward from the river bank on that side. Now, an imported coolie costs, landed in Debrooghur, from 55 to 62 rupees, not from 40 to 50 rupees; however, it must be remembered that I speak of prices in 1869, 1870, and 1871. Mr. Campbell states that sâl timber is impervious to white ants. Unfortunately, I must differ with him. Almost all the planters' bungalows are built on sâl posts, the walls being composed of a thick, strong reed, called "ekra," bound between strips of bamboo (say 18 inches or 2 feet apart), with bêaut or cane rope, the cane being got everywhere, and of various thickness. This is split into long strips, and is stronger than any hempen rope, and quite as lasting as the ekra. Being fastened to timber scantlings, it forms a good, clean, and strong wall, and when plastered on both sides, presents an appearance equal to any brick wall, and is by far drier. The platform of the house is generally from 4 to 7 feet from the ground, leaving free passage for the air underneath. Well, on many occasions I have passed my riding-cane six inches into several of those sâl posts, and sometimes right through, disturbing the ants considerably. As an officer of the Public Works Department, it was my official duty to examine and report on the state of all the government buildings in my district while on tours of inspection; and the number of beams and bugahs, &c., I have found quite rotten I would not venture to state. Only three weeks ago, in Tirhoot, while at breakfast in a friend's house, I remarked a few beams that looked doubtful, and requested him, if he valued his safety, to have them examined that day. A "burky-mistry" (carpenter) was sent up, and the head of his hammer disappeared. He came down double quick, and I cleared out also, and that room was quite empty in twenty minutes. Two of the beams were quite rotten. One would last another season, he said. Now the shell of those beams was perfect, but I observed certain dirty stripes, like small cracks, appearing through the paint, and I knew of old what that meant. Nahoar lasts many a long year, but trees of any size are scarce. Kerai is so hard that it is not worth working, and is scarce also. Cuttûher, or jack (a fruit tree), stands longest, but trees of any size are very scarce. However, as far as the ants are concerned, if we could only understand them, I believe they are as particular over the age and state of the wood they attack as any gourmand is over the age of his haunch, or the smell of his grouse or woodcock; and every tree is doomed when it becomes, according to their taste, ripe.

Now, as to the advisability of selecting lands within the area of the inundations. That seems an extraordinary suggestion. Surely water leaves its mark plain enough, and why should a stranger expose himself to the almost certainty of a fever, the effects of which may last for his lifetime, and make him rue the day he ever saw the country. Assam fever is no new sickness, and its tenacity in holding on through a series of years, and the terrible prostration while it lasts, many an unfortunate resident can tell to his sorrow. Health is first, worldly prosperity may follow after. I have painful reminders sometimes of the Assam fever, though I have met many who suffered more severely, and are still nearly as bad at times as I was at first. Most assuredly any settler who may be induced, through reading Mr. Campbell's statements, to go to Lower or Central Assam between the months of June and October, will not feel grateful for his advice. I knew one case of a young, active fellow, who had money, and wanted to start a garden, and after the eleventh day he turned and fled. He would not wait to see the sun; if he had, he would have remained in all probability. One intending settler was saved through a friend telling him to go up in the rains and look for land; he blessed that friend afterwards most fervently for his escape. Travelling in the rains is enough to damp the ardour of the most sanguine, and prospecting is much worse. Many a time have I taken nine hours to do that number of miles. You come to a stream, yesterday 40 feet wide, and find a torrent 200 yards, the flooring of the bridge caught in some tangled jungle, and floating here and there, while the rain is coming down like a shower bath, and smiting you like hail. You take off your traps, get them on a high spot—if you can find such on the road, for each side is jungle, dense, and like a sponge—get the tarpaulin over them, then take off the guddy, or pad, and lie on it, thoroughly soaked with rain, then send in the elephant to test if it is shallow enough to get across with his load. This precaution is necessary; for, though the sagacious beast is as cautious as possible, a bit of the bank may slip, and down go your traps under the water, and it may be a week before they are dried, if indeed they are not completely destroyed or lost. If unsuccessful in finding a fordable spot for the elephant, the mahout takes his chains and ropes, and tracks back to the nearest large stream, gets a dugout (boat made from a single trunk), and drags it up. This is an hour at least, and may be more. You at last get your traps in and float over, load up again, and off; and loading up is not a pleasant job—a wet guddy, wet ropes, and a wet elephant, carrying the sahib, the mahout, and the grassee, who cuts jungle for the elephant, through the wide-spread inundation, broken only by occasional verdurous islands, where the higher lands surmount the level of the floods. I am here describing one of my own journeys in the rains; and after crossing the next stream—when I had all the leeches taken off the legs and belly of my elephant, say 35 or 40, as thick as my middle finger, and twice as long—I cast my eyes around for some ark of refuge, and resolved that the next hut I came to should be my halting place. Fortunately, two other rivers were fordable, and I soon reached a planter's hospitable house, where, after a good bath, and a peg, I felt quite comfortable, and no cold or fever followed. One journey of this kind my friend, the intending settler, had gone through, and who can wonder at his bolting. The revenue survey officers are sometimes very hardly treated in being sent out in the rains; but no department in India can more fully tell what such hardship is than the officials of the Public Works Department. Police officers may, on rare occasions, be obliged to go out in the rains, but we must be constantly about. Evidently Mr. Campbell has not had any hydropathic experiences of Assam.

I remember once a spell of 30 days and 30 nights' rain unceasing in June, 1869, and I was elephant travelling with another gentleman for four nights and five days, and was none the worse, though, in very truth, I was not once dry during the whole time; but planters are stationary, need not travel in the rainy season, and can be very snug within doors, always selecting the high lands, beyond reach of the inundations, for their huts or bungalows.

On the other hand, let the stranger come here in November, and thence up to May, then, indeed, he will fully endorse Mr. Campbell's idea. Then the climate is unsurpassed, I believe, in the known world. The great variety of strange and lovely orchids, &c., the gorgeous flowers of the creeping plants that festoon the trees along the roads—and often right across—the bright plumaged birds, keeping up an unceasing song of praise to the great Builder and Maker of all, who lavishes such fertility and beauty with an open hand on every side. Then look for your spot of land, and mind the water-mark, and you will do your work and gain your end, and also learn a lesson by resting an hour, and contemplating God in nature, for truly the land is one of wondrous beauty, and a man feels the better of seeing such wealth of loveliness and of useful natural productions lying unappropriated—almost unknown—in the picturesque vales and forests of Assam.

I bear distinctly in memory many a detached spot of scenery where the diversified surface, the richness of the soil, the luxuriance of the vegetation, the view, limited, but lovely still, and the situation all combines to make, with very little toil and care, a miniature paradise; water-carriage within 20 yards, and every material needed for your house and garden on the spot, awaiting and inviting the hand of industry.

It is truly a glorious land, and fertile beyond all description. The skill of man and money, the great civilizer, will yet make Assam the garden of India, and the brightest jewel in our Empress's crown. Gold is in her rivers—I saw it in the Dihong-Dibong, above Suddya—and I am persuaded immense mineral wealth only requires enterprise to bring it to light.

As a field for the sportsman, too, Assam is unrivalled. Let him take his rod, rifle, and fowling-piece and go up to the Brahmapootra and among the Upper Assam planters, between the 5th November and the 5th February, and ply his vocation, from cheerful morn to dewy night serene, day after day, and when he goes home to the dear Fatherland let him tell what he has seen, and my poor attempt at a description will be a meet preface to his words.—I am, &c.,

R. Langford Locke, C.E.
Officiating Executive Engineer, P.W.D., Patna
Division, Bengal.

Dinapore, 22nd May, 1872.

WOOD OR ASPHALTE.

Sir,—Wood paving seems to be again rising into favour, and the battle is raging between the wood companies and the asphalte companies, and thereupon I beg to state that neither material has had as yet a fair trial, nor will have so long as our present Patent Laws may subsist, for they constitute the most fearful opponents of any public improvements. Any proposal, however simple and practicable it may be, if it cannot be screwed by legal fiction into a form capable of holding a patent right, such proposal must inevitably sink ultimately into the Slough of Despond.

Wood pavement is exactly a case in point, for, in order to secure the possibility of a patent right, the timber must be cut and pared into some patent shape, by patent machinery, otherwise no one will be found to take up the work.

Now, the only wood pavement fit to stand London traffic, and entailing the smallest cost, could not be patented by the most astute lawyer. Instead of fashioning the blocks into patent dice, hexagons, polygons, or dove-tailed complications in any form, we have only to slice barked trees of any size or quality into cylindrical slices about thirteen inches in thickness, and put the largest size down first into a good rammed foundation, and then the smaller sizes, until the remaining interstices may be filled up with what may be called pegs, the proper ramming of which will render the whole one solid mass of timber, while the economy of wood is so great that not a chip will be wasted. The surface will present end-grain only, and with the different sorts and sizes will afford a much better foot-hold than granite blocks. I should like to know how any patent lawyer would set about working this mode of proceeding into a patent-right system.

The most recent proposal for planking the whole street under the patent-shaped wooden blocks is absurd in every respect, only suited to the range of a parish vestry, and will be found ruinously expensive, and impracticable for repairs after having been opened up for a succession of water, gas, telegraph, and sewage pipes, a matter of daily occurrence in the London streets.

I do not trouble your readers with any comments upon the rival principle of asphalte, as I have published my views on that material, and will conclude by stating that the ultimate and general adoption of either material will add four years to the life of cattle, and ten to that of the vehicles using the London streets.—I am, &c.,

Henry W. Reveley.

Reading.

THE COTTON INDUSTRY IN AUSTRO-HUNGARY.

The principal seat of the cotton-spinning trade in Austro-Hungary, according to the information furnished upon this subject by Count Andrassy, is Bohemia; next in importance are Lower Austria and the Vorarlberg. Scattered in the other western provinces of the empire there are smaller spinning manufactories. Hand-looms are fast being replaced by machinery, and there are now 1,500,000 machine-spindles at work. The numbers in Bohemia are 600,000; in Lower Austria, 484,000; in the Vorarlberg, 210,000; the bulk of the remainder are distributed over the Tyrol, Upper Austria, and Styria, with a few in the other provinces. With regard to Bohemia, two-thirds of its spinning is done in the district of Reichenberg, where the chief manufactories are situated. The oldest manufactory in that province and in the empire is at Kuttenberg. It has been at work since 1787. Some of the others date from the Continental blockade, but most have been established since 1830.

The spinning trade in Lower Austria, which increased very quickly at first, has, since the great cotton crisis, somewhat declined in face of the rival manufactories of Bohemia. This decline must be attributed to the decrease of water-power in Lower Austria, and the consequent necessity of applying machinery; to the greater expenses, as compared with Bohemia, incurred in the transport of the raw material from Liverpool, the principal mart for American and East Indian cotton; and to the inferior machinery used in Bohemia. In 1866, Lower Austria had 46 manufactories, with 600,000 spindles at work; in 1870, 34, with 517,083 spindles; and in July, 1871, 32, with 484,055. As compared with the year 1869-70, there is an increase in 1870-71 in the number of spindles at work of 68,416. The number being in 1869, 399,629; and in 1870, 468,045. The largest manufactories in 1871 were those of Truman-Marienthal, 67,584 spindles; Pottendorf, 57,688; and Teesdorf, 23,372. The most important manufactory in Vorarlberg is at Kennelbach, near Bregens, 27,000 spindles. The new manufactories of Upper Austria, three of which are in Kleinmünchen, have 91,888 spindles; and in 1867 converted 27,379 cwts. of cotton into 25,236 cwts. of yarn.

Thread-making is carried on chiefly in the makers' houses and in manufactories expressly devoted to it—only a few of the large spinning manufactories take part in this trade. Its principal centres are Lower Austria, where there are from 15,000 to 16,000 spindles; and Bohemia, where, at Karalitz, there is a manufactory of 6,400 spindles, which monopolises the greater portion of the trade. Hand-loom weaving, which was formerly very general throughout the monarchy, and filled up the spare time of the agricultural population, has been during the last fifteen years almost supplanted by machinery. Common looms are those most used in houses; not more than 15 per cent. of the entire number at work are regulator looms. One-half of the weaving is done in spinning manufactories; the other half in manufactories exclusively devoted to it. The number of mechanical looms at work is at least 150,000. Weaving is chiefly carried on in the provinces of Bohemia, Lower Austria, Vorarlberg, Moravia, Silesia, Upper Austria, and Tyrol. In the other provinces the trade is unimportant. In comparison with the other provinces, especially Lower Austria, mechanical weaving has been much developed in Bohemia, where it is favoured by the cheapness of labour and fuel, and the proximity of the best markets. About 70 per cent. of the weaving manufactories of Bohemia are in the Reichenberg district. The trade in cotton goods, especially the Gladbachner branch of it (cotton hose and clothing) is concentrated in Warnsdorf and its vicinity, and, under the name of Warnsdorf manufacture, enjoys a great reputation. Next to Warnsdorf, Rumburg, Friedland, Sommitz, Neupaka, Rochlitz, and Hohenelbe, are the most important places for this trade in this district. At Taunwald and Swarrow there are manufactories of 480 and 400 mechanical weaving looms.

In the Prague district, Beraun has 424, Smikow 350, mechanical looms. In the Eger district, mechanical and hand-weaving are confined to certain places. Purstein has the largest manufactory, 435 power looms. In Lower Austria weaving is divided into three branches—one producing *articles de mode*, and employing 120 looms in Vienna and its vicinity, which is fast being banished from Vienna itself to the country by wool and silk-weaving; the second, producing all sorts of fine goods, especially organdine muslins and baltists, and employing 5,000 looms in the district of Waldviertel; and the third, machine weaving, confined to nine manufactories, with 2,800 mechanical looms. The woven goods of Vorarlberg are produced by a number of manufactories, the chief of which is at Dombin, and by hand-looms. Light goods are principally made. In Moravia, the manufacturing of cotton goods is chiefly done in piece-work, and the chief centres are—Zittau, where is the Barchen weaving factory; Marisch, Trubau, and Datchitz, in the district of the Chamber of Commerce of Brunn; and Prossnitz, Sternberg, Frankstadt, Mislek, and Schildberg, in that of Olmutz. In Silesia the weaving trade is concentrated at Friedek and neighbourhood. In Upper Austria, the most important of the four factories, with 356 looms at work in 1867, is at Kleinmunchen. In the Tyrol, there are large factories at Innspruck and Schroarzach; in the province of Görz, at Strazig.

There are few factories in the monarchy specially devoted to the production of the finest cotton goods. The principal of them are the chenille factories, very flourishing since 1865, and the fringe and galloon factories of Vienna. Perkals are chiefly made in Bohemia and Moravia. Lace, bobbinet, and tulle, at Vienna and at Lettowitz, in Moravia. Niedergrund and Georgenthal, in North Bohemia, are most celebrated for plushes and velvets. Cotton ribbons are chiefly made at Vienna and Great Sieghardtz, in Lower Austria, and in factories and by piece in the districts of Schluckenan, Hainspach, and Aussig-Türnitz, in Bohemia. This branch of trade is so prosperous, that a very insignificant quantity is imported. Of importance are likewise the manufactories of furniture stuffs, mixed wool and cotton, woven, smooth and striped; they not only supply the home market, but likewise export their produce to the Danubian Principalities, Russia, Italy, Denmark, and Holland; lastly, great perfection has been attained in the manufacture of table-covers and gobelins. These articles are highly appreciated in the English market as well as in many others. In printing, dyeing, and dressing, great progress has been made within the last few years, especially as regards beauty and execution. Bohemia is the principal seat of this trade. The calico factory of Kosmanos is one of the first rank; it employs 700 hands, and owes its celebrity to the application of Krapp's extract to calico-printing. Considerable printing factories exist also in the Reichenberg and Prague districts. Their produce—jaconets, calicoes, and cloths—find good markets in Austro-Hungary, Prussian Silesia, and Hamburgh. The dyeing and dressing trade is concentrated in Bohemia, at Wornsdorf and vicinity, at Rumburg, Schluckenan, Georgenthal, and Zurichan, in the Reichenberg district. There are few exclusively cotton bleachers, but most of the numerous bleaching machines near Reichenberg are constructed for cotton bleaching. In Lower Austria there are several small calico printing factories. For many years muslin has ceased to be printed to any extent in Austria. The principal factories of this province for dyeing, bleaching, and dressing, are in Vienna and its neighbourhood. In Vorarlberg there are also numerous bleaching, dyeing, and printing factories of considerable extent, principally occupied in the production of variegated kerchiefs for the head, neck, and shoulders, for the greater part of the empire; next to these in importance for similar articles are the factories of Upper Austria, Moravia, and Hungary.

THE RESOURCES OF SOUTHERN PERU.

The opening of the line of railway from the Port of Mollendo to Arequipa marks the era of a totally new national life in Southern Peru. Although comparatively trivial in its length, about 108 miles, this railway is the first instalment towards the traffic connection between the city of Arequipa and the farther interior places of Puno, Cuzco, Moquegua, and their dependencies, as well as Bolivia, and between the whole of them and the seaboard, whilst the very rapid development of navigation and commercial activity in the Pacific, and the increasing intercourse with the populations on the Asiatic side, impress a totally new significance upon the penetration of the interior by practicable courses of traffic. The chief mineral, vegetable, and pastoral resources of the country, which are enormous, are to be found far inland, converging upon those cities, and hitherto cut off from the Pacific coast by the breadth of an arid and seemingly inhospitable tract stretching westward from the Cordilleras, and measuring 100 miles, more or less, which has afforded no other means of transit but sumpter mules, and which has been chiefly dependent for the necessaries of life upon the navigation along the coast, whereas the incalculable riches of the wonderfully varied and intact indigenous products abounding in the heart of this great and prolific continent can be opened by enterprise by way of Cuzco more directly, except as to ocean transit, from this tract than from the east by way of the Amazons.

Mr. Consul Vines, in his report upon the district of Islay, which he describes as the Peru of the Peruvians, having regard to the characteristic isolation of the people, informs us that the reserve resources at the command of the Peruvian government in the depôts of guano alone, are reputed to represent above £300,000,000 still free from incumbrance, enabling the State to contemplate the liberal subvention of useful public works. The risk and enormous relative cost of opening up railway communication have devolved upon the government in the name of public utility, which has been prompted fairly to pierce the main trunk of the Cordilleras athwart elevations of more than 14,000 feet of rugged difficulties, separating the fertile valley of Cuzco, the inexhaustible mineral wealth of Bolivia, besides the great mineral regions of the Peruvian interior, the large inland waters of Titicaca, and even the head waters of the Amazon and its greatest tributary, the Madeira, from the highway of the west coast, within the trade of this part of Peru. And the cost set down for the first 108 miles has been £2,250,000; the estimate for the 220 miles contemplated to Puno £6,250,000, and the rest in proportion for single lines throughout, making in all about 640 miles of railroad; whilst it is probable that the ultimate total outlay will materially exceed these figures before the lines be fairly completed. When the interior is rendered accessible up to the eastern boundary, the population of the interior are likely to find profit in the wake of eager mineral explorers. This is the more fairly to be taken into account, for the mountain territory to be traversed by the railway forms, so to speak, an irregular basin and mineral receptacle in the chain of the Andes, in different parts of which the precious metals, including platinum and highly-prized jewels, such as the diamond, sapphire, and emerald, do exist in fair quantities and under very favourable conditions for exhumation, in a country not more remote from the equator than from 13° to 17° south, yet tempered by an elevation mostly of 10,000 feet and upward, and by the vicinity of perpetual snow. Not much has heretofore been made of these resources, and the famous Mina del Manto, near Puno, has been abandoned, even by English adventurers, because they could not transport the machinery they wanted to the spot, and because they were too insecure in many respects, owing to circumstances now totally changed.

Whether or not the fertile expanse towards Cuzco and beyond it would be developed as an agricultural country, and increase the native supply of food commensurately with the wants of a largely multiplied population, is a more remote question. Yet, as to the vast pastoral extent for the production of wool, now the only noteworthy article of export, there can be little doubt but that the collection of alpaca and sheep's wool would be likely to become improved and much augmented; whereas the most valuable and silky, but scanty, fleeces of the wild "vicuna" would soon be exhausted in the relentless chase and extermination of the animal, which, under the present system of collection, is killed to obtain its average of 6oz. of coat, to the extinction of future production, and the total loss of carcass. Under actual circumstances the exportation of alpaca wool reaches nearly 2,500,000lbs. weight in the year, and that of the sheep about 2,000,000, but by no means of such quality as might be anticipated from animals descended from Spanish flocks, under conditions of pasture and climate so favourable as they are in the uplands. As to the most valuable of all, that of the "vicuna," the product and exportation is statistically insignificant. In 1869 it amounted only to 8,275lbs., worth little more than £2,000 in Europe, where the value may be set down at 5s. per lb. What this country does not promise to be rendered by any changes resulting from facilities of communication is the seat of important manufactures. However considerable might be the demand for consumption, the supplies can be obtained more advantageously from abroad; and Great Britian has at present recovered a very largely predominant command of the market, having in this respect displaced France since the memorable calamities of that country, dating from 1870, although, beyond the deficiency of her hitherto more favourable fabrics, this country was wholly unaffected by, if not indifferent to, the issue of the struggle of that year.

Official and perfectly authentic materials for statistical illustration of the condition, habits, administration, inland commerce, and so-forth, as affecting the people of these regions, are extremely deficient. The very scantiness of such materials deserves remark, as throwing light upon the inner life of the people, by affording an example of the reluctance of the government to make itself felt, incidental to the unobtrusive disposition of the public mind. Setting aside cases of great wealth, which are more conspicuous in and about the capital of Lima, the resources of all classes are humble though sufficient. The working people are very rarely penurious, and, though they know of few indulgences, they usually have money about them; and, even in extreme necessity, it is questionable whether their feelings would permit them to seek after public eleemosynary aid if it were provided. The inhabitants are generally sober and, in all senses, temperate; they are wiry and enduring, and their wants are few. The climate is healthy, exhilarating, and genial; and the remuneration of all occupation is commensurate with the high cost of what constitutes the necessaries of each class respectively, that is, the purchasing power of the money bears a fair relation to the exertion which obtains it and the wants which it is required to supply. The prevailing national currency of the country, which is abundant and distributed amongst all classes, down to the apparently poor, is chiefly comprised in gold and silver pieces. The paper money issued by the Bank of Lima is also freely circulated, and comprises notes down to five soles each, a little less than twenty shillings, British sterling, in value. The British sovereign circulates freely at 5 soles 47 cents, about 5½ dollars, the sole being rated at 3s. 9d. British. The United States' gold coin is also readily convertible.

With reference to the aboriginal or Indian race, or races, northward of the 35th parallel of south latitude, they have not a tendency to become extinct—like those of North America and Australia—in the presence of modern civilization; nor are they physically, morally, socially, or intellectually disqualified from contributing much to the modern spirit of progress. Possessed of a peculiar but, nevertheless, very striking civilisation of their own, of which the strange archives were ruthlessly and heedlessly destroyed, and predisposed by disposition to appreciate and return a friendly encouragement of intercourse, their cordial relations with the enterprise of their former conquerors and of Europeans would be invaluable, especially to the young and rising States founded upon the seaboard. It would be a wise point on the part of the Peruvians, henceforward to cultivate a cordial understanding with these curious people, and to encourage them by thorough confidence to develop the strength and productiveness of their number and activity—remembering that it was the by-gone and cruel policy of the mother country, and not the colonists that alienated the Indians—and that generous principles will inevitably secure the grateful acknowledgment, respect, and confidence of all enlightened governments and people, and notably of Great Britain.

ANNUAL INTERNATIONAL EXHIBITIONS

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

His Royal Highness the Prince of Wales presided on Wednesday, at Marlborough-house, over a meeting of the Royal Commission for the Exhibition of 1851. There were present his Royal Highness the Duke of Edinburgh, his Royal Highness the Prince Christian, the Marquis of Ripon, the Duke of Buccleuch, Earl Granville, Lord Portman, Lord Overstone, Mr. Ayrton, Sir Thomas Bazley, Sir Francis Grant, Sir Francis Sandford, Mr. Baring, Mr. Edgar Bowring, Mr. Gibson, Mr. Hawksley, Dr. Playfair, Mr. Thring, and Major-General Scott, secretary. Mr. Cole attended the meeting.

Evening Promenades.—At the evening promenade to be held on the 18th July, illustrations of electric science, showing the progress of telegraphy in England, will be given at 9·30 p.m., in the Royal Albert-hall, by Mr. W. H. Preece, of the Postal Telegraph Department.

GENERAL NOTES.

Gas Reform.—With reference to the mention of Mr. A. A. Croll, in the Council's report, a "Member" calls attention to the fact that it is rather for two other services rendered to the public that Mr. Croll may feel a pardonable satisfaction. Firstly, for having suggested the appointment of independent chemical referees to test the purity of the gas, and also the necessity for public officers to examine into the accuracy of the meters. Secondly, for efforts to prevent the undue competition and needless multiplication of gas companies, by means of allotting a separate district to each company.

Experiments with Explosives.—Interesting experiments were recently made by Messrs. Leygue and Champion, to ascertain the temperature at which certain explosives ignite. They used for this purpose a bar of copper, which was heated at one end only. It was provided with small grooves, placed 10 centimetres apart from each other, and provided with metallic alloys of different fusibility, so that the temperature of each part of the bar was easily ascertained. The substance under trial was then strewn upon the bar in small quantities, and the place where it ignited gave the temperature of ignition. Thus was it shown that, for their explosion, was required for:—

	Deg. Cent.		Deg. Fahr.
Chassepot percussion-cap powder......	191	..	374
Fulminate of mercury	200	..	392
Equal parts of sulphur and chlorate of potassium	200	..	392
Gun-cotton	220	..	428
Nitro-glycerine	257	..	494·4
Chasse powder......................	288	..	550·2
Cannon powder	295	..	562·8
Picrates of mercury, lead and iron	296	..	564·6
Picrate powder for torpedoes..........	315	..	598·8
,, ,, musket	358	..	676·2
,, ,, cannon	380	..	715·8

The German Army.—Since the conclusion of the late war, military commissions have been engaged in considering the means of improving the organisation of the German army. The following are the principal questions said to be under consideration:—*Infantry*—Before the war, the transformation of rifles according to the Beck system was commenced; this has since been pursued, and the modified arms are being delivered to the troops; but new models of arms are being constantly tried, and the opinion seems to be that a modification of the Manser gun will be adopted. There is talk of the bayonet being abandoned. As regards tactics, the infantry of the guard is now being put through a series of new exercises, some of which seem likely to be adopted. *Cavalry*—The effect of the cavalry during the war seems to have given complete satisfaction, and little is proposed to be done with respect to that arm, but the improvement of the arms employed. It has been decided that in future one regiment of cavalry shall be attached to each division of infantry, and all the rest placed directly under the orders of the commander-in-chief, each cavalry division to be composed of two brigades, with three regiments in each, or of three brigades with two regiments each. The maintenance or the formation of "chasseurs à cheval," or "mounted infantry," has been renounced, it being the opinion of the commission that the action of the divisions of cavalry will be made more independent and effective by giving the men arms specially suited to them. What changes will be mode in this respect is not decided, or not yet made known; it has been proposed to arm the light cavalry with rifles and cuirassiers, and uhlans with rifles and lances, or to give all rifles only, with, of course, the sabre. *Artillery.*—The first and great change to be made in this branch of the army is the complete separation of the field and siege artillery. It is a question also whether the mounted artillery will not be diminished, as it was only found to be of service with cavalry divisions, and, on the other hand, to form the foot artillery into regiments, as in the French army. Beyond question, the augmentation of the foot artillery is decided upon, but will probably only be carried out gradually. With regard to cannon, nothing seems yet to be decided; experiments and trials are still proceeding, but the opinion seems in favour of Krupp's new cast steel fours and sixes, and against the bronze guns, the adoption of which was under consideration some time previous to the war. The adoption of the shrapnell shell had been recommended before the late war, and partially adopted; but the field artillery was not furnished with them during the campaign, or only partially; but the shrapnells performed great service whenever they were used, as at the siege of Paris, on the 19th of January, by the field artillery, and at Strasbourg by the siege artillery. The armament of the field artillery will now consist of shrapnell and other shells, probably even without mitraille. Amongst the other matters under consideration is a new kind of gunpowder, the effects of which are spoken of as very important.

Aluminum Money.—It has been a question in Paris of replacing the present bronze money by an alloy of aluminum. The adoption was supported by M. Sainte-Clair-Deville, but opposed by MM. De Marcotte de Quivières, the Director of the Mint, and Peligand, chemist and assayer of coin. The reasons *pro* and *con* are not yet made public, but the government is recommended by the Commission of the Mint to continue the experiments with aluminum.

Discovery of a Stalactite Cave.—A correspondent of the *Messager* of Odessa says that a splendid stalactite cave has been discovered at the distance of seven verstes from Soukhoum. It is, according to the report, a long series of caves and galleries, the whole extending over a length of about two hundred feet; the principal chambers are very lofty, and the stalactites remarkably beautiful. Some fossil bones have been found in the caves, and search is now being made for pre-historic arms and other remains.

Sponge Gathering in Tunis.—The sponge fishery, as it is called, is most active in the months of December, January, and February, as, during the other seasons, the spot where the sponges are found are covered with dense masses of seaweed. The tempests of November and December clear away the latter, and allow the sponges to be seen. The fishery has, however, two seasons; one commencing in March and finishing in November; the other occupying the rest of the year. In the summer season the production is small, because diving apparatus is then necessary, and can only be employed when there is a rocky or other firm bottom; but the Arabs search along the coasts, feeling for the sponges with their feet beneath the masses of tangled weeds. The sponges which they find are generally of an inferior kind, as they cannot go into any depth of water. The success of the work of sponge-getting depends upon sea the being calm. The are not more than 40 or 50 days during the winter season which are favourable. The Arabs who inhabit the coasts, the Greeks, and principally those of Kranidi, near Nauplia, and the Sicilians, all engage in the sponge fishing, but the Greeks are considered the most adroit and the Arabs the least so. The gathering is performed by means of a trident, or "*arth*," a kind of dredge, similar to that used for taking oysters. The Arabs employ boats called "sandah," with crews of four to seven persons, one of whom only uses the harpoon. As soon as this man sees a sponge the boat is brought to a stand; the work is carried on to the depth of 15 to 35 feet. The Greeks, although very expert divers, also use the harpoon, but they employ small and very light boats, carrying only the harpooner and the sculler. The former explores the bottom of the sea by means of a kind of telescope, a tin tube about fourteen inches in diameter and twenty inches long, with a thick glass at the lower end; the object of this tube is to get rid of the surface oscillations and allow the fisherman to see the bottom. The Greeks exhibit sometimes extraordinary dexterity in getting sponges from a depth of sixty feet with short harpoons; they hold in their hands three or four harpoons, which they throw with such extraordinary rapidity and precision, that scarcely has one harpoon disappeared beneath the water, when the second strikes its upper end and adds to the force of the propulsion; the third is in the same way struck into the second, and so on. Neither the Arabs nor the Sicilians avail themselves either of the above methods of using the harpoon or of the wave tube. The sponge fishery is considered to be capable of great development, and the danger of exhausting the supply is not great, as a new sponge takes the place of one removed, within twelve months.

Live Penguin in Paris.—The Jardin d'Acclimatation of Paris, which was completely depopulated of its animals during the late siege, has been restored and re-filled with surprising rapidity, and now presents a highly interesting, as it is a very fashionable, resort. Amongst its most recent acquisitions are six magnificent zebras, and a great penguin. This curious bird stands about twenty-six inches high, and its enormous feet and curious stately walk, the body being carried completely upright, cause it to be an object of great attraction. The Parisians say that the movements of the penguin are as grave and majestic as those of an academician. The creature cost, or is said to be valued at, £200, and each of its eggs, or rather, the empty shell of the egg, £20. The latter must surely be a joke!

Old Leather.—"What becomes of all the old leather? We know," says the *Scientific American*, "that the straps and trimmings that fall from the shoemakers' bench are collected and sold, and that these finally reach manufacturers of leather board, which, in cheap shoes, is used to give thickness to a sole which has but little real leather in it. But what becomes of worn-out boots and shoes, and all other articles made of leather, which have been cast aside as of no further use? It was in pursuit of this inquiry that we learned that worn-out hose and belting are cut up into soles for boots, and that the 'uppers' of boots and shoes whereof the soles have become demoralised, are carefully separated, subjected to various processes which make them take on the semblance of newness, and then trimmed round, leaving them sufficiently large to make the 'uppers' for smaller feet than they covered before. Thousands of such 'uppers' are marketed annually, and it is not safe for those who buy their boots, without regard to the standing of the dealers, to assume that their understandings are new throughout."

Experiments with Dynamite in Italy.—A series of trials of dynamite as a blasting agent were made during the past year at the Biassa tunnel, on the line of railway now in course of construction between Genoa and Spezzia, and which fully show the superiority of that substance over ordinary blasting powder, and especially when water is met with. *Eastern end.*—Compact lime stone and hard dolomite. 1st. With ordinary blasting powder, 203 metres of tunnel driven 7·50 square metres in section in 200 days, or at the rate of 1·015 metres per day of 24 hours. 2nd. With dynamite, 300·80 metres run of equal section in 160 days, or at the rate of 1·88 per day of 24 hours, showing a superiority in favour of dynamite of 0·865 per day. *Western end.*—Rock, clayey schist, with beds of sandstone and abundant filtration of water. 1st. With ordinary blasting powder, 80·75 metres run of tunnel, 7·050 square metres in section, driven in 190 days, or 0·425 per day of 24 hours. 2nd. With dynamite, 107·10 metres run of tunnel of above section in 170 days, or 0·63 per day, showing 0·25 per day in favour of dynamite. From a careful estimate made as to the relative cost of blasting with gunpowder, as compared with dynamite, a saving of six francs per cubic metre was found to be obtained when the latter substance had been used.

SCIENTIFIC MEETINGS FOR THE WEEK.

Sat.......**SOCIETY OF ARTS, 12.** Conference. Technological Examinations. H.R.H. Prince Arthur, K.G., will preside.

Conference on Workmen's Clubs, 11. Lecture Theatre, South Kensington.

Working Men's Club and Institute Union, 6.30. Annual Meeting. Royal Albert Hall.

Journal of the Society of Arts.

No. 1,026. Vol. XX.

FRIDAY, JULY 19, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TECHNOLOGICAL EXAMINATIONS.

The Conference on this subject is appointed to take place, at 12 o'clock, to-morrow, the 20th of July, when His Royal Highness Prince Arthur, K.G., has consented to preside. The members of the Society, members of the City Companies, and of the Chambers of Commerce, merchants, manufacturers, and others interested in this movement, are invited to attend. To this Conference the representatives of the Institutions in Union are invited, and the Annual Report of the Educational Officer will be laid before it.

DRILL REVIEW.

The Review of School Drill, organised by the Society, will take place in the Royal Horticultural Gardens on Thursday, the 25th July. His Royal Highness the Prince of Wales, President of the Society, has graciously consented to honour the review with his presence. The boys, about 4,000 in number, will assemble in Hyde-park at 12. After being inspected, they will proceed to the vacant ground to the south of the Royal Horticultural Gardens, where refreshments will be served out to them. The march past will take place in the Gardens at half-past three. His Royal Highness the Prince of Wales will afterwards present, in the Albert Hall, the prize banners to the schools successful in the competition. The united bands of the schools will, after the review, perform a selection of music in the hall.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

THE LIBRARY.

The following books have been presented to the Library:—

Quarterly Weather Report of the Meteorological Office. Part 4, October—December, 1870. Presented by the Meteorological Committee.

L'Eucalyptus; rapport sur son introduction, sa culture, ses propriétés, usages, &c. By Raveret-Wattel. Presented by Dr. Soubeiran. Also Ventilation Economique et Chauffage des cafés, salles d'asile, &c. Par M. Coulier. Presented by Dr. Soubeiran.

Yorkshire Institution for the Deaf and Dumb. Inquiry respecting former pupils, 1870; together with the School Register, 1829—1870. Presented by Charles Baker, Head Master.

Six diagrams, illustrative of "Articulation for the Deaf and Dumb." By Charles Baker, Head Master of the Yorkshire Institution for the Deaf and Dumb.

PROCEEDINGS OF THE SOCIETY.

UNION OF INSTITUTIONS.

The following is the report of the Educational Officer on the proceedings of the Union during the past year:—

To the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Gentlemen,—As the officer of the Society entrusted with the Educational Department, I have the honour to submit to the Council, for the information of the Conference, and of all specially interested in the Society's educational work, an account of its proceedings under this head during the past year.

The first and most important branch of this subject is the Society's system of examinations, which has been carried on for seventeen years, and, as many present are aware, is now about to be given up, and a system of Technological Examination substituted.

The announcement that this was to be the last year of these examinations has, as might have been anticipated, had the effect of lessening the number of candidates as compared with last year, though the diminution has not been considerable. The tables printed in the Appendix to this Report show that there were 1,198 candidates examined, and 972 passed, as compared with 1,251 examined and 985 passed last year, and thus the proportion of those who have succeeded in obtaining certificates is greater this year than last, when only 79 per cent. were successful, while on the present occasion rather more than 81 per cent. have been so. Only 55 prizes have been given this year, as compared with 60 last year, but it should be observed that those not awarded this year are, in most cases, merely book prizes.

The Prince Consort's Prize of twenty-five guineas has been awarded to William Pollitt, of the Salford Working Men's College, a clerk, who in this and the three preceding years gained nine first-class certificates, and no less than seven prizes.

It is to be regretted that neither this year nor in the two preceding ones have the Council been able to award the prize of 10 guineas offered to females, no qualified candidate having fulfilled the conditions, but out of the 12 other prizes offered specially to females four have been taken—an improvement on former years. Sixty-one female candidates are included in the list of those who have obtained certificates, their favourite subjects being French, German, and Arithmetic, only one having passed in Domestic Economy. I ought to mention that the first prize in German has this year been gained by a female candidate.

Almost ever since the establishment of these examinations, other societies, as well as individuals interested in particular branches of knowledge, have offered special prizes for encouraging candidates to come forward in these subjects. Most of these special prizes have been taken this year, the principal exception being those offered by the proprietors of the *Gardeners' Chronicle.* The four prizes offered by the Royal Horticultural Society to gardeners, and the Royal Geographical Society's prize to the best candidate in geography, have been claimed.

It is hoped that the new Technological Examinations will, in a similar way, enlist the support of public companies, societies, and manufacturers interested in special subjects taken up year by year.

In the year 1870 prizes were, for the first time, offered by one of our Vice-Presidents—Mr. Henry Cole—for the best specimens of writing and manuscript printing, but on that occasion no candidate was thought by the examiner to be worthy of reward. The last two years, however, the four prizes (now given by the Society) have been awarded, as well as those offered for the best specimens of ordinary handwriting, as shown in any of the papers worked in any subject; but the examiner—Mr. A. J. Trendell—in his remarks, printed in the Appendix to this report, complains that a "large per-centage of the papers are badly written;" and suggests that, "if young people would learn in the first instance to draw the letters with exactness, holding their pens more like drawing pencils, writing slowly, and without allowing themselves to scribble, there would be less obscure and bewildering writing in the world." It is to be regretted that this novel feature in the Society's system of examinations, so likely to exercise a favourable influence in this specially neglected branch of education, should have so soon come to an end.

Another recent feature in the programme was the attempt to encourage the acquirement of a knowledge of the German and French languages, as applied to commercial correspondence. The number of candidates in these two subjects had considerably increased in this, the second year of their introduction (having been trebled in German), and doubtless, were the system continued, these subjects would become popular amongst the candidates.

The *viva voce* examinations in modern languages, suggested by a member of the Council, Mr. Hyde Clarke, have been held by only one Board, that of the Birkbeck Institution.

The annexed table shows the result of the elementary examinations held by local boards, the papers being furnished by the Society:—

ELEMENTARY EXAMINATIONS, 1872.

NAME OF UNION OR LOCAL BOARD.	Number of Centres.	HIGHER GRADE.				LOWER GRADE.			
		MALE CANDIDATES.		FEMALE CANDIDATES.		MALE CANDIDATES.		FEMALE CANDIDATES.	
		Examined.	Passed.	Examined.	Passed.	Examined.	Passed.	Examined.	Passed.
*Aldershot and Farnham District	..	..	..	..	..	..	..	..	..
Christchurch (Hants)	1	6	6	..	..	31	24	19	13
Hertford	7	22	17	7	7	17	69	32	26
Lancashire and Cheshire Union of Institutions	48	262	144	32	7	883	464	242	131
Leeds Young Men's Christian Association	1	9	7	..	..	20	14	..	..
New Swindon	1	16	12	..	..	20	14	20	16
Penzance	1	24	3	3	2	17	4	18	13
Rugby	1	..	..	3	2	..	..	13	6
Stockton-on-Tees	1	7	5	..	..	14	1	..	..
Weston-super-Mare	1	8	3	..	..	16	6	..	..
Yorkshire Union of Mechanics' Institutions	1	61	21	..	..	223	66	20	..
Totals	63	415	218	45	18	1,241	662	364	205

* No return received.

I must not dwell longer upon this year's examinations, but, as this is the last year in which examinations of this kind will be held by the Society, I will ask you to bear with me for a few moments while I give you a brief history of the origin and progress of the system, now about to be numbered among things of the past.

It is remarkable that the question of the encouragement of education, and even of holding examinations, occupied the attention of the Society in the earliest days of its foundation, as is shown by the following extract from the volume of our "Transactions" for the year 1787 :—

> "In the year 1783, the Society, considering the education of youth a matter of the utmost importance, and reflecting on the great length of time usually employed in the study of languages, offered the following premiums to the masters of academies or schools teaching languages :—
>
> "Whereas it has been observed that the living languages, or languages spoken in schools, are much sooner acquired than the dead languages, which are only taught grammatically :
>
> "The Society, desirous to improve the present mode of education, hereby offers the gold medal to the master of any academy or school for boys, situated within or not more than thirty miles distant from London, who shall, within three years from the date of this advertisement, teach the greatest number of scholars, not less than four, to write and to speak Latin in common conversation correctly and fluently.
>
> "Also, the gold medal for teaching in like manner each of the following languages, viz., the German, the Spanish, and the Italian, being commercial languages not usually taught at schools in England.
>
> "The masters who propose being candidates for the above premiums are to send notice of their intention to claim them at the Society's house in the Adelphi, on or before the second Tuesday in November, 1786 ; soon after which the Society will appoint a day for examining the young gentlemen, and for adjudging the said claims."

The Society's Union of Institutions was formed in 1852, when a large number of the principal Mechanics' Institutions, Athenæums, and similar bodies became affiliated to the Society. This Union was owing to one of the valuable suggestions of the late Mr. Harry Chester, whose efforts in the promotion of education, whether officially, as Assistant-Secretary to the Committee of Council, or as a Vice-President of this Society, or in his private capacity, were unceasing, and whose loss the Society must long deplore.

The question of holding examinations of members of classes of such institutions was first introduced in a circular addressed to them in March, 1852, and it was discussed at the annual conferences held in 1852 and 1853. In January, 1853, the Council passed the following resolutions :—

> "To appoint a committee, to take into consideration, and to report how far and in what manner, the Society of Arts may aid in the promotion of such an education of the people as shall lead to a more general and systematic cultivation of arts, manufactures, and commerce—the chartered objects of the Society.
>
> "That the committee do consist of the following members of council: The Rev. Dr. Booth, Mr. John Bell, Mr. Le Neve Foster (our present secretary), and Mr. Thomas Twining."

This Committee having obtained a large mass of evidence from endowed grammar schools, from private schools, from Mechanics' Institutions, from the friends of education of every grade, and especially from a considerable number of the leading manufacturers of the country, published their "Report on Industrial Instruction," in which the whole subject of education as bearing upon industry was most fully and ably treated, and in the course of which many proposals which have since received or are receiving practical fulfilment were shadowed forth. I may just refer to one, "the improvement of the Endowed Grammar Schools," now being so boldly and energetically carried out by the Endowed Schools Commission, many of whose views are seen to have been anticipated by the Society's Committee so far back as 1853.

In a circular sent by this Committee to well-known friends of education, several suggestions were thrown out, one among them being, "to hold public examinations at certain central localities" for awarding "prizes and certificates of different degrees of merit." This proposal appears to have met with the almost universal approval of those with whom the Council corresponded, and in April, 1854, there appeared in the Society's *Journal* a memorandum on the subject, in which the outline of the system of examinations, as at present conducted, was put forth, and the cooperation of the Institutions in union with the Society was invited.

At the Conference of the representatives of the Institutions, held in July of the same year, a list of subjects proposed for examination, and of examiners, most of them men of the highest scientific reputation, was put forward.

At the opening meeting of the session 1854-5, held in November, 1854, Lord Ebrington, the Chairman of the Council, again referred to the subject, and in December a second memorandum was published, in which an attempt was made to classify the subjects proposed for examination as follows :—

> "1. Mathematical Sciences.
> "2. Experimental Sciences.
> "3. Sciences of Observation.
> "4. Mechanical Sciences.
> "5. Social Sciences.
> "6. Moral and Metaphysical Sciences.
> "7. Fine Arts.
> "8. Literature.
>
> "Under the first head are included Arithmetic, with its application to Book-keeping and Accounts, Geometry, Algebra, Trigonometry, with their application to Land-surveying and Navigation, Mechanics, Hydrostatics, Pneumatics, Optics, and Astronomy.
>
> "Under the second, Chemistry, Laws of Heat, Light, Electricity, Magnetism, Metallurgy, Photography, &c., and the Mining, Manufacturing, and Agricultural Processes dependent on them.

"Under the third, Geography, Geology, Mineralogy, Zoology, Comparative Anatomy, Physiology, Botany, Meteorology and Microscopical Observation, &c., and the Mining, Manufacturing, and Agricultural Processes (including Management of Stock) dependent on them.

"Under the fourth, Machinery, Engineering Construction, Economy of Materials and Labour in Construction, Architectural Construction (including buildings for dwellings, manufacturing, farming, and other purposes), Naval Architecture, &c.

"Under the fifth, Economy of Trades, Manufactures, and Commerce, Political Economy, Domestic Economy, and Social Science, &c.

"Under the eighth, History, Grammar, Composition, French, German, Italian, &c."

This is curious, as showing the very wide range of subjects which it was then thought the examinations might embrace.

Ultimately the month of March, 1855, was fixed for holding the first examination, but so few candidates were returned as desiring to be examined, that it was decided to defer the examination till the following year. In the meantime the following "declaration" was issued, and received a large number of influential signatures, including many leading manufacturers and commercial men:—

"We, the undersigned, having considered the circular letter of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, dated March, 1854, and the plan therein set forth for examining and granting certificates to the students of classes for adult instruction in the Literary and Scientific Institutions, Mechanics' Institutes, Athenæums, and other similar bodies in union with the said Society, do hereby declare that we desire to promote the success of the said plan, and are prepared to regard as testimonials worthy of credit such certificates as may be awarded in conformity thereto."

In his address, as Chairman of the Council, delivered in November, 1855, the Rev. Dr. Booth, who had long been known as one of the foremost champions of the competitive system for granting appointments in the Civil Service, strongly urged the importance of a general system of examinations as the best means of bringing to the surface and rendering fruitful for the good of mankind the "genius, energy, and talent which lie buried in the masses around us." "If one may be permitted," he says, "to argue from the analogy of God's providence, as manifested in the works of nature, which of the innumerable seeds, both in the animal and vegetable creations, permits but comparatively few to come to perfection, we are led by the hand, as it were, to the conclusion that of the vast amount of uncultivated intellect and rude genius which at any given age of the world existed in the great mass of mankind, but a very minute and insignificant portion has been ripened to perfection for the use and advancement of man. We should no more tolerate the waste of intellectual power than of material wealth. I believe no better method could be devised to secure so important an object than the one we are now discussing—an universal system of examinations."

In February, 1856, another memorandum from the Council appeared in the *Journal*, in which they pointed out the remarkable fact that while the Council had as yet vainly attempted to introduce among its Associated Institutions a system of examinations, the principle of giving appointments by competition had been extensively introduced into various branches of the public service.

"Success in competitive examination has very recently become the sole passport to employment in the civil service of the East India Company. Success in examination is also a necessary preliminary to admission into the Royal Artillery and the Royal Engineers, into the Admiralty, into the War Department, into the Privy Council Office, and into the Government departments generally. Examination has been revived in the Inns of Court, and it is in contemplation to incorporate them into a legal university. Now that minute and systematic examination into the natural ability and acquired attainments of candidates for employment in their services which the Crown and the East India Company are enabled efficiently to secure, the Council of the Society of Arts would desire to effect for the Manufacturing and Commercial interests of the country. It is obvious that the valuable employments connected with these bodies will always secure a large supply of well-instructed Candidates. Though the Society of Arts cannot hold out equal inducements, yet there can be little doubt that, were the extensive commercial establishments of this country, the great employers of labour, the railway companies, the large manufacturers, and the friends of education, to agree to recognise the results of the examinations conducted under the sanction of the Society of Arts, and set forth in Certificates, awarded with discretion and integrity, a great boon would be held out to the unfriended talent of the country. The Society of Arts' Certificate would thus be accepted, instead of the vague and worthless testimonials so frequently and so heedlessly given."

Soon afterwards an important stimulus was given to the system by the late Mr. John Wood, then Chairman of the Board of Inland Revenue, who placed two appointments in the Excise at the disposal of the Council, to be competed for at their Examinations.

A definite programme of the subjects in which examinations were to be held was published in the *Journal* for the 22nd February, 1856, and the first Examination was actually held in the Society's Rooms on the 10th, 11th, 12th, and 13th of June, 1856, under the direction of a Board of Examiners consisting of the following gentlemen:—

Mr. Ball, Mr. John Bell, Dr. Bernays, Rev. Dr. Booth, F.R.S., Professor Brasseur, Professor Brewer, Mr. C. Brooke, M.A., F.R.S., Professor Browne, Mr. James Caird, Dr. W. B. Carpenter, F.R.S., Mr. F. S. Cary, Rev. S. Clark, Rev. Dr. Elder, Rev. W. Elliot, Mr. James Glaisher, F.R.S., Professor Henfrey, F.R.S., the Dean of Hereford, Mr. G. H. Jay, Dr. Bence Jones, F.R.S., Mr. J. C. Morton, Rev. A. Bath Power, M.A., Mr. (now Sir) F. R. Sandford, Professor Solly, F.R.S., Dr. Stenhouse, F.R.S., Rev. F. Temple, Professor John Wilson, F.R.S.E. There were 52 Candidates. The subjects were as follows :—Mathematics, Bookkeeping, Mechanics, Chemistry, Physiology, Botany, Agriculture, Geography, English History, English Literature (including English Composition and Writing from Dictation), Roman History, and Latin, French, German, and Freehand Drawing in outline from objects.

On this occasion oral examination, as well as the system of written papers, was adopted, rendering it necessary to bring the candidates face to face with the examiners, and the difficulty thus created began to be immediately felt, and was discussed at some length by the Conference held shortly afterwards. The late Mr. Barnett Blake, of the Yorkshire Union, whose absence from the Conferences for several years past will have been noticed with regret, as well as other well-known friends of education, pointed out the extreme difficulty of inducing candidates who resided at a distance from London to come so far to be examined, the expense and loss of time rendering it out of their power to undertake so long a journey. As it was at this time thought that oral examination could not wisely be dispensed with, a practical attempt was made in 1857 to meet the difficulty by holding examinations simultaneously in London and Huddersfield. On this occasion there were no less than 220 candidates, of whom 80 presented themselves at the former, and 140 at the latter centre, this higher number showing the superior educational activity of the manufacturing districts of the country.

At the Conference in June, 1857, the examination question was again discussed, and attempts were made to induce the Council to increase the number of its centres the following year. But now a great change was made in the system. The Council felt that, however advantageous oral examinations might be, it was practically impossible to continue them if the scheme was really to be extended over the whole country; and in their programme for 1858 they returned to the plan originally proposed by Mr. Harry Chester—that of holding written examinations, using the same papers simultaneously at any number of centres where Local Boards could be formed to superintend them. An important addition was also made—that of insisting on a "previous" examination in elementary knowledge by the Local Boards themselves.

Notwithstanding that the alteration in the system and other circumstances led on this occasion to a long delay in the issue of the programme, the effect of the change was immediately felt. No less than 58 local Boards were at once formed, of whom 40 held previous examinations, and returned 501 candidates as eligible for the final examinations. Of these 288 were examined, and 197 of them obtained certificates.

In the following year, 1859, a large increase took place in the number of candidates, 480 having been examined, and from that time the system became thoroughly established. The number of candidates rapidly increased, and in 1864 exceeded 1,000, while in 1869 they reached their highest number, 2,160.

I must not omit to mention that in the programme for 1862 first appeared the announcement of the Prince Consort's prize of twenty-five guineas, given to the candidate who had most distinguished himself during four successive years. This prize our late president, whose memory is held by all of us in such especial reverence, never lived to see awarded, but it has been graciously continued every year by Her Majesty, and has always been regarded as a blue ribbon worth any exertion to attain.

In the meantime other bodies were not behindhand in following the good example set them by the Society, and one of the most valuable indirect results of our system was the establishment of the Oxford and Cambridge Middle Class Examinations. In April, 1857, the Rev. F. Temple (now Bishop of Exeter), for many years one of the Society's examiners, in letters to the Master of Pembroke College, Oxford, sketched the outline of the system for the examination of candidates not members of the University, which both Universities have since carried out with such brilliant results, and in doing so he especially referred to the success of the Society's examinations as a reason why those great seats of learning should not confine their benefits to their own members, but extend them as widely as possible.

The Government Department of Science and Art which, in spite of the strongest opposition, has gone on steadily increasing its influence year by year, and bids fair ultimately to make Englishmen designers as well as artificers, some years ago instituted science examinations which, to a large extent, covered the ground occupied by the Society. In the programme for 1870, therefore, the Council thought it right to omit those subjects in which the Department was also holding examinations (no less than sixteen), and consequently in that year the number of candidates was largely reduced. This year, as I have already said, they have decided to give up the system altogether; not because the class of persons for whom it was established begin to fail in their appreciation of it; not because they have changed their own views as to the value of examinations as a stimulus to the acquirement of knowledge; but only as consistent with the principle they have always adopted, that it is rather the business of this Society to initiate good objects than to attempt to carry them out to completion. Any one who studies its history will find that it has done this again and again, and among the infinite variety of benefits that, during its career of more than a century, it has conferred upon mankind, not the least will be the encouragement it has given by its system of examinations to the cause of education.

In reference to other educational subjects, I may mention that in August last year the Council appointed a committee "to promote the better education of girls of all classes." In my last year's report I referred to a paper read before the Society by Mrs. Grey on this subject, and the object of this committee was mainly to aid that lady in her laudable endeavour to remedy the evils therein pointed out. An influential meeting was held in the Society's Room in November last, when Lord Lyttelton presided and it was decided to form a National Union for Improving the Education of Women of all Classes, of which her Royal Highness Princess Louise, Marchioness of Lorne, consented to accept the office of President. Much good has already been effected, especially by calling public attention to the want of really good girls' schools, a question which it is known that the Endowed Schools Commission have warmly taken up.

In my last Report I referred to the Educational Collection which formed so important and interesting a portion of the International Exhibition of 1871. The official reports upon it have since been published, and full abstracts of them have appeared in the Society's *Journal.*

I also mentioned the subject of the drill review of school children, which now appears likely to become an annual gathering. A large and influential committee was formed in 1869 "to consider how drill may be introduced into all schools throughout the United Kingdom," and in June, 1870, a most successful review of military, district, and other schools was held at the Crystal Palace, in presence of His Serene Highness the Duke of Teck. In June last year a similar review was held by His Royal Highness Prince Arthur, and on Thursday next, the 25th inst., our Royal President, the Prince of Wales, will honour a gathering of the same kind with his presence.

I have now given you a brief and imperfect sketch of the educational proceedings of the Society during the past year, including a short history of the past examinations, which it has now so successfully conducted since 1856, when I first had the honour of becoming one of its officers. I can only hope that the Technological Examinations, which it is proposed to substitute for them, will be equally successful.

I have the honour to be, Gentlemen,
Your faithful servant,
Charles Critchett,
Officer for Education.

Appendix.

EXAMINERS' REMARKS.

The Examiner in *Arithmetic* says:—"The work has this year been done with great care. There is a marked improvement in the general intelligence which has been brought to bear in the questions. A large number of the solutions are characterised by neatness, accuracy, and a thorough acquaintance with the most approved arithmetical principles."

The Examiner in the *Metric System* says:—"A larger number of candidates than hitherto have come up for examination on this subject, and, as a whole, they have come better prepared. This steady increase in numbers and knowledge is one gratifying result of this examination, for it indicates that there is spreading through our community a wider and sounder acquaintance with the principles and practice of the Metric System. The Examiner would repeat his recommendation that candidates should familiarise themselves with this system, by employing it as far as possible in their daily pursuits, and that when they come up for examination they should thoughtfully strive to make their answers as clear and concise as possible. A number of excellent little text-books have recently been published on this subject."

The Examiner in *Book-keeping* says:—"The papers generally are somewhat above the average of those of former years."

The Examiner in *Mensuration* says:—"The subject has been very fairly done. Of the 48 candidates six are in the first class, and only eight among the 'not passed,' while the remaining 70 per cent. are equally divided between the second and third classes. The questions relating to the "solid contents of cones, cylinders, spheres, &c.," have not been very generally attempted."

The Examiner in *Floriculture* says:—"The papers were this year about up to the average, so far as regards an appreciation of the questions set. The greatest fault I have to find with them—and this is no new fault, as I have frequently mentioned it before—is in regard to the spelling of the names of plants, many of which—and some of them even common names—are barely intelligible. On the whole, I regard them as about an average set of papers, as to intelligence, but inferior as to caligraphy and orthography."

The Examiner in *Fruit and Vegetable Culture* says:—"As a whole, the papers of 1872 in this subject are of a very high order, and I may say, much superior to those of any previous year."

The Examiner in *Domestic Economy* says:—"Very few candidates have come forward for this subject. Three have answered the questions very well, three fairly, and the rest very badly, failing also in composition and spelling."

The Examiner in *Political Economy* says:—The answers are not, as a whole, otherwise than creditable, but, so far as my recollection serves, they appear to me not to be so good as in former years. Some of those in the first class have answered very well, and the knowledge of elementary political economy is in no wise wanting, but as regards the few questions in which there was room for original inference or for knowledge of facts which, though tolerably familiar, are not to be found in elementary books, I think that—at all events as compared with those of last year, this year's candidates are somewhat deficient."

The Examiner in *Geography* says:—"The papers of this year cover a wide range of merit and demerit. The proportion of first-class papers is a good one, and several among them are of a very high order, evincing real thought as well as industry on the part of the writers. On the other hand, the number of failures is very large, so large as to involve the inference that these writers have entered into the competition, not merely without sufficient preparation, but, in many cases, without any preparation whatever."

The Examiner in *English History* says:—"I am very glad to state that the papers are superior this year, with few exceptions, to any I have received for some years past. The answers are more accurate, and display more careful spelling; and I have no fault to find, except in one or two instances, with the spelling or the grammar."

The Examiner in the *English Language* says:—"The exercises on the whole are very satisfactory. But few of the candidates have failed to pass, and a fair proportion are placed in the first-class. The parsing is generally correct and intelligent. The hand-writing, spelling, and general style of the papers, are, I think, better than they have been in any previous year."

The Examiner in *Logic* says:—"Some of the better candidates give evidence of rather careful reading, and, if they have not enjoyed the advantage of instruction, show a creditable understanding of the points of inductive logic. Even the best, however, betray weakness in working deductive examples, evidently from want of sufficient practice. The inferior candidates (this year in considerable force) either do not attempt the second half of the paper, or do it very badly. Some of them make comparatively a respectable figure in the questions on deductive logic, but only one or two answer these well enough to entitle them to a place in the third class upon the whole paper. Though the inferior candidates come still farther short than the others in the working of practical examples, this is not the point in which the inferiority is most marked. The knowledge of principles, in the better candidates, is not accompanied by a corresponding power of applying them. In short, all alike need to exercise themselves more in treating, as directed, the examples of terms, propositions, and arguments given in the text-books."

The Examiner in *Latin* says:—"I am sorry that no candidate reaches the first class, but having looked through the three best papers a second time, I do not feel that a first-class certificate is deserved. At the same time there is some very fair work in the papers of each of these three. I am bound to add that the books do not seem to have been prepared nearly as much as was necessary. I could very seldom feel that the candidate was on ground thoroughly familiar to him. The first piece of Cicero, in particular, was very poorly done. Scarcely any candidate knew the meaning of 'Succensere.' The parsing was, I think, somewhat better than in the last two years, though still leaving a good deal to be desired."

The Examiner in *French and Commercial French* says:—"I am very glad to be able to report satisfactorily. Not only have the candidates increased in number, but the average quality is decidedly better, and is really as good as can reasonably be expected. It is very gratifying to mark the increased progress that has attended this work of the Society. Of the 193 candidates for the language and literature, 114 have obtained certificates, 11 of the first class, 22 of the second, and 81 of the third. The results in Commercial French are still more gratifying. Out of 20 candidates six have been awarded a first-class certificate, and if certificates of lower grades had been granted in this subject, a large proportion of the other candidates would have been entitled to them. These figures, I think, speak for themselves, especially considering the character of the papers, which cannot be said to be otherwise than fairly difficult."

The Examiner in *German and Commercial German* says:—"I have much pleasure in stating that the result of the last examination in German has been far more satisfactory than any of those which I have hitherto had the honour to conduct for the Society of Arts. The improvement consisted both in the quality of the work and in the number of candidates, which was almost double that of former occasions; and it gives me the more pleasure to call attention to this circumstance, because I took occasion last year to express my regret that so very few only out of the large numbers of candidates for the Society's examinations took up the subject of German. Out of the whole number of candidates who presented themselves this year, only six failed entirely; they aspired to a third-class certificate, but were not sufficiently prepared. The answers of the candidates for first-class certificates were this year, in general, very good. I attribute this favourable circumstance chiefly to the fact that they had properly studied the subjects set for the examination. I may also add that, guided by my experience of former examinations, I did not set them this time so large a number of questions. I noticed that the candidates fancied that they must answer every question on the paper, and the result was that most of the answers were merely superficial. This year, however, they were mostly thorough and complete. To sum up, I must state that the general satisfactory result of this examination was, according to my opinion, owing in a great measure to the close attention paid by the candidates to my former recommendation, which I venture again to repeat for the benefit of future candidates, viz., 'to acquire, first of all, an accurate knowledge of German accidence, and to devote afterwards considerable attention to the acquisition of a certain facility in translating from English into German, and finally that they should only make use of such grammatical works as give the theory of German grammar in a systematic form.' I am glad to be able to record likewise a marked improvement as regards the examination in German Commercial Correspondence. There have been, this year, three times as many candidates for that subject as last year; and whilst only one candidate was successful at the last examination, seven passed this time. The rest did, however, their work so well, that they would have been entitled to a second-class certificate, if such a one were granted. I should advise future candidates to read and translate a number of commercial letters, but not to neglect at the same time the study of the language in general."

The Examiner in *Italian* says:—"Although it is not very marked, yet there is a sensible improvement over last year in the working of the examination papers by the candidates. This improvement is especially observable in the grammatical knowledge disclosed, and also in the evidence of a more extensive and varied reading of Italian authors."

The Examiner in *Spanish* says:—"Contrary to the expectation of last year, the number of candidates for the present has been much smaller. Those who have obtained the highest marks show in their work great improvement, being well acquainted even with the idiomatical phrases. Unusual negligence is shown in the other papers."

The Examiner in the *Theory of Music* says:—"The

TABLE I.

RESULTS OF THE FINAL EXAMINATIONS OF 1872.

NAME OF LOCAL BOARD.	No. of Candidates Examined at Previous Examination by Local Board.	No. of Candidates who Passed Previous Examination by Local Board.	No. of Candidates Examined at Final Examination.	No. of Candidates who Passed at Final Examination.	No. of Papers Worked at Final Examination.	No. of First-class Certificates awarded.	No. of Second-class Certificates awarded.	No. of Third-class Certificates awarded.	No. of Prizes awarded to Candidates.	No. of Unsuccessful Candidates.
Aberdeen	39	28	27	24	32	5	13	10	...	3
Accrington	...	...	4	4	4	...	1	3	...	...
Aldershot and Farnham District	34	34	29	18	59	6	8	17	...	11
Alnwick	...	...	9	...	12	...	...	...	...	9
Ashford	3	3	9	8	10	2	4	3	...	1
Bacup	60	40	18	11	27	1	6	9	...	7
Birmingham	37	34	42	33	52	17	5	17	7	9
Bollington	21	2	5	3	5	...	...	3	...	2
Bolton Church Institute	...	...	7	7	18	1	3	6	...	...
,, Mechanics' Institute	...	...	10	8	18	...	1	10	1	2
Bradford	9	7	10	8	11	1	4	4	...	2
Bromsgrove	...	...	3	3	4	1	...	2	...	...
Burnley	...	...	2	2	5	...	2	1	...	...
Carlisle	8	8	9	9	14	5	7	2	1	...
Cork	...	...	3	2	3	...	1	1	...	1
Crewe	10	10	7	6	11	1	1	5	...	1
Dean Mills	...	...	5	4	7	1	2	3	...	1
Derby	2	2	4	3	9	2	2	4	...	1
Devonport	6	6	5	5	5	2	1	2	...	...
Dudley	...	...	2	2	2	1	...	1	1	...
Edinburgh	15	15	17	14	22	4	6	8	...	3
Gilford (Ireland)	2	2	3	3	5	...	2	3	...	...
Glasgow Andersonian University	33	31	45	42	60	10	25	21	2	3
,, Athenæum	50	48	42	36	58	13	14	23	2	6
,, Mechanics' Institution	100	89	80	66	87	7	21	45	...	14
,, Young Men's Society for Religious Improvement	22	16	9	4	9	...	...	4	...	5
Halifax Mechanics' Institution	12	9	8	6	11	1	2	4	...	2
,, Working Men's College	26	19	24	18	30	...	10	13	...	6
Haslingden	...	...	5	4	5	...	1	3	...	1
Hebden Bridge	3	3	3	2	3	...	1	1	...	1
Hertford	2	2	3	2	5	...	2	1	...	1
Hitchin	2	2	2	2	2	1	...	1	...	...
Huddersfield	...	...	8	8	10	1	2	7	...	...
Hull Church Institute	3	3	3	1	3	...	...	1	...	2
,, Young People's Christian and Literary Institute	20	17	27	24	31	12	9	8	3	2
Hulme	2	2	7	6	7	2	1	3	...	1
Ipswich	25	23	26	21	33	5	8	13	1	5
Irwell Institute (Rawtenstall)	32	32	5	2	5	1	...	1	...	3
Leeds Church Institute	12	12	13	12	26	3	6	12	...	1
,, Mechanics' Institute	4	4	6	5	7	1	3	2	...	1
,, Young Men's Christian Association	36	34	32	21	47	4	9	19	...	11
Leicester	...	...	18	8	20	1	2	6	1	10
Liverpool	35	35	29	24	51	13	10	17	1	5
Lockwood	1	1	5	4	8	...	2	4	...	1
London, Birkbeck Literary and Scientific Institution	75	67	94	84	135	32	46	39	6	10
,, City of London College	70	63	90	75	129	38	35	37	7	15
,, Royal Polytechnic Institution	35	32	47	41	72	9	15	40	...	6
,, St. Stephen's (Westminster) Evening Schools	21	17	14	10	23	1	4	11	...	4
,, Walworth Literary and Scientific Institution	...	...	2	1	2	...	...	1	...	1
Lynn (King's)	1	1	3	3	4	1	...	2	...	...
Macclesfield	4	4	4	2	6	...	...	2	...	2
Manchester	150	130	74	66	118	32	38	30	6	8
Mossley	5	5	11	6	18	...	2	8	...	5
Newcastle-on-Tyne Church Institute	5	5	7	7	11	1	2	8	...	...
,, Excelsior Temperance Class	1	1	9	9	14	3	4	6	...	...
New Mills	..	...	2	2	4	...	1	2	2	...
New Swindon	...	...	10	6	12	4	3	1	...	4
Oldham Lyceum	...	...	5	5	5	2	...	3	...	...
Paisley	8	8	14	14	18	6	8	2	...	...
Parsonstown	1	1	2	2	2	1	1	...	...	...
Pembroke Dock	14	14	19	19	28	16	8	4	3	...
Penzance	5	5	7	6	11	2	4	4	...	1
Plaistow, Beauvoir College Evening Classes	3	3	27	24	33	10	9	10	1	3
Preston	4	4	4	4		...	3	4	...	...

TABLE I.—(Continued).

NAME OF LOCAL BOARD.	No. of Candidates Examined at Previous Examination by Local Board.	No. of Candidates who Passed Previous Examination by Local Board.	No. of Candidates Examined at Final Examination.	No. of Candidates who Passed at Final Examination.	No. of Papers Worked at Final Examination.	No. of First-class Certificates awarded.	No. of Second-class Certificates awarded.	No. of Third-class Certificates awarded.	No. of Prizes awarded to Candidates.	No. of Unsuccessful Candidates.
Richmond	...	...	2	2	3	3	...	...	4	...
Rotherham	3	3	7	6	8	3	2	1	...	1
Salford	50	45	46	41	75	20	20	21	4	5
Scarborough...	11	11	7	5	10	...	3	2	...	2
Southampton	...	...	2	2	2	2	...	...	1	...
Stamford, St. Martin's School of Art ...	...	...	4	3	8	2	3	2	1	1
Stockport Sunday School Improvement Society	30	30	20	10	29	1	5	9	...	10
Stourbridge	...	...	5	4	5	...	1	3	...	1
Wakefield	9	8	6	3	6	...	1	2	...	3
Walsall	7	7	7	5	11	4	4	...	...	2
Weston-super-Mare	...	...	1	1	1	...	...	1	...	...
York	14	14	17	9	22	4	4	4	...	8
Totals	1192	1051	1198	972	1689	322	423	582	55	226

Number of Local Boards, 76.

N.B.—Seventy Candidates came forward in Writing from Dictation, and nineteen in Writing and Manuscript Printing, but, as Certificates are not given for those subjects, they are not included in the above Table, but the prizes awarded in both these subjects, and also the prizes awarded by the Council for Handwriting generally, are included in the list.

TABLE II.—Number of Papers Worked in each Subject in the Four Last Years, with the Result for the Year 1872.

SUBJECTS.	1869.	1870.	1871.	1872.				
				No. of Papers Worked.	No. of First-class Certificates.	No. of Second-class Certificates.	No. of Third-class Certificates.	No. of Papers in respect of which no Certificate was awarded.
Arithmetic	621	501	546	431	88	115	141	87
Metrical System	42	52	30	56	7	19	19	11
Book-keeping	253	290	295	254	53	73	99	29
Mensuration	98	63	74	48	6	17	17	8
Floriculture	12	9	5	6	1	3	1	1
Fruit and Vegetable Culture ..	9	8	6	7	4	2	..	1
Domestic Economy	31	13	29	13	3	3	2	5
* Political Economy	*19	25	31	23	5	7	6	5
Civil Government	*8		..	..	..	..	..	..
Geography	99	103	103	91	10	22	31	28
English History	94	120	105	103	32	25	31	15
English Literature	37	82	..	..	..	..	..	..
English Language	..	..	170	174	24	41	87	22
Logic	24	16	23	30	1	4	14	11
Latin	17	20	21	16	..	6	4	6
French	140	145	158	193	11	22	81	79
†Commercial French	..	..	17	†20	6	..	..	14
German	26	26	26	48	13	10	19	6
†Commercial German	..	..	4	†12	7	..	..	5
Italian	9	3	3	3	1	1	..	1
Spanish	13	10	19	6	3	2	..	1
Theory of Music..	69	72	87	109	39	35	15	20
Elementary Musical Composition	57	51	59	46	8	16	15	7
Totals	1.698	1.609	1.811	1,689	322	423	582	362

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* These two subjects were united in 1870.

† Only First-class Certificates awarded in this subject.

papers are more in number and better in quality (I think) than any I have yet had to examine."

The Examiner in *Elementary Musical Composition* says:—"The average merit of the exercises for this year has been much the same as in 1871. The amount of knowledge displayed has been purely elementary, but, in a large number of cases, sound. Not one paper was entirely faultless, but several showed a considerable amount of musical feeling, such as cannot be taught, but must come from nature."

The Examiner in *Writing* says:—The general character of the handwriting this year is somewhat higher than in 1870 and 1871. But a large percentage of the papers are badly—a few extremely badly—written. Candidates should bear in mind that no writing can be good unless it be perfectly legible. It should be impossible for a person with ordinary eyesight to take any letter, looked at without the context, for any other letter. There should be ample and even space between words and letters, short loops, regular thicknesses and a general appearance of clearness. Every tendency to flourish or make unnecessary strokes should be guarded against. If young people would learn in the first instance to *draw* the letters with exactness, holding their pens more like drawing pencils, writing as a rule slowly and without allowing themselves to scribble, there would be less obscure and bewildering writing in the world. The habit of writing illegibly is not only unbusinesslike, but it is uncivil, since it exacts unfair and unnecessary attention from the reader. There were but few specimens of writing by female candidates among this year's papers, and none of them had any particular merit. The Examiner suggests, for the consideration of the Council, that one or two prizes to such candidates might be usefully offered next year. These prizes might have the effect of convincing them that extreme angularity and minuteness are not consistent with legibility."

CANTOR LECTURES.

MECHANISM.

By the Rev. Arthur Rigg, M.A.

Lecture V.—Delivered Monday, March 4, 1872.

"Motions produced by links," which is the title of this evening's lecture, is a phrase expressive of the leading branch of it only. Mechanicians may have a very clear idea of the meaning intended by it, but to others very varied may be the ideas which the title conveys. Practical mechanics, by the word "links," may have entered the room with an impression that they were about to listen to a discourse upon the elemental pieces of which chains are made. Social science enthusiasts may be anticipating a discussion upon friendship, and even marriage, and upon the proclivities of individuals to walk "linking." Antiquarians' thoughts will probably turn to those ornamental extinguishers high above the railings at the doors of aristocratic houses, by means of which during the last century "link" boys extinguished their torches. Landowners may be thinking of estates, from the fact of there being generally so many "links" in an acre. A Scotchman's thoughts may revert to one of his country's rivers, and the grounds called "links" lying along its windings; and Americans, if there be any present, may not unreasonably be expecting some description of London sausages, for sausages are called "links" in America. All these expectations must be disappointed. "Link," in an antiquarian's view is from a Greek word which signifies a lamp; but we have nothing to do with that. In the other sense it is from a German word which signifies "a joint," and it is in the simple sense of a piece joining two pieces, and by which the motion of one may be conveyed to the other, that the word is generally used by engineers. Such a link is either rigid, as in the case of wood or metal; or flexible, as in the case of rope or wire; and it is a means by which the motion of one moving piece is transferred to another. Thus employed, it truly comes under the ordinary definition of "a connecting or joining piece."

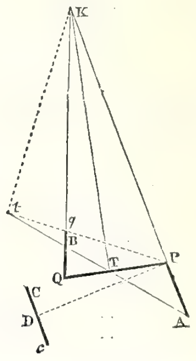
A link, therefore is now to be regarded simply as the connecting piece of two movable pieces; the form and the material are not in any way concerned. Contacts in rolling and sliding cease when we deal with links—flexibility, as in cords, is neither an essential nor a hindrance. It may be well therefore to take a preliminary example of a link, for those who have not given the subject attention may be informed that the complexities of link movements far surpass the complexities of cam movements. On the board are a couple of pieces of wood joined by a link, quite sufficient to illustrate the general idea. These two pieces are capable of motion about two drawing pins as centres. A third piece, connecting these two, is the link. If now this third piece be connected with the two movable arms at varying distances from the centres of motion, the paths of the driver and follower will be very different, the variations depending entirely upon the relative lengths of the arms. Sometimes an oscillatory motion of the driver will communicate a circular one to the follower. Sometimes these relations will be reversed. Under other circumstances a continuous communication of motion is impossible, in consequence of a locking of one or other of the arms, owing to the rigidity and length of the connecting link.

[The lecturer illustrated these remarks by altering the lengths of the arms connected by the link.]

The first question to be solved by those who deal with link movements is, what is the law which governs the motions of the two arms when they are under the influence of a link? The law is a very simple one; simple in expression but complicated in result. It is one of those simple laws that produce very singular consequences; it depends upon the inclination of the link to the line joining the centres of motion of the arms.

Let A P and B Q or B q (Fig. 29) be the arms, movable in the same plane about A and B, P Q or P q be the link, then the link will cut the line A B, either in T or (produced if necesary) in t.

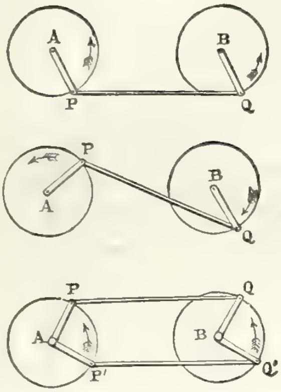
Fig. 29.



Wherever it cuts, whether between or beyond the centres of motion A B, this law holds good that the velocity ratio of one arm is to the velocity ratio of the other arm inversely as the segments into which this line of centres is divided by T or t. Or take it in another form (one more convenient probably in some respects), the velocity of P is to the velocity of Q, as a line drawn from A square upon the link is to a line from B drawn square upon the same link. Observe for a moment the nature of these motions. Assume the shorter arm to be the driver, that driver therefore conveys a very small motion to the driven and longer arm, in certain positions it ceases to convey any motion. For example, in this position, viz., B Q and Q P in one straight line, it cannot convey motion. Putting it in other positions will show the relations more plainly. Observe how slight the motion is upon one arm, and now that the perpendicular from B upon the link is passing from one side to the other, the directional relation of motion also is changed. This is a serious question with links; there is a continual change of the direction and velocity ratio. Through a small motion of either arm there may be what is, for all practical purposes, a communication of uniform motion. This is the case when the direction of the links being produced and meeting as in K, the line joining K and T is at right angles to the link.

On the table is a number of examples of links; let us follow the action in this one.

Fig. 30.

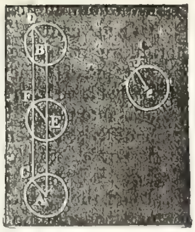


A and B are the centres of two equal wheels, P and Q pins near the circumferences, P Q the link.

If slow motion be communicated to A, then through the intervening link, P Q, a motion will be communicated to B. So long as by the hand or otherwise, P Q moves parallel to A B, then clearly whatever be the motion of A it will be repeated in B. This is the principle on which the ordinary parallel ruler is made. For, in this case of parallelism, the link never cuts the line of centres, the ratio of the velocities of A P and B Q will be constant and equal. You may observe that the motion is apparently communicated with great regularity. In truth it is not so, for the link cannot be left to itself. The hand by which the link P Q has been hitherto supported and guided, is now withdrawn, and you will notice a failure of motion takes place when the pin, P, is in the same line with A B. In fact there are then two paths which this link, P Q, may take; it has the choice either of ascending or descending, and it will probably take sometimes one course and sometimes the other. The nature of the motion is thus changed, sometimes there will be a complete revolution communicated to B Q, and at other times an oscillating motion only. Consequently, to place a link upon two arms and leave it freely to act, is a matter that is quite hopeless if continued systematic action is required. The second and third parts of Fig. 30 illustrate, by the position of the link and directions of the arrows, what takes place. There must therefore be some plan by which this link shall not have a choice of paths.

There are three modes of doing this. In the one case, if we place a third equal crank, and connect it to the others by links, observe the way in which it acts. A C, B D (Fig. 31) are the original cranks, E F (or *e f*), is a third crank. The link, C, F, D, cannot now leave the prescribed course. A fourth or fifth crank may be added, in fact we may take any number, and we obtain a system of bars capable of a very regular motion one with the other; they move parallel to each other. On the table there are bars so arranged. The link connecting those arms is not free to move, being bound by another arm, and the links are parallel in all positions of the cranks.

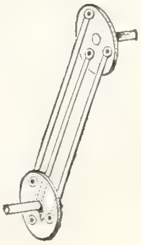
Fig. 31.



There is another mode of preventing an uncertainty in the path, by putting an additional pair of cranks and a second link. Observe, there is now no longer any freedom of position, for each link is compelled by this second arm to retain a pre-ordained course, and the consequence is we have uniform motion in these arms. This is the most simple mode of overcoming the difficulty of variableness in the direction of the link, and it is the plan adopted in all locomotives. You see a link generally on each side of a locomotive, the object being to prevent the accident that has been described, which is sure to happen when there is only one link.

There is still a third plan, viz, to multiply the links. Here (Fig. 32) are two shafts parallel to each other, but the ends are not vertically one over the other. If you look at this yellow bar [the three sloping bars in Fig. 32 were painted three different colours in the model] you will see it is in reality acting as a link. If there was only one bar it might assume a cross position. Owing to the other bars being constrained to follow the path that has been allotted for them, the yellow bar cannot take a cross position. Hence this mode of transferring motion by links from one shaft to another as freely and uniformly as though they were straps. The motion is not very old, having been invented in 1834, when the Society of Arts awarded a silver medal for it. It is mentioned in the "Transactions" for the year 1834, p. 83, and "the silver medal was presented to M. Victor Baum, member of the Royal Chapel of Munich, for a method of communicating rotatory motion, a model of which has been placed in the Society's repository."

Fig. 32.

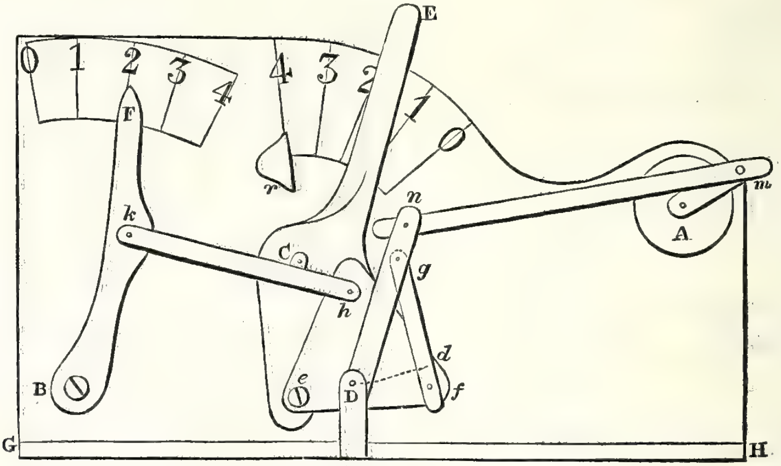


With these three contrivances, links can be safely carried over what are called their centres. These centres are peculiar, and the laws of them are important. You have seen that when a link is in a certain position there is an option of two paths. Both of those paths cannot be followed. Owing to there being, as it were, no decision on the part of the driver, and, in fact, at that particular point, no motion communicated by the driver, it has been called a "dead centre," simply because there is no living motion in it. Mechanics have tried in various ways to overcome a difficulty which, under the influence of a fly-wheel, is more theoretical than practical. On the table is one plan. Here is a section of the vertical cylinder of a steam-engine. When the piston is at the lower part of the cylinder it cannot move the crank, but when it has risen a short distance it is capable of acting upon the crank. This very short additional cylinder causes the double action of another link. By allowing steam to operate in this very small second cylinder, at the instant that the crank reaches a dead centre it is thrown over, and thus the crank of the engine is placed in position for the continued action of its own piston.

On the table are some peculiarities of link motion. Multiplicity of links leads to multiplity of arrangements and results. [The lecturer here referred to models, which consisted of cranks or arms, acting under the influence of connected links. They were produced to show how rapidly motions could be multiplied by means of links. In one contrivance there were three links and four arms. These caused eight movements in one pointer, consequent upon one rotation of the first crank. In another grouping of links and arms one revolution of the crank produced at the two extremities of the combination alternate rest and oscillatory movement.]

Professor Willis has arranged a very ingenious plan for doing that by means of link-work, which is difficult to do under any circumstances, viz., to throw machinery into gear while the shafts are moving, and where advantage cannot be taken of the slip consequent upon the action of straps on smooth pullies.

Fig. 33.



The illustrative apparatus was on the table. Fig. 33 is an outline of it from Professor Willis's "Principles of Mechanism." A is a continuously rotating shaft, acting by means of a crank upon the link, *m n;* to the extremity, *n*, is connected an arm, *n* D, movable about D. Between *n* and D, at *g*, is a pin, from which is suspended the bar, *g f*. Consider *e h f* to be a triangular piece, attached to *g f* at *f*, and movable about the screw, *e*, by which it is attached to the arm E C *e*, which arm moves on a pin C, fixed to the back board. From *h*, in the triangle *e h f*, a link, *h k*, is connected to the arm F B, which moves freely about a fixed centre, B. It will be observed that when the handle, E, is at O, on the divided scale, the link, *g f*, is in line with *n* D, the centre, *f*, being immediately under D. Consequently, when the shaft, A, rotates no motion is commmunicated to *f*, and therefore none to the triangle, *e h f*. Let, however, the handle, E, be moved to 2, then *f* is placed as in Fig. 33, and owing to the handle, E, being stationary, the screw, *e*, becomes a pin, on which the triangle, *h e f*, can be moved. When, therefore, the shaft, A, rotates, the oscillation of the link, *n* D, is communicated by means of the arm, *g f*, to the triangle, *h e f*, consequently *h* oscillates and imparts to the arm, F B, a vibratory motion. The extent of this vibratory motion at F will evidently depend upon the distance, D *d*, and this is determined by the position of the arm, E C. When, by the action of E C, *e* is below D, the throw of F is a maximum. When *f* is below D, the throw of F is a minimum or F is at rest.

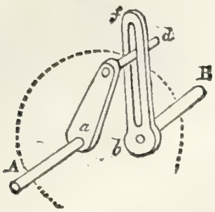
Motion may evidently be not only communicated to F, but varied to any extent within the constructed limits, without altering the velocity of the prime moving shaft, A. The figures on the two scales indicate this. In the apparatus, as E successively occupied the positions 1, 2, 3, 4, so F oscillated from O to 1, 2, 3, and 4 respectively, and these changes were made whilst the shaft A was rotating.

Some may, perhaps, before this, have been asking of what use are these movements. The answer, not only from a mechanician's point of view, but also from a science standpoint, is very easy. With the mechanic rests the utilitarian element. Science has nobler aims than those which money can buy. There is that constant searching for truth—that humility which is teachable, and which is willing to be learning an alphabet without impatiently asking what is the use of this or that letter, and why is it of this or the other shape? Let none, therefore, assume that in this course of lectures the mechanical combinations most valuable in the workshop are those most likely to be produced. Mechanicians are not concerned with workshop economies and trade profits.

Whilst thus avowing the tendencies of scientific research, one is nevertheless often led to ramble on that border-land which separates the physical laboratory from the trade workshop. Let us, therefore, now so ramble and deal with some of the mechanician's schemes which the mechanic and the manufacturer have in their own estimation utilised, *i.e.*, employed in getting money.

Instead of connecting a crank, as at A in Fig. 33, with the parts to be moved by a connecting rod direct, as is shown by *m n*, the crank itself is caused to act upon a variable radius. Fig. 34 may serve to explain the action of the mechanism, of which there were on the table many varieties of combinations. A, *a*, Fig. 34, is a shaft which rotates uniformly; *d* is the extremity of the pin which constitutes the crank. If the shaft, A *a*, be moved uniformly, then will the pin, of which *d* is the extremity, move uniformly in the path of the dotted circle in the figure. Let B *b* be a shaft to be driven, not in the same line with A *a*, but in a line parallel to it. Suppose these shafts connected in this manner. At *b* is keyed on the shaft an arm similar to the way in which that at *a* is keyed on. The arm, *b f*, is called a "slotted" arm, and the pin of the crank passes through the long "slot," *f b*, as shown in Fig. 34. If, now, the effect of the uniform motion of *d* on the shaft B *b* be noticed, it will be seen that the rate of rotation in B *b* is variable, whilst that in A *a* is uniform. The reason of the variation will be apparent to any one who considers that whilst *d* passes over equal spaces in equal times, it acts, as regards B *b*, upon an arm of varying length. The consequence of this will be that, when that arm is short, *i.e.* when *d* is near to B *b*, then the velocity of B *b* will be greatest, and when it is near to *f* the velocity will be the least.

Fig. 34.



There are parts of the path of *d* which are nearly at right angles to the arm *b f*, and there are parts where *b f* is nearly tangental to the path *d*. In this latter case the travel of *d along* the "slot" *b f* will be much more rapid than in the former case. Clearly, the resolved part of the motion of *d*, along the slot, is lost as a motion communicated to the shaft B *b*. Hence the transition of the motion in B *b* from quick to slow is rather impulsive than progressive. It is this peculiarity of the combination which renders it valuable as an elemental form on which may be grafted that which converts it into a "quick return" motion. A quick return motion deduced from the simple one,* which Fig. 34 should make clear, is to be found in that designed by Sir Joseph Whitworth, and which, in principle as well as in form, is extensively used.

Fig. 35.

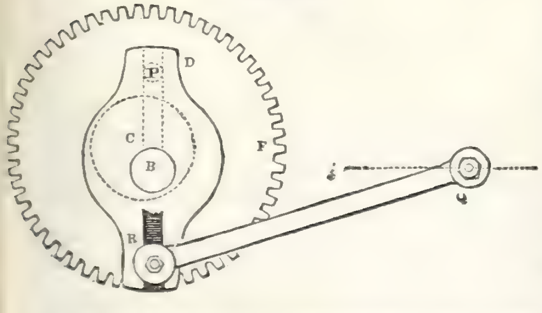
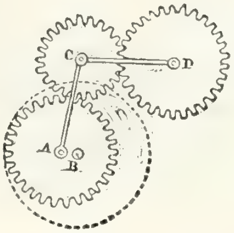


Fig. 35 is a diagram of the apparatus as usually made, although the necessities of the workshop and the ingenuity of Sir Joseph Whitworth have almost disguised the elementary combination in Fig. 34. F (Fig. 35) is a wheel, moved by some part of the general machinery. The large dotted circle, *c*, is a fixed shaft. and on the very end of this shaft the wheel, F, rotates. P is a pin fixed to the wheel, F; this pin corresponds to the one marked *d* in Fig. 34. In the large fixed shaft, or bearing C, is bored a hole, B, which serves as a centre of motion for the peculiarly shaped piece D E. To compare with the elementary form, Fig. 34, the centre of circle C is as the shaft A *a*; the centre of circle B is as the shaft B *b*. Remembering that the distance of the pin, P, from the centre of C is invariable, the eye can readily trace on the diagram that in one revolution of the wheel, F, the pin, P, must approach the centre, B, of the shaft, on which the peculiarly shaped piece D E rotates.

It will be observed that to one extremity of the piece D E, viz., at E, an arm is attached, the end of which is constrained to move in the dotted line at Q. It is therefore evident that there will be changes in the velocity of Q depending upon the nearness or distance of the pin, P, from the centre of B. The length of the travel of Q may be varied by screwing the end nearer to B, as shown at E.

Regarding "links" as "joinings," Fig. 36 illustrates a mode in which toothed wheels may be kept in true gear, even though one of the wheels should rotate on a shaft placed eccentrically. The wheel whose centre is A, rotates on the eccentrically-placed shaft, B. The wheel, D, rotates on a shaft in fixed bearings. The centres, A and D, are connected by links with an intermediate wheel, C. Thus the centres, A C and D, being always at equal distances, as measured along the links, the gearing of the teeth remains constant; therefore as A is moved round upon B, motion is communicated through C to D. The nature of the connections is such that whilst the directional relations are constant, the velocity ratios are variable.

Fig. 36.



[The lecturer had models in which, by means of a pencil, the paths of portions of some of the previously described apparatus could be traced on paper.]

Let us now pass from cranks and links properly so called to systems of movements which seem to have originated in them, much as cams may have originated from irregularly made wheels. Clicks, detents, ratchets, or by whatever other names the contrivances are sometimes called, are elementary forms by which at defined intervals equal progressive and sudden motions may be conveyed to shafts or sliding bars. They are employed to advance work on which a tool is operating, as in the sawing of balk-timber, the planing machine, the shaping machine, the slide-lathe, &c., &c.

Fig. 37 illustrates an arrangement by which the click and detent alternately change places. It may serve as the type of a class. An arm can be moved about a fixed centre, A. *a b* and *c d* are respectively click and detent. The circular ratchet-wheel is to be moved by one tooth at a time in the direction of the arrow. Expressed in other words, the contrivance is the mechanician's answer to the mechanic's requirement:—"Wanted the means to move a shaft through equal intervals at each single oscillation of a pendulum or arm."

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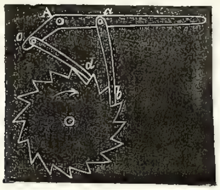
* The actual movement shown in the lecture, and now illustrated in Fig 34.

Fig. 37.



From each side of the centre, A, are suspended by joints the pieces *a b* and *c d*. These pieces are so shaped at their extremities as to rest in the spaces between the ratchet teeth.

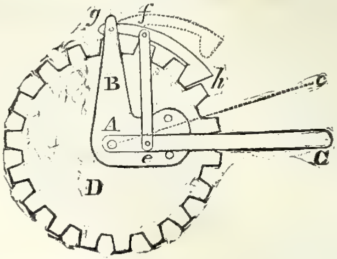
If now the arm be depressed, when the pieces are as in the Fig. 37, then *h* will cause a tooth to be driven so far that *d* would drop behind the tooth on which it now rests. When this has taken place let the arm be raised. It will be observed that, owing to the motion given to the extremity *e* of the arm, there will be imparted to *d* a propelling power, and the tooth behind which it fell will now be advanced in the direction shown by the arrow. Hence, partly by the rising action of the arm, and partly by the propelling action at *d*, the end of *b* will fall behind the tooth on which it may then be resting. Thus, an alternating motion of the arm imparts motion to the wheel. At the same time all return slip is prevented by one or other, viz., either *b* or *d*, pressing a tooth forward. The piece that holds the wheel and prevents slipping is called a "detent." The piece that is driving is called a "click." Assuming that instead of one advance for each *single* oscillation, the mechanic required only one advance for each *double* oscillation, it would be accomplished by detaching *c d* from the arm, and fixing the pin at *c* to the framing which carries the wheel. With this arrangement no advance would take place whilst the arm was being raised.

From the construction and description of this combination of click and detent, it will be manifest that as each of the pieces *a b* and *c d*, Fig. 37, slide over the teeth, there must be a frequent dropping or "clicking." Hence the name "click."

Now, although noise is a consequence of motion, and may therefore be said to belong to "mechanism," yet it is not that form of result which the mechanician is often required to produce. In kinematics "noise" is but another name for wear or destruction. In kinetics "noise" is but another name for wasted energy, and if the machinist reads his machinery aright, "noise" is indicative of bad workmanship, bad proportions, injudicious arrangement; thus implying deficiency of intelligence and skill in the superintending head either of the maker of the machinery or the manager of the works.

Fig. 38 and Fig. 39 exhibit two modes by which the noise of the click is obviated. They are instructive, as showing how the mind of one mechanician sought simply to retain the click and detent, and remove the defects. The other mechanician, whilst retaining the principle of the oscillating arm, sought to remove entirely both click, detent, and teeth, and with much of novel ingenuity he has succeeded. Fig. 38 consists of an ordinary spur-wheel, and as in Sir Joseph Whitworth's quick return motion the two shafts were brought to one centre, so here the wheel and arm are on one centre, A. B is a peculiarly-shaped piece, on which is a pin, G, carrying the click, *g*, *h*. A C is an arm not attached either to the wheel or the piece B, but moving on A as a centre. *f*, *e* is a link from the arm, A, C, to the click, *g*, *h*. When the arm, A, C, is raised, the link, *e f*, is also raised, and therefore the click, *g h*, is lifted out of gear with the teeth. If the upward motion of the arm is continued, a small pin in B is acted upon, and so B is carried round for a distance dependent upon the travel of the arm. The return action of the arm brings with it the link, *e f*, and therefore the click, *g h*, which falls between two teeth. A lower pin, shown near to *e*, being pressed by the arm, carries with it the piece B, and also the wheel D. There may be a detent (not shown in the figure) to hold the wheel in position whilst the arm repeats the operation. The click being thus lifted away from the teeth, causes the action of the combination to be silent; hence it is called a "silent click motion."

Fig. 38.



There is, however, a great improvement on the foregoing in a motion called the "silent feed motion." The arrangement is one of much simplicity, much ingenuity, and well worthy of study and adoption, whether considered as to the durability of the parts, or the extensiveness in the range of its adaptability.

Fig. 39

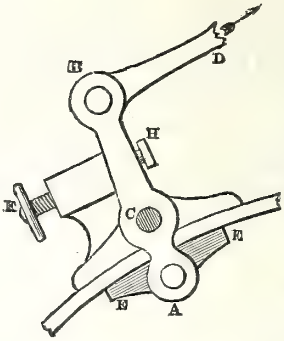


Fig. 39 shows the portion in which its peculiarity lies. D B is an arm oscillating in line with the arrow. A C B is a link having centres at A, C, and B. Between the centres A and C is shown the smooth edge of a metal wheel; the internal and external surfaces of the raised rim are smooth.

Formed to the curvature of the concave and convex surfaces are the two pieces, one shown at E E and the other on the outside.

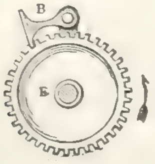
The distance between the convex and concave surfaces of E E and the upper one is such that when A C B is a prolonged radius of the wheel there is space for the rim to move freely.

If now B C A is by the oscillating arm, B D, drawn in the direction of the arrow, then the rim of the wheel will be gripped between the convex and concave pieces. When the strain upon the arm, B D, cannot further tighten the two pieces upon the rim, then that strain is expended in dragging the wheel itself.

Thus, the travel of the rim, and therefore of that which the motion is to accomplish, is determined. The first tendency of the return action of the arm, D B, is to loosen the grip upon the rim, and if by means of the screw, F, the arm, A C B, is stopped from travelling beyond the position shown in the figure, then the whole of the apparatus slides along the rim until a return action of the arm renews the grip. By having an arrangement at H similar to that at F, then either F or H may be adjusted to stay the arm in the line of a prolonged radius, and so the apparatus be made applicable for advancing or reversing motion. Without entering more fully into an arrangement now fast displacing the click and detent, sufficient may have been said to satisfy those interested in mechanism that this "silent feed" motion is one well worthy of that commendation which the extending adoption of it implies.

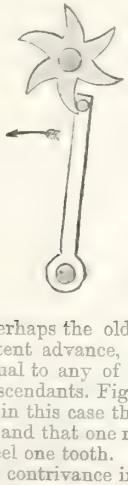
Fig. 40 is another of these intermittent motions; it is one much used in lathes, and has the recommendation of simplicity and comprehensiveness. A vibrating arm carries the T-shaped piece B. This piece is so shaped at the ends of the cross of the T that in passing from left to right over the teeth of an ordinary spur wheel the piece B rides upon them. When, however, B is moved in the opposite direction, the spur wheel is carried with it, because the edge is locked between two teeth as shown. Thus dependent upon the throw of the oscillating arm which carries the pin on which B moves, is the travel of the wheel, E, in the direction of the arrow.

Fig. 40.



If B be turned upwards, the action of the arm produces no motion in the wheel, E. If B be turned over to the right, the action of the arm causes a reverse travel of the wheel.

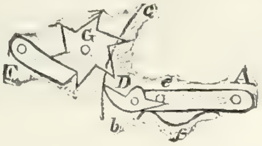
Fig. 41.



The star wheel is perhaps the oldest of the forms for obtaining an intermittent advance, and there are many cases in which it is equal to any of its more complicated and highly finished descendants. Fig. 41 represents one. It will be observed that in this case the oscillating arm becomes a rotating one, and that one revolution of the arm advances the star wheel one tooth.

Fig. 42 illustrates a contrivance in which the pendant click arm of the other arrangements is held in position by a spring, *f*. From the construction of the small piece at D, jointed to the arm (Fig. 42), this contrivance is called the "hare's foot" ratchet motion.

Fig. 42.



The star wheel, G, in this case is moved by an oscillating arm, A D; and lest the back action of A D should move the wheel, this is prevented by the detent, F. Such detent is evidently not required in Fig. 41, where there is not any back motion.

Other and very different results from combinations of links may be produced. Indeed, to motions from links alone might be applied Mr. Anderson's term, the variations of them are "endless."

When introduced into organs, to convey action from the keys to the pipes, they are called "stickers" and "trackers." They produce very peculiar results in pianos and harps. Here are models illustrative of the application of them in organs, pianos, and harps. In the violin these mechanician's substitutes are dispensed with, and nature's combination of links, as in the fingers, takes their place. How comprehensive these are, and how narrow are the limits of the former, is obvious, when we consider that the violinist has a range and variety of tones to which no keyed instrument can attain, for he can bring a perfect combination of many links, needing neither "end-shake," "clearance," "loss of time," nor any of these appendages to some of our best mechanical works. By a system of links of marvellous perfection the pianist and harpist may claim for the links in their fingers which nature has supplied whatever is comprehended in "touch." The organist surrenders touch, and glories in the range his "stickers" and "trackers" produce. The violinist alone can give to his finger-links that wonderful play and power which enables him to create and combine notes of such purity, variety, and delicacy as neither pianist, harpist, nor organist can ever attain.

[The lecturer next illustrated on a large model the link motion as used for the reversing of locomotives, marine engines, winding engines, &c.]

Passing from the somewhat elementary combinations of links, the relation between the crank, as concealed in the form of an excentric, and the travel of a pin in a straight line drawn from its centre, and caused to travel by the intervention of a connecting-rod or link, is one full of practical instruction. The arrangement is so generally adopted for moving the slide-valve of a steam-engine, that the mechanician may well consider that whatever throws light upon the relations here involved is worthy of his attention. Hence the large model now before you, containing as it does great facilities for such changes in the mechanism as an experimenter might wish to introduce. It was designed by Professor Willis, and to him and Messrs. Longmans the readers of the *Journal* are indebted for the copy of the woodcut, which the Professor uses in the recent re-publication of his book on "The Principles of Mechanism." No verbal description can make clear the results of the actual movements, as shown in the lecture, and repeated afterwards to those who felt interested in a plan to which various irregularities observable in small steam-engines may be assigned.

The diagram having been taken from the Professor's book, it may, perhaps, be well to extract his own description of it:—"When an excentric pin, crank, or equivalent contrivance is employed to produce back and forward motion in a sliding bar or plane surface, the length of the link, or connecting rod as it is usually termed, compared with the radius, is a very important element, and therefore its influence on the motion of the reciprocating piece must be developed by formulæ and construction. Generally speaking, the radius being supposed to revolve uniformly, the sliding piece, beginning from one of the extremities of its course, will move slowly, but its velocity will increase as it approaches the middle part of the course, and then decrease to the end, where, with a slight pause, it will begin to return, and so on continually. The position of the maximum velocity is not necessarily in the middle of the course, and there are other irregularities which may be developed by diagrams and formulæ.

To illustrate these varieties of motion practically, I will explain the construction of a piece of lecture apparatus devised by me in 1857, and employed ever since.

Figs. 43, 44, 45.

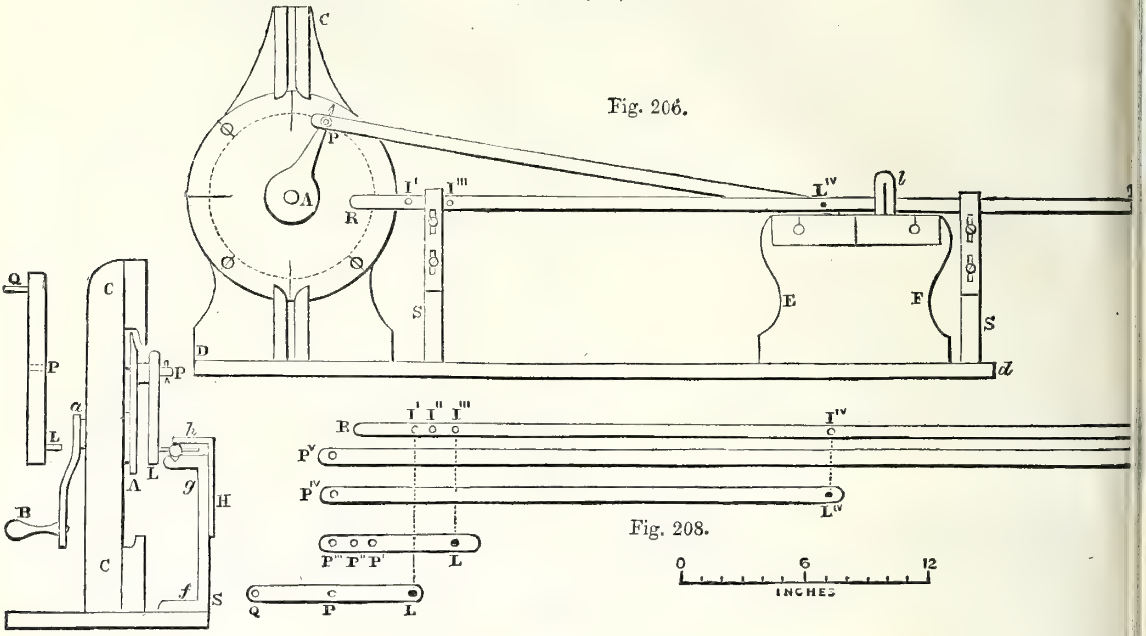


Fig. 206.

Fig. 208.

These figures represent the side and end aspects of the apparatus in question. Fig. 206 is the front, and Fig. 207 is the end view of the machine. On a base board, D d, a standard piece, C C, is fixed, in the middle of which, at A, a socket is implanted, which receives an axis rotatable by a handle, *a* B (Fig. 207), at the back, and carries in front the radial arm, A P, whose revolutions communicate the reciprocations which the machine is intended to exhibit to a sliding rod, R *r*. This rod is best supplied by a straight piece of brass tube three-fourths of an inch in diameter, which is sustained by two iron standards, S S (Fig. 206), that allow it to slide endlong. The form of these appears in Fig. 207, at S H. An iron bar of sufficient length is bent at right angles at *f* and *g*, the lower end is thus provided with a foot *f*, by which it can be screwed to the case board, the upper end *g* is furnished with an angular notch, in which the tube lies and slides, and is kept in its place by a rectangular strip or cap of metal, H *h*, attached to the front vertical face of the standard by screws in slits, which allow the pressure on the tube to be regulated, so that it may slide freely without looseness.

The radial arm, A P, carries a joint-pin, P, at its extremity, which is inserted into a hole at the end of a link, and secured by a spring cotter of wire placed in the edge of the joint-pin, as shown in Fig. 207.

Link-rods, P L, of wood are provided of several lengths, distinguished in the figures by accents P^5, L^5, P^4 L^4, P^3, P^2, P^1, L^1, selected to show the variations of motion. Each link has at one end one or more holes, P, to receive the joint-pin of the radial arm, as expressed above. At the other end a piece of brass wire is fixed normally into the vertical face of each link at L, and connected with the sliding brass rod by simply inserting it into one of the holes drilled through the rod, which bears the same accents as the link.

In Fig. 207 the linked P L is seen in the joint-pin, P, and spring cotter at its upper end, which connects it with the radial arm, and at the lower end of the link, L, the wire projects from its face and is passed through the brass tube.

To withdraw the link, the arm, A P, must be set pointing upwards as in Fig. 206, the spring cotter must then be removed, and the upper end of the link drawn outwards to release it from the pin. The cylindrical form of the tube allows of this motion by rotating upon its own axis.

On the face of the standards, C D, a circle or dial is described with centre A, and is divided into four quarters, indicated by the cross diameters, and each of the quadrants, inserted by a short line distinguished by a circular spot, which for distinctness, is in the actual machine coloured red. The end of the radial arm being pointed serve as an index, by which the radius can be placed at eight equidistant points of the circle, which are sufficient to show the general nature of the inequalities of motion produced in the sliding points by varying the lengths of the link.

The motion of the sliding rod is exhibited by means of a graduated scale on the face of a vertical board, E F, fixed to the base immediately below the sliding rod. An index *l*, fixed to the rod slides along its edge and shows the distance through which the rod travels.

The scale is simply divided into two equal parts by a line, and each of these parts is again divided unequally by a line marked with a red spot. These spots being placed so that when the longest link P^5 L^5 is employed, the index of the radial arm and that of the sliding rod will coincide simultaneously on the respective scales with the rectilinear graduating line and with the red spot lines. When shorter links are substituted this coincidence fails. The whole length of the course remains unaltered, but the intermediate graduations of the slide scale corresponding to the eight points of the radial dial are all drawn towards that dial.

By putting in turn into their respective places the three links, Fig. 208, beginning with the longest, P^5 L^5, P^4 L^4, P^3 L^3, and exhibiting for each the positions of the sliding index when the radial index is placed opposite the eight points of the dial in succession, the increasing deviations from symmetry will be made apparent very strikingly.

Three links are provided, but the shortest has three holes, P^1, P^2, P^3, by which it is enabled to perform the functions of three links. The shortest L P^1, when the hole, P^1, is placed, on the radial pin, is equal to the radius, A P, of the excentric driving arm.

A double link, Q, P, L, Fig. 208, and sideways is Fig. 207, has a hole, P in the middle fitting the excentric pin P, and two pins, Q and I, turned in opposite directions, of which one is placed in the hole I^1 of the sliding rod, and the other received in the short vertical grooves formed above and below the dial. By this combination the rod is carried by the rotation through a trip equal to the diameter of the dial, instead of the radius."

ANNUAL INTERNATIONAL EXHIBITIONS

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

FRENCH REPORTS ON THE INTERNATIONAL EXHIBITION OF 1871.

In the last number of the *Journal* these reports were noticed with respect to painting, sculpture, ceramic ware, &c. It will be well to add a few extracts and notes relating to the applications of terra-cotta, architecture, &c., especially in relation to the buildings at South Kensington.

M. Viollet-le-Duc, after describing the mode of construction of the new portion of the museum buildings in Exhibition-road, says:—"The colour of this terra-cotta is pleasing [*jolie* is the word actually employed], and during the last fine days of autumn, with a sun such as is rarely seen in London at the end of September, the building, standing out against a blue sky, assumes the tone of certain marbles gilded by the climate of Italy. This application, on a grand scale, of a solid material capable of being moulded and modelled in the most varied forms, seems to be one of the most important results which the English have ever achieved in industrial art, and, if I lay stress on this fact, it is because I think that we (the French) may make good use of the example. We are not dealing here with the caprice of an architect or an archæolgical fancy, but with the practical application of an improved art, the employment of a material the base of which is the soil of the country, and inexhaustible. Stone is rare in England, plaster is soon changed and destroyed by the humidity of the atmosphere and the effect of frost, and it is certain that terra-cotta, manufactured under good conditions, and proved by mechanical means, may transform architecture, give it all possible guarantees of durability, and satisfy all the demands of luxury."

Speaking of France, and recommending the adoption of terra-cotta in places where stone is rare or poor in quality, the reporter says that the rudiments of the industry rests in some parts of the south, but that little is produced besides balustres, balustrades, flooring, tiles, and lumps, spring-courses, masks, small spires, and a few other constructive accessories; but adds, that an Englishman, who has terra-cotta works at Vallauris, near Cannes, promises, by his energy and capital, to give a great impulse to the business.

The collection of objects in terra-cotta in the Arcade, and that of the machinery, with the methods employed, are spoken of with great admiration. "We assist," says the reporter, "in the transformation of an earthy matter without consistence into a solid, unalterable substance, which will take any forms or colours." He enumerates the most important articles shown by English manufacturers:—"Not only bricks of all forms, &c., but columns, entire windows, all set up, good in style and solid in arrangement, bell turrets, chimneys and chimney-pieces, balustrades, and even whole staircases in terra-cotta, and enamelled like majolica; in short, all that is required for the construction and decoration of any kind of building." The collection of floor and wall-tiles of all kinds, is referred to in more than one place with the highest admiration. The efforts that have been made, and the successes achieved in mosaic work are also warmly recognised.

M. Gruyer describes the best specimens of terra-cotta as showing great progress accomplished in the way of architecture and grand ornamentation, as having the effect of the finest stone, and, although moulded, the fine outlines of the best sculpture, the edges being as sharp as if cut with a chisel. Here, then, is an industry, a very near neighbour of art, and having a grand future before it. The painted and enamelled faïence, decorative panels, imitation mosaics, pilastres, figures, bas-reliefs, friezes, &c., call forth the almost enthusiastic admiration of the reporter.

The refreshment rooms of the South Kensington Museum are described at length, M. Gruyer laying special stress on the decorations of the "grill-room," which he describes as "sketched by a skilful and learned hand." All this, he adds, forms an *ensemble* in which the eye and the mind are both satisfied at once. Antiquity, the renaissance, all the good models of old times, have brought their contingent of information to artists as well as to manufactures. It is evident that the men who have conceived and executed such things live in intimacy with the best works of art.

Professor de Luynes, who reports specially on ceramics, is quite as laudatory as his colleagues respecting the terra-cotta, faïences, mosaics, &c., of the English potteries, and bestows the highest praise on the brown stone pottery for economic and sanitary purposes.

The reporters are as severe in their strictures on English architecture as they are laudatory on English ceramic work. M. Viollet-le-Duc, speaking of the collection of plans and drawings shown in the Albert-hall, recognises the proofs of long and conscientious labour, but finds "little sign of intelligence in the art of construction, and, above all, complete want of observance of the architectural proprieties in matters of taste as well as logically. There is a little of every kind—Byzantine, Roman, Gothic, Renaissance, Louis XIV., and Neo-Greek, but, whatever the epoch or the century selected by them, the English architects mix with it a foreign element, which destroys the harmony, and introduces disorder." As an illustration, M. Viollet-le-Duc cites the Albert memorial, and as this is the object of special attention at the present moment, the passage is here given entire. "This monument, which has the form of an immense baldaquin, recalls the Italian Gothic style. It is surmounted by a sharp spire, and four decorated gables ornamented with mosaics. In a word, everything so far recalls the Middle Ages. But on the four angles of the steps forming the basement of the monument are placed groups in white marble, conceived in the antique style, that is to say, composed of allegorical and nude figures. I say nothing of the proportion of the figures, which is in complete discord with the rest of the monument, but I must insist on the deplorable effects caused by these discrepancies. In all modern English architecture it is the same; there is a want of unity, and, I repeat it, of harmony. English architects, however, know how to find the laws of logic and good sense when they touch practical subjects. Take, for instance, their plans for schools, hospitals, asylums, railway stations, markets, factories, and workshops."

This is rather hard upon English architects, but then the reporter is not, perhaps, aware of the fact that they are struggling to escape from the pedantry of the schools, and to form a grand new style, so that the inconsistencies he notes must be looked upon as marking a new "transition," out of which the coming style is to be produced. He is not prepared, perhaps, for what insular originality may bring forth.

M. Gruyer also finds fault with the want of proportion in nearly all the decorative furniture exhibited, but his criticism is mildness itself compared with that of M. Viollet-le-Duc; his remarks have, moreover, a general reference:—"What is the use," he asks, "of lavishing ebony, ivory, lapis-lazuli, copper, gold, &c., on a piece of furniture, if you know not how to marry the rare and precious materials with discretion and harmony? When you desire to reproduce the furniture of past centuries, you must first penetrate the sentiment of these epochs, otherwise you produce mockeries of no period whatever. What is wanting almost everywhere is proportion, measure. We (the French) have not yet ourselves hit the mark; far from it; the English are yet still further off."

Growth of Cotton at the Exhibition.—The cotton plants in the hothouse near the entrance from Prince Albert's-road are just commencing to ripen and disclose the fleecy bolls of cotton which are the successors to the yellow flowers of the plant, and the growth of some twenty Egyptian, American, and Indian varieties may be examined.

EXHIBITIONS.

Vienna Exhibition.—The Sultan has, it is said, promised the Archduke Charles Louis, of Austria, to send a selection of the works of art and curiosities from the treasures of the imperial palaces for the coming Vienna Exhibition. The Sultan's collections are rich in art productions of the Middle Ages, and in MSS. Amongst the latter is a celebrated illuminated edition of Dante of the 14th century.

Paris Salon.—The salon closed on the last day of June, and the number of visitors during the second portion of the session, from the 19th to the 30th of June, eleven days, is reported at 102,628. Four of the eleven were free days, when the number of visitors probably averaged about 20,000, leaving more than 3,000 visitors for the other days. The number of catalogues sold during the eleven days was 3,031; this very large demand for catalogues arises, doubtless, from the fact that the works are not only divided under the natural heads of painting, sculpture, &c., but in alphabetical order under each head, so that no index is required to find any artist's work, which are all together in perfect alphabetical order. When it is added that the works are, as far as possible, hung in the same alphabetical order on the walls, and that each room, or section of the galleries, is conspicuously marked with the letter or letters of the alphabet to which it is devoted, the utility of the catalogue will be apparent. The alphabetical arrangement is universal throughout France, and pretty general all over Europe; England stands almost alone in her illogical, inconvenient method. The *salon* catalogue has the further advantage of being printed in a portable form, convenient both for reference and for the pocket. The lady *quêteuses* who attended every day, purse in hand, to beg sous for the wounded and the sufferers by the late war, collected during the eleven days above named a sum equal to more than four hundred and eighty pounds sterling.—The medals and decorations were bestowed a few days since by the Minister of Education, the Cross of the Legion d'Honour having been presented to 13 artists, and also to M. Charles Blanc; while MM. Barbet de Jouy, of the Louvre, and Henri Chapu, sculptor, were promoted to the rank of officers of the Legion. M. Chapu is the author of a charming statue of Jeanne d'Arc. It is a remarkable fact that M. Antoine Mercie, who receives one of the crosses of the Legion, and who obtained a first-class medal for his statues of David and Dalilah, and was proposed for the grand medal of honour, is still a pupil of the French Academy at Rome, he having won the grand prize in 1868 only.—M. Guiffrey has just completed a curious undertaking—the republication of the catalogues of the *Salon.** The three volumes now published are those of 1798—1800 (years 6-7, of the first republic). It is curious to note that in the two former years quoted every one without distinction is styled "citoyen" and "citoyenne;" thus the entries run as follows:—"Citoyenne femme Oyon, élève de la citoyenne Lebrun, &c." "Portrait of citoyen. . . . with his child in his arms." In 1800, however, the word "Madame" appeared before the name of married ladies. M. Guiffrey is now about to undertake another similar work—the publication of the seven known catalogues of the exhibitions of the Academy of St. Luc. These will only form one volume, and the number of impressions will be limited.

CORRESPONDENCE.

ENDOWMENT FUND FOR THE SOCIETY OF ARTS.

Sir,—I, for one, am glad that the Council are seriously considering the formation of an endownment fund. Such a scheme as the one they have put forth will not be carried out in a day; and I think that they show a great wisdom in simply letting the idea lie fallow in the minds of the members for a little while before commencing active operations. The scheme is a big one, and if carried out will make our Society one of the grandest and most useful societies ever established, and its operations in the past, great though they have been, will pale before those of the future. The fact is, at the present time the Society is crippled in its action; this is evident by the narrow circle, comparatively speaking, in which it works. In a large body of members there must be certain sections interested more particularly in one thing than another. I, for instance, am interested in machinery and mechanical appliances, and a section of the working operations of the Society devoted to this alone would be an immense advantage to such men as myself.

I have waited patiently for years in the hope that something would be done. Education has, however, had the attention of the Council almost exclusively, and the work done with its influence upon national character may be added to the long list of triumphal works of the Society; but I respectfully beg to submit that there are many matters of vital interest to other members of the Society which the Council would do well to take up and work as they have done education, that is, earnestly and persistently.

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* Anciens Livrets du Salon. Paris, Liepmannssohn.

I am led to this by the fact that I see education is still to the front, and in such a form as to demand a large amount of the income of the Society for some years. I was in hopes that the attention of the Council would have been turned in another direction, for the Society was not established simply to promote education. I am, however, disposed patiently to wait a little longer, now that I see that the Council are endeavouring to enlarge the basis of action of the Society.

The legitimate objects of the Society are deeply interesting to a very large proportion of the members. I think the time has come when those objects should be promoted *directly*. Education only does so *indirectly*.—I am, &c.,

Playfair.

STEAM HAMMERS.

Sir,—I entirely agree with Mr. Merrifield's statement on this subject, inserted p. 648 of your *Journal*, that some of the work of the hammer is lost by the want of solid resistance in the anvil-block, and that the remedy should be sought for in the duplex system, if it could by any means be practically carried out. There are obstacles, however, to any system for causing the two hammers to strike together with exactly equal force from opposite directions, so great and insurmountable, that the solid anvil-block, with all its defects, will never be entirely superseded.

The force of gravity existing in one direction only—the vertical—we must dispense with it for one of the hammers, and substitute complicated mechanical means, expensive both in construction and working, without any adequate return.

The plan carried out by one patentee has been to work two hammers horizontally, thereby relinquishing the natural force of gravity altogether, a beautiful invention, but only available in a few rare cases on a small scale. Neither can the mode suggested, of raising the anvil-block to meet the blow of the hammers, be expected to be more successful, especially on the colossal scale of our modern steam-hammers. The framing that carries the shears for cutting iron bars of large dimensions cold, in the act of cutting not only trembles and jumps, but, for the moment, becomes distorted. In fact, what is usually termed "fastening," is utterly useless against a sudden impulse or shock.

We must therefore put our trust in solid anvil-blocks, and should any one doubt the possibility of success, let him suppose the Trafalgar Column to be of solid iron, sunk in a deep well, would he imagine for one moment that such an anvil-block would tremble and dance under the blows of a hundred, or a three hundred, ton steam-hammer. Even in a common blacksmith's shop, with a stake anvil of sufficient length and thickness sunk in a well, his hammer-man would be far more effective. I greatly admire the ring of the smith's anvil, especially in the country—it is a heart-cheering sound; but in these advanced days sentiment must give way to utility, and labour must be saved by every possible expedient.

A really free, direct-acting steam-hammer, without framing or guides, may be seen at work at the Polytechnic, by application to the engineer. The force of gravity is accelerated by a down-pulling vacuum cylinder.—I am, &c.,

Henry W. Reveley.

Reading, 27th June.

GENERAL NOTES.

French Railway.—The first section of the new railway from Gap to Avignon was opened for traffic on the 8th instant. It extends from Pertuis, in the Vaucluse, to Voix, in the Basses-Alps, the intermediate stations being at Manosque, Sainte-Tulle, Corbières, and Mirabeau. Before the opening of this section the department of the Basses-Alps was without any railway communication.

Re-naming of Paris Streets, &c.—It is announced that streets are to be named after Commandant Franchetti, a very brave officer, who fell at the head of his corps of Francs-Tireurs during the siege of Paris; David D'Angèrs, the sculptor; Alexandre Dumas, Seveste, Frédéric Soullé, Latude, Lally-Tollendal; Marshal Niel, and Generals Lamoricière and Charras. The late Avenue de l'Impératrice, which has been re-named at least twice, will, it is said, be in future simply the Avenue du Bois de Boulogne. The commission of the Municipal Council charged with the study of the question recommends that in future no street or boulevard shall be named after a person still living, and, moreover, that all political significations shall be avoided. If these recommendations be adopted the name of the Rue du Quatre Septembre and of many other streets will have to be altered.

Cotton, &c., Printing.—M. Vial, a chemist, of Paris, has taken advantage of the fact that when metal rods are plunged in saline metallic solutions they become covered with coatings of the metal in suspension, to arrange the following mode of printing on cotton and other fabrics:—He lays a solution of azotate of silver on a piece of stuff, or a sheet of paper, by means of a brush, and a metal pattern being then pressed upon the material, the design shows itself immediately; thus a copper coin, being placed on paper prepared with the above solution, all the lines of the design on the coin are at once marked out by the deposit of silver in black lines. Of course the application of a solution of salts would not be applicable in all cases, but for some purposes the invention may prove useful. Thus, a stamp or seal may be made to impress its design on paper, linen, cotton, &c., by merely damping the material first with the above-named or other metallic solution.

Practical Science Teaching.—In France, as in England it has been felt for a long time that collections of objects in museums and galleries, without teaching in connection with them, are standing, illogical mistakes. In some instances efforts have been made to bring the teacher, the illustrations, and the pupils together, and with success; thus the professors of the admirable Ecole des Hauts Etudes, founded by the former Minister of Public Instruction, M. Duruy, give their lectures and lessons in various places, according to the special circumstances of each case. A course of Natural Philosophy takes place in the new Physical Laboratory of the Sorbonne; Natural History is taught in the well-known galleries and the Laboratory of the Jardin des Plantes; the lessons on Egyptian and other ancient languages, in presence of the inscriptions and illustrations relating to them in the galleries of the Louvre, and so on. Another step in the same direction is now being taken. General Morin, five years since, advocated a similar system for the free schools of science of the Conservatoire des Arts et Metiers, which contains magnificent collections of philosophical and other instruments, machines in motion, models; ceramic, chemical, and other specimens; and it has been decided that every Sunday the professors of the Conservatoire, including some of the most eminent scientific men in France, shall give class lectures and lessons of two hours duration in the galleries themselves. The success of the Ecole des Hautes Etudes, and this experiment for a totally different class of pupils, principally young artizans and apprentices, and the great public scientific schools and laboratories of Prussia, are facts so important that it would be unpardonable if the friends of education in this country were longer to shut their eyes to the importance of some such practical modes of teaching as are indicated above. Great Britain should not lag behind when practical knowledge is the question of the day, all over the world.

Musical and Dramatic Examinations in Paris.—The annual competitions have commenced at the Conservatoire de Musique. The jury for the examination in solfeggio, for the special singing classes, was composed of MM. Ambroise Thomas, F. Bazin, Comettant, Marmontel, Pasdeloup, George Pfeiffer, A. Savard, Vervoitte, and Wekerlin. Of the male pupils eleven passed the first stage of the examination, and nine of these were admitted to the final competition. There were awarded one first, one second, and one third class medal. Of the twenty-six female pupils admitted to compete, sixteen passed the first and second trials; there were awarded three first class, three second class, and three third class medals. The other competitions, which are open to the public by ticket, are fixed to take place on the 24th instant and six successive days—Sunday excepted. Those who desire to judge of the effects of the teaching of the Conservatoire would do well to attend these examinations. They take place in the following order:—Piano, singing, violin and violoncello, opera, comic opera, tragedy and comedy, wind instruments. In the case of opera and the drama, whole scenes are given by the pupils in costume.

Topography in France. — The constantly-repeated assertions respecting the want of topographical knowledge in the French army has given rise to much attention being paid of late to the teaching of geography in the colleges and schools. A journalist, M. Wachter, has placed the subject before the public in the columns of the *Soir* in a striking form:—"Topography," he says, "is a science of the highest utility; the study of it cannot be too much encouraged and disseminated;" and he introduces to his readers the name of M. Hennequin, who has commenced a course of topography intended especially for the teachers of common schools, and adds that such courses will be continued until all the primary schoolmasters are well grounded in the principles not only of using, but of drawing, maps and charts. M. Hennequin also proposes further to deliver a course of three lectures in the common schools of each of the twenty arrondissements of Paris, gratis. "These three lectures," he says, "will enable boys of ten years of age to understand a map, and to find their way about the environs of Paris as the Prussian Uhlans did, without making inquiries of any one." The idea is good and practical.

Prospect of Cheap Cotton.—A correspondent of the *Manchester Guardian* thus concludes an elaborate investigation of the condition of the cotton market:—"One thing is certain, we shall have on the 30th of the present month, in London, Liverpool, and surplus in the hands of spinners, a stock of over 1,300,000 bales, and this is within a few thousand bales of what the stock was on July 5, 1860, when the price of middling Orleans was 5⅞d. per lb., and now the price is 11¾d. per lb.; and I presume that this stock, with further imports, will enable us to keep the mills going until the new American crop finds its way to Liverpool. No doubt this will be quite as early as in 1860, and as the stock of long staples will give us a full supply until then, and later on a better selection, with such a prospect in view, I fail to see any dearth of cotton, notwithstanding expressions of opinion to the contrary; for the cotton which has been hoarded for fear of a famine will be sure to be used up during the summer. Taking everything into consideration, it seems to me that cotton is now much above its intrinsic value, and a lower scale of prices must inevitably follow. It may come suddenly, and as there will be a large stock in the country when this takes place, heavy losses are sure to be sustained upon the raw and manufactured article then in hands of the merchant and also of the retailer. Up to the latest dates the accounts of the weather and the growing crop in America continue most favourable. It is therefore probable that the crop will make up for the late spring, and may mature early. If so, more cotton will be received at the ports in September than last year. With an early season, 150,000 bales or 200,000 bales may be received in the month, or, even more, and the exports to Great Britain may be considerable in September.

Artillery Museum, Paris.—The Museum of Artillery is being moved from the old convent of the Dominicans, in the Place Saint Thomas d'Aquain, where it has been installed ever since 1795, to the Invalides, where it will occupy four large apartments, situate in the pavilion on the right hand when entering the quadrangle. The great number of pieces to be moved, and the large size and weight of some of them, render the operation one of considerable time and trouble, and it will not be completed till about the month of September.

Gun Boats.—Admiral Pothuau, with the aid of the maritime prefects of Toulon, Rochfort, Brest, and Cherbourg, is engaged in the special organisation of corps of founders, fitters, and engineers for gun-boat work. It is argued that the use of gunboats must in future be general on all the rivers in France, and that therefore it is necessary to have at all important stations men ready at a moment to construct, put together, repair, or dismantle them. Nothing is said about sea-going boats, but it is unnecessary, as the same organisation evidently applies equally to gunboats of all kinds. The point is to make their construction and maintenance the objects of special training, and the importance of such a step is self-evident.

Russian Mercantile Steam-packet Service.—A commission has for some time been sitting at St. Petersburg, for the purpose of revising the statutes of the "Russian Mercantile and Steam-packet Company," which has hitherto received a considerable subsidy from the Government, besides having the monopoly of the goods and passenger traffic on the Black Sea. The commission has now presented its report, and its recommendations have an important bearing on commercial interests in Russia, and her communications with the East. It considers that the establishment of a regular line of mail-steamers to distant Asiatic countries would be too costly, besides being unnecessary for the present requirements of the country. "The position of Russia in this matter is different from that of several Western States, such as England, France, Italy, &c.; and the commission is of opinion that the only point to be considered is the establishment of a permanent communication by means of steamers with Eastern Asia, cheifly for commercial objects." It therefore proposes that the government should repay "to all Russian steamers which proceed from a Russian port to China or India, and return thence with at least a half-freight of Chinese or Indian products, such as tea, cotton, &c., the tolls they have to pay in passing through the Suez Canal." The object of the condition with regard to freight is stated to be that the government wishes to prevent Russian ships from having any claim to repayment when they deliver their goods in foreign ports, as in such cases Russia derives no commercial benefit from the journey. The above proposal will, of course, virtually destroy the monopoly of the company; and, as regards the postal service performed by its steamers in the Black Sea and the Mediterranean, the subsidy of 1,000,000 roubles (£130,000) hitherto received by the company will be reduced by one-half from and after the year 1877, the date on which its present convention will expire. The commission also recommends that a postal communication should be maintained with Constantinople at least twice a week.

SCIENTIFIC MEETINGS FOR THE WEEK.

Tues. ...East India Association, 3. (At the House of the Society of Arts.)
Thurs...**SOCIETY OF ARTS, 3.** Review of School Drill by His Royal Highness the Prince of Wales, at the Royal Horticultural Gardens.
Fri.......Quekett Club, 8.
Sat.......Royal Botanic, 3¾.

Journal of the Society of Arts.

No. 1,027. Vol. XX.

FRIDAY, JULY 26, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

VIENNA UNIVERSAL EXHIBITION.

The Council have received the following letter:—

Temporary Offices, South Kensington Museum,
London, S.W., 18th July, 1872.

Sir,—I am directed by her Majesty's Commissioners for the Universal Exhibition to be held at Vienna in 1873 to transmit, for the information of the Council of the Society of Arts, the enclosed papers, which contain the Royal Commission issued on the 29th of April last, and also (on page 20) a summary of the conditions upon which the Vienna Exhibition will be conducted, so far as Great Britain, India, and the colonies are concerned.

I am to ask you to be good enough to take an early opportunity of submitting these papers to the Council of your Society, specially calling the attention of that body to the summary of conditions, and at the same time requesting the Council to take into consideration what steps it may be possible for them to take in order to cooperate with her Majesty's Commissioners to secure a proper representation of the manufactures and productions of Great Britain at the Vienna Exhibition.

I have the honour to be, Sir,
Your obedient servant,
P. Cunliffe Owen,
Secretary.

P. Le Neve Foster, Esq., Society of Arts,
18, John-street, Adelphi.

It was thereupon resolved:—"That the Council have received with gratification the letter from the Royal Commissioners for the Vienna Universal Exhibition, and cheerfully constitute themselves into a Committee to assist producers to become exhibitors at Vienna in 1873, and will appoint an early day to hold a public meeting on the subject."

DOMESTIC ECONOMY IN THE CONSUMPTION OF COAL.

The following letter has also been received:—

West-hill, Highgate, July 19th, 1872.

Dear Sir,—A respected friend of mine has just communicated with me upon a subject of present interest, to which I am desirous of calling the attention of the Society of Arts.

He has for some time been considering how best to secure greater economy in the consumption of coal in private houses, and, referring to an article which appeared in the *Times* of Wednesday last (and which has been very generally appreciated), it is his wish to avail himself of the instrumentality of the Society in offering a suitable inducement to persons conversant with the subject to consider the practicability of producing a form of stove, for ordinary sitting-rooms and kitchens, to consume as far as possible its own smoke, and to ensure the most perfect and judicious use of the coal to be consumed therein.

With this object he would leave to the Council the preparation of such rules and conditions as they may think it advisable to annex to a public appeal for competitive designs, should it be considered within their province to entertain his proposal.

My friend does not wish his name to be published, but I am authorised, on his behalf, to guarantee any reasonable amount (say £500) for prizes or otherwise, in the confident expectation that the effort may lead to a satisfactory solution of what has been truly stated to be one of the urgent problems of the day—"the attainment of sufficient warmth for cooking and for comfort, with the least possible consumption of coal."

I venture to trouble you in this way, as official engagements will prevent my attendance.

I am, dear sir,
Yours faithfully,
W. H. Bodkin.

P. Le Neve Foster, Esq.,
Secretary Society of Arts.

It was resolved that the Council thankfully accept the offer, and refer it to a committee, consisting of the Chairman of Council, Captain Galton, C.B., Robert Rawlinson, C.B., and E. Chadwick, C.B., with power to add to their number, to confer with Sir William Bodkin, and concert with him the proper action to be taken.

PROCEEDINGS OF THE SOCIETY.

CONFERENCE ON TECHNOLOGICAL EDUCATION.

A Conference on the above subject was held on Saturday, the 20th inst. The chair was taken by his Royal Highness Prince Arthur, K.G. Amongst those present were—

The Lord Chancellor (Vice-President of the Society), Lord de Lisle and Dudley (Vice-President), Lord Henry G. Lennox, M.P. (Vice-President), Sir John Pakington, Bart., M.P. (Vice-President), Sir William Bodkin (Vice-President), Dr. Lyon Playfair, C.B., F.R.S., M.P.; Mr. Henry Cole, C.B. (Vice-President), Mr. Edwin Chadwick, C.B. (Vice-President), and Mr. Seymour Teulon (Vice-President).

The following members of the Council were also present:—Major-General Eardley-Wilmot (Chairman of Council), Lord Alfred Churchill, Mr. Hyde Clarke, Mr. Andrew Cassells, Captain Douglas Galton, C.B., F.R.S., Major Donnelly, R.E., Mr. Edwin Lawrence, Vice-Admiral Erasmus Ommanney, C.B., F.R.S., Lord Clarence Paget, Mr. Samuel Redgrave, Lieut.-Col. Strange, Mr. E. C. Tufnell, Mr. T. R. Tufnell, Mr. E. Lawrence, and Mr. J. T. Ware.

There were also present Professor Huxley, F.R.S., Dr. Frankland, F.R.S., Dr. Anderson, Professor Bloxam, Mr. Warren De la Rue, F.R.S., Professor Curtis, LL.D. (Queen's University, Ireland), Professor Robert Kerr, Major Harvey, R.E., Mr. Daniel Watney, Jun. (Master of the Mercers' Company), J. Norman Lockyer, F.R.S., Dr. D. S. Price, Professor Hughes, Rev. J. S. Brewer, M.A., Professor T. N. Goodeve, Mr. H. L. Hammack (Plasterers' Company), Dr. Crace Calvert, F.R.S., Mr. T. Webster, Q.C., Mr. Samuel Strange (Master of the Clothworkers' Company), Mr. E. J. Gibbs (Chamber of Commerce, Wolverhampton), and Mr. C. J. Bloxam (Clothworkers' Company).

The following is a list of the Institutions and Local Educational Boards represented at the Conference, with the names of their respective representatives :—

Aldershot and Farnham District Local Board	Mr. Carnegie. Mr. H. Poppleton.
Bishop's Stortford Literary Institution	Mr. Edward Taylor.
Bishop's Stortford Local Board	Rev. Godfrey Goodman, D.D. Rev. R. Alliott.
Carlisle Mechanics' Institute	Mr. Edmund Potter, M.P.
Crewe Mechanics' Institute...	Mr. Thomas Creech. Mr. R. C. Stapley.
Derby Local Board	Mr. H. M. Holmes.
Edinburgh Watt Institution	
Faversham Institute	Mr. F. Johnson.
Glasgow Mechanics' Institution	Mr. Dalglish, M.P. Captain James London.
Guildford Institute	Mr. Charles Bond. Mr. C. D. Campbell.
Hertford Local Board	Mr. Robert Dimsdale, M.P. Mr. O. H. Wagner.
Huddersfield, Mechanics' Institute	Mr. Joseph Bate.
Ipswich Working Men's College	Dr. E. Christian.
Lancashire and Cheshire Union of Institutes	Dr. Pankhurst. Mr. Thomas Lawton.
Leeds Young Men's Christian Association	
Lockwood Mechanics' Institute	Mr. Charles Kaye.
London, Birkbeck Literary and Scientific Institution	Dr. G. G. Zerffi. Mr. G. M. Norris. Mr. J. H. Levy. Mr. J. Rigby Smith.
„ City of London College	Mr. A. Bakewell. Mr. J. D. Simmons. Mr. J. Knight. Mr. J. H. Levy.
„ Royal Polytechnic Society	Rev. C. Mackenzie.
„ St. Stephen's, Westminster	Rev. W. Tennant. Mr. S. Elliott. Mr. W. H. Baker.
„ Walworth Literary and Scientific Institution	Mr. J. S. Noldwritt. Mr. Frederick Wood.
Macclesfield Useful Knowledge Society	Mr. W. Jeffery.
Patricroft Mechanics' Institute	Mr. R. Wilson.
South Staffordshire Association	Mr. Frederick Talbot.
Stockton-on-Tees Mechanics' Institute	Mr. Jos. Dodds, M.P.
Yorkshire Union of Mechanics' Institutes	Mr. Edw. Baines, M.P. Mr. Thomas Baines. Mr. James Hole. Mr. Thomas Wilson. Mr. W. Kempe.

The following report of the Council was read by the Secretary :—

May it Please your Royal Highness,—It has long been acknowledged that if this country is efficiently to maintain its manufacturing supremacy in the markets of the world, the technical education of our artisans must be improved, and the Council of the Society of Arts are of opinion that technological examinations (which do not form part of the systems either of the Universities or of the Government) would be of great use in furtherance of this end.

The Council have had before them a proposal by Major Donnelly, R.E., a member of their body, that the Society of Arts should establish such examinations, and he furnished an outline scheme for the purpose, and this having been referred to a Committee for consideration and report, the Council, in accordance with its recommendations, are of opinion that it would be of public advantage if the Society of Arts were to supplement the existing examinations of the Science and Art Department, by organising examinations in the science and technology of the various arts and manufactures of this country.

These examinations should be conducted by a Board of Examiners, capable of testing the practical knowledge and skill required in the application of the scientific principles involved in each art or manufacture.

The Council are further of opinion that the scheme of examinations proposed by Major Donnelly, and which is appended, may with advantage be adopted, with such modifications as may from time to time be found from experience desirable. (See Appendix.)

The Council propose to give notice annually of the subjects which would be taken up the following year. In making their selection, it may be advantageous to include those Arts and Manufactures which are to be the subjects of the International Exhibitions of the year.

The Council have entered into communication with the various Guilds, Companies, Chambers of Commerce, and large manufacturers, and have convened this conference with a view of eliciting their opinions, and obtaining their support to the undertaking.

The Council propose to hold their first Technological Examination in 1873, and to take up as the subjects the manufactures of Paper and Cotton. With this view they have, with the assistance of two Special Committees, drawn up the detailed rules for the conduct of these examinations, which they now lay before the Conference. By order,

P. Le Neve Foster, *Secretary.*

Appendix.

Outline Scheme of the Technological Examinations proposed by Major Donnelly, R.E.

If the Society of Arts approve of the idea of instituting technical examinations, the course of proceeding should, I think, be as follows :—

1. The Council should decide what Arts or Manufactures should be the subjects of examination each year.

2. They should then appoint a Committee of, say, three or five gentlemen conversant with the science and technology of each such Art or Industry. This Committee would then frame the syllabus of examination.

3. In framing the syllabus, it should be an instruction to the Committee that it is essential that the candidate should possess, on the one hand, such an elementary knowledge, at least, of science, as will prove that he understands the scientific principles of which his art is an application, and, on the other hand, such a knowledge of the application of those principles in his trade as will show that he is practically conversant with the various processes and manipulations of the factory or workshop. The theoretical knowledge must not be a mere "cram" of empirical dicta, nor the practical knowledge a mere committal to memory of descriptions of manufactures picked up from text-books.

4. The Committee would therefore lay down—

(*a.*) What branches of Science it was essential that the candidate should possess a knowledge of, as a preliminary to his technological examination.

(*b.*) What branches of Science it might be of advantage to him in his industry to possess a knowledge of, though they were not essential to his technical knowledge.

(*c.*) A more or less detailed syllabus of the matters which would form the subjects of the technological examinations.

5. As respects (*a*) and (*b*), the examinations of the Science and Art Department provide the requisite machinery. It would only be necessary for the Committee to determine what were the essential subjects, and what number of marks (or classes) in those subjects it was essential the candidate should have obtained in order to *qualify* in this branch of the examinations (*a*); and, having qualified, what number of marks he might count in certain other branches of science (*b*).

6. Under these heads are included also mechanical and free-hand drawing, painting, and designing for manufactures, for they, as well as most subjects of science, are included in the examinations of the Science and Art Department.

7. As respects the syllabus (*c*), the Committee should frame one on which the examination would be based. The syllabus should give the various heads of the technological examination—the examination being framed to test the candidate's knowledge of the practical application of scientific principles to his art or industry. Eventually the Committee, or one or two examiners appointed by it, would set the examination paper or papers. These would be worked under the superintendence of local committees—either those organised in connection with the Society of Arts or with the Science and Art Department—immediately after the examinations of that Department in May. The candidates' papers would then be returned to London for examination. In addition to these papers, it might be advisable, and it would be quite practicable, to have a return of the candidate's employment in his trade, certified by his employer, somewhat in the form appended, which is a modification of the Whitworth candidates' "Workman's" form. Under these circumstances, the Committee might find it desirable to define precisely the amount of practical experience the candidate must have had in his art or industry to enable him to obtain a certificate.

8. When the candidate has satisfied the examiners on these points a certificate should be awarded. These certificates should be of three grades, according to the proficiency of the candidate:—

(1.) The elementary grade, or what may be termed the "workman's" certificate.

(2.) The advanced, answering to the "foreman's" certificate.

(3.) Honours, answering to the "manager's" certificate.

9. Each grade may further be subdivided into two classes—first and second class. In addition to the certificates, prizes and medals should be given in each grade.

10. It is to be hoped the various Chambers ot Commerce, Trade Companies, &c., may assist in offering prizes in the industries in which they are interested. Independently of this, however, it may reasonably be expected that the certificates themselves will carry sufficient weight to make them valuable objects of competition.

11. If the Society of Arts has not the funds for carrying out this scheme, I would suggest an application being made to the Royal Commission for the Exhibition of 1851 to provide, or assist in providing, funds for the examinations in those industries which form the subjects ot their Exhibitions; and that it should be announced that any other industries would be taken if its representatives provided sufficient funds. It would thus depend on each industry itself whether there will be technological examinations for it annually, biennially, triennially, or only decennially, in connection with the International Exhibitions.

Form with Heads of Information to be supplied by Candidates in the Technological Examination of the Society of Arts.

It will be necessary for this Form to be returned not later than the———

1. Name in full.
2. Age last birthday.
3. Address in full.
4. State here where you began to work, and when

whether you were apprenticed, and if so, to whom; and what workshops or manufactories you have been employed in—if you have been employed in more than one—up to the present time.

5. What is your present rate of wages, and what has it been for the last two years?
6. What is the precise nature of the work you have been employed on latterly? If there has been any special or noteworthy piece of work done in the workshops or manufactories on which you have been employed, mention it. And state what, if any, specimens of your work can be seen, and where.
7. Are there any specimens of your work that you could send to be inspected if required? If so, state what they are, their weight and size.
8. I hereby certify to the accuracy of the preceding statement.

(Candidate's Signature.)

9. Having filled up the preceding form, the candidate must have it certified by his employers; or, if he should be out of employment at the time, by his last employers; or, in case he cannot obtain such certificates, it must be certified by some person of position who can speak to its correctness. In the latter case, an explanation must be given why the employer's certificate has not been given.
10. I hereby certify that, to the best of my belief the foregoing particulars are correct.

(The employer is requested to give any information as to the candidate's ability that he considers may be of use to the examiners in forming their judgment.)

N.B.—The preceding form, filled up by the candidate, must be handed to the employer, who is requested, after stating his own opinion himself, to put the form under cover and send it, directed to the Secretary, Society of Arts, John-street, Adelphi, London.

11. Opinion of employer.

(Signature of employer.)

PROGRAMME AS TO THE MANUFACTURE OF COTTON.

This Programme has been prepared by the following Committee:—G. C. T. Bartley, Sir T. Bazley, Bart., M.P., John Cheetham, General Cotton, Major Donnelly, R.E., Thiselton Dyer, Lieut. Grover, J. F. Iselin, Hugh Mason, John Radcliffe, Alexander Redgrave, and Dr. Forbes Watson, F.R.S.

1. Your Committee, having considered the question referred to them, recommend that the examination in the art and technology of the manufacture of cotton should be as stated below. In framing the examination it must be understood that we have confined ourselves to the manufacture of purely cotton goods.

2. Adopting the general outline laid down by the General Committee of Technical Examinations, and following the recommendations of the Committee on the Manufacture of Paper, which we had before us, we consider the examination as divided into three parts.

3. The first part relates to those branches of science a knowledge of which we consider requisite as a foundation for sound technical instruction. In the specification of this course, we have borne in mind the present limited opportunities for obtaining a scientific education in this country, and have restricted our demands as far as it is possible to do so, while securing a sound basis of scientific knowlege.

4. The second part relates to the technology of the manufacture, or the special application of the various branches of science to it.

5. The third part relates to the practical skill in the manufacture itself.

6. The requisite knowledge as respects Part I., General Science, will be tested by the May Examinations of the Science and Art Department. That of Part II., Technology, will be tested by special examination papers, set immediately after those examinations. The practical skill, Part III., will be judged by the returns of the candidates' employment in cotton-mills.

Part I.—General Science.

7. We consider that for the Elementary Grade or Workman's Certificate, the Candidate should possess knowledge of the Elements of Mechanics, and of Practical Geometry. When he has qualified in these subjects, he may be allowed to count marks in any of the other subjects given in section 2 of Appendix A which he elects to take up.

8. For the Advanced or Foreman's Certificate, the Candidate should possess some knowledge of Practical Geometry, Machine Construction and Drawing, Elementary Mathematics, and Applied Mechanics or Steam. When he has qualified in these subjects he may be allowed to count marks in any of the other subjects given in section 2 of Appendix A which he elects to take up.

9. For Honours, the Candidate should show a higher knowledge of the subjects mentioned in the preceding section, and when he has qualified in these subjects he may be allowed to count marks in any of the other subjects mentioned in section 2 of Appendix A.

Part II.—Technology.

10. The nature and properties of the various kinds of raw material. Sea Island, Queensland, Fiji, Egyptian, New Orleans, Boweds, Dollerah, Hinginhaut, Surat, &c.

11. A general knowledge of the mode of preparing the raw material; cotton gins, &c.

12. A knowledge of cleaning cotton by opening, scutching, carding, and combing machines.

13. Processes of elongation or attenuation, through drawing frames, slubbing, intermediate and finishing roving frames, and best drafts in rollers.

14. Spinning operations upon the throstle, jenny, and mule, with best drafts for rollers.

15. Weaving preparations, winding and warping, sizing, colouring and printing in warps.

16 Weaving by the common loom, by looms

for fancy fabrics, bed-quilt looms, and looms for every varied manufacture.

17. The manufacture or doubling of single yarn for lace, sewing thread, and kindred purposes.

18. Stiffening and weighting processes, with the per-centage of weight thereby added.

19. The various kinds of woven cotton fabrics, such as calicoes, drillings, tickings, sheetings, towellings, muslins, shirtings, long-cloths, quiltings, toilet covers, diaper for table-cloths, window curtains, furniture dimity, ginghams, woven checked goods, brillantés, tapes, cotton beavers, velvets, velveteens, cotton chenille, madapollams, cotton flannel, jeans, hosiery, &c., &c.

Part III.—Practical Knowledge.

20. The Candidate should be required to produce a certificate, on a form supplied, certified by his employer, stating the nature of his employment in a cotton mill, and showing that he is conversant with at least one branch of the manufacture.

Appendix A.

The following is the detailed statement of the examination which candidates will have to undergo in the general science subjects :—

1. As the knowledge of these subjects will be tested by the May Examinations of the Science and Art Department, the terminology employed will be that of the Science and Art Directories, in which a careful syllabus of each subject, and the divisions of each subject, are provided.

2. The following branches of science are more or less involved in the manufacture of cotton:—

Subject 1. Practical Plane or solid Geometry.
,, 2. Machine Construction and Drawing.
,, 3. Building Construction.
,, 5. Pure Mathematics.
,, 6. Theoretical Mechanics.
,, 7. Applied Mechanics.
,, 16. Vegetable Anatomy and Physiology.
,, 22. Steam.

3. For the Elementary Grade or Workman's Certificate, the Candidate will be required to have passed in the elementary stage of—

Subject 1. Practical, Plane, and Solid Geometry, or in 2nd grade Geometry (Art).
,, 6. Theoretical Mechanics, or in
,, 7. Applied Mechanics.

He may then count marks in any of the subjects given in section 2.

4. For the advanced or Foreman's Certificate, the Candidate will be required to have obtained at least a First-class in the elementary stage of—

Subject 1. Practical, Plane, and Solid Geometry.
,, 2. Machine Construction and Drawing.
,, 5. Pure Mathematics.
,, 6. Theoretical Mechanics, or in
,, 7. Applied Mechanics, or
,, 22. Steam.

He may then count marks in any of the subjects given in section 2.

5. For Honours, the Candidate must have at least passed the second stage of Mathematics, and in the advanced stage of the other subjects given under section 4, including Steam. He may then count marks in any of the other subjects mentioned in section 2.

6. The scale of marks will be those taken for the Competitions for the Royal Exhibitions (see section lxi., Science Directory).

7. For Special Competition for Prizes, &c., it will be necessary that the Candidate should come up in all the subjects in which he wishes to count marks at one Examination. But for the Certificate alone, he may take the subjects in successive years.

PROGRAMME AS TO THE MANUFACTURE OF PAPER.

This Programme has been prepared by the following Committee :—F. A. Abel, F.R.S., G. C. T. Bartley, General Cotton, Major Donnelly, R.E., Professor Thiselton Dyer, Lieut. Grover, R.E., E. N. Haines, J. F. Iselin, J. Jackson, R. Marchant, Wyndham S. Portal, W. De la Rue, F.R.S., J. Wrigley, Messrs. Easton and Anderson.

1. Your Committee, having considered the matter referred to them, recommend that the examination in the art and technology of the manufacture of paper should be as follows. It must be understood that this examination applies only to the *manufacture* of paper, and not to any of the allied industries of stationery, printing, papier maché manufacture, &c.

2. Following the recommendation of the General Committee on Technological Examinations, we consider the examination as divided into three parts.

3. The first part relates to those branches of science, a knowledge of which we consider requisite as a foundation for sound technical instruction. In the specification of this course, we think it right to state that we have borne in mind the present limited opportunities for obtaining a scientific education in this country, and restricted our demands, as far as possible, consistently with our primary duty of securing a sound basis of scientific instruction.

4. The second part relates to the technology of the manufacture, or the special application of the various branches of science to it.

5. The third part relates to the practical skill in the manufacture itself.

6. The requisite knowledge as respects Part I., General Science, will be tested by the May Examinations of the Science and Art Department. That of Part II., Technology, will be tested by special examination papers, set immediately after those examinations. The practical skill, Part III., will be judged by the returns of the candidates' employment in paper-mills.

Part I.—General Science.

7. We consider that for the Elementary Grade or Workman's Certificate, the Candidate should possess an elementary knowledge of Mechanics, of Chemistry or of Botany, and of Practical Geometry. When he has qualified in

these subjects, he may be allowed to count marks in any of the other subjects given in section 2 of Appendix A, which he elects to take up.

8. For the Advanced or Foreman's Certificate, the Candidate should possess some knowledge of Practical Geometry, Machine Construction and Drawing, Elementary Mathematics, Mechanics or Steam, Light and Heat, Chemistry or Botany. When he has qualified in these subjects he may be allowed to count marks in any of the other subjects given in section 2 of Appendix A which he elects to take up.

9. For Honours, the Candidate should show a higher knowledge of the subjects mentioned in the preceding section, and when he has qualified in these subjects he may be allowed to count marks in any of the other subjects mentioned in section 2 of Appendix A.

Part II.—Technology.

10. The general syllabus is given below. The questions in it should be adapted to the amount of knowledge of general science required for each grade of certificate, as stated above, that is to say, the Candidate should be required to show a knowledge of such of the several technical details as are based upon, or explicable by, the branches of General Science, a knowledge of which is required for the respective certificates. Subject to this proviso, the candidate ought to be acquainted with—

11. The characteristic properties of the fibres of hemp, flax or linen, cotton, esparto, straw, wood, &c., when made into paper.

12. The composition and special properties of the chemical agents used in paper-making processes, such as the caustic alkali, chlorine, antichlor, bleaching powder, mordants, vegetable and animal size.

13. The nature of the action of caustic alkali on straw or esparto, in the process of making paper pulp from these raw materials, and the means which can be adopted for the recovery of the alkali used.

14. The characteristic difference between the pulps obtained from wood, 1st, by the process of grinding, and 2nd, by submitting it to the action of alkali under high pressure.

15. The mechanical effect of the rag engine, and the method of controlling its action, in order to produce pulp consisting of a long and fine fibre, or of a short fibre.

16. The general construction and action of the machinery employed in the conversion of pulp into sheets; and the manufacture of paper by hand.

17. The conditions necessary for producing a good writing paper; printing paper; drawing paper; bank-note paper; packing paper.

18. The most suitable mineral admixtures, or "loading," to be added to the pulp.

19. The determination of the per centage of such admixture or "loading."

20. The difference between vegetable size, animal size, and the so-called rosin size, and when it is advantageous to employ them separately or combined.

21. The action of size on water-leaf.

22. The difference in the nature of the paper when sized with animal size, when it is dried rapidly over cylinders heated by steam, or when dried slowly at a lower temperature. The effect of loft-drying on the quality of paper when sized with animal size.

23. The manufacture of size, and the advantage or disadvantage of employing a high temperature or a low temperature in its preparation; also the most suitable temperature for conducting the operation of size making.

24. The nature of the process when chloride of lime or chlorine gas is employed for bleaching, and the effect of using too much bleach.

25. The use of antichlor in paper-making.

26. The most suitable form of construction for paper mills, with precautions against fire.

27. The general arrangements for water supply throughout the works, and the conditions to be attended to as respects its quality.

28. Electric action in certain processes of paper-making; cause of; remedy for.

Part III.—Practical Knowledge.

29. The Candidate should be required to produce a certificate, on a form supplied, certified by his employer, stating the nature of his employment in a paper mill, and showing that he is practically conversant with at least one branch of the manufacture.

Appendix A.

The following is the detailed statement of the examination which candidates will have to undergo in the general science subjects:—

1. As the knowledge of these subjects will be tested by the May Examinations of the Science and Art Department, the terminology employed is that of the Science and Art Directories, in which a careful syllabus of each subject, and the divisions of each subject, are provided.

2. The following branches of Science are more or less involved in the manufacture of paper:—

Subject 1. Practical Plane or Solid Geometry.
" 2. Machine Construction and Drawing.
" 3. Building Construction.
" 5. Pure Mathematics.
" 6. Theoretical Mechanics.
" 7. Applied Mechanics.
" 8. Acoustics, Light, and Heat.
" 9. Magnetism and Electricity.
" 10. Inorganic Chemistry.
" 11. Organic Chemistry.
" 16. Vegetable Anatomy and Physiology.
" 17. Systematic and Economic Botany.
" 22. Steam.

3. For the Elementary Grade or Workman's Certifi-

cate, the Candidate will be required to have passed in the elementary stage of

Subject 1. Practical, Plane, and Solid Geometry, or in 2nd grade Geometry (Art).
,, 6. Theoretical Mechanics, or in
,, 7. Applied Mechanics.
,, 10. Inorganic Chemistry, or subject 16, Vegetable Physiology and Anatomy.

He may then count marks in any of the subjects given in section 2.

4. For the Advanced or Foreman's Certificate, the Candidate will be required to have obtained at least a First-class in the elementary stage of—

Subject 1. Practical, Plane, and Solid Geometry.
,, 2. Machine Construction and Drawing.
,, 5. Pure Mathematics.
,, 6. Theoretical Mechanics, or in
,, 7. Applied Mechanics, or
,, 22. Steam.
,, 8. Acoustics, Light, and Heat.
,, 10. Inorganic Chemistry, or subject 16. Vegetable Physiology and Botany.

He may then count marks in any of the subjects given in section 2.

5. For Honours, the Candidate must have at least passed in the second stage of Mathematics, and in the advanced stage of the other subjects given under section 4, including Steam, Vegetable Physiology, and Economic Botany; and, in addition, he must have passed in the elementary stage of Organic Chemistry. He may then count marks in any of the other subjects mentioned in section 2.

6. The scale of marks will be those taken for the Competition for Royal Exhibitions (see section lxi., Science Directory).

7. For Special Competition for Prizes, &c., it will be necessary that the Candidate should come up in all the subjects in which he wishes to count marks at one Examination. But for the Certificate alone, he may take the subjects in successive years.

Prince Arthur, K.G., said:—Gentlemen,—When first asked to take the chair at this conference, I felt some hesitation in accepting the responsibility. The subject is one which has of late years much engaged public attention, and I should have preferred some one presiding who is better acquainted with its details. One of the chief reasons which have induced me to assist in this undertaking, so far as lay in my power, is the fact, well known to you all, that the Prince Consort constantly endeavoured to advance the application of science to art and industry, bearing in mind, as he termed it, that they should form the conscious regulators of productive industry. I hope I may be allowed to read a clear expression of his views on this subject from one of his addresses. The extract which I desire to place before you is as follows:—"The courage and spirit of enterprise with which an immense amount of capital is embarked in industrial pursuits, and the skill and indefatigable perseverance with which these are carried on in this country, cannot but excite universal admiration; but in all our operations, whether agricultural or manufacturing, it is not we who operate, but the laws of nature which we have set in operation. It is, then, of the highest importance that we should know these laws, in order to know what we are about, and the reason why certain things are which occur daily under our hands, and what course we are to pursue with regard to them. Without such knowledge we are condemned to one of three states—we either merely go on to do things just as our fathers did, and for no better reason than because they did them so; or, trusting to some personal authority, we adopt at random the recommendation of some specific, in a speculative hope that it may answer; or, lastly—and this is the most favourable case—we ourselves improve upon certain processes, but this can only be the result of an experience hardly earned and dearly bought; and which, after all, can only embrace a comparatively short space of time and a small number of experiments. From none of these causes can we hope for much progress; for the mind, however ingenious, has no materials to work with, and remains so in presence of phenomena the causes of which are hidden from it. But these laws of nature, these divine laws, are capable of being discovered and understood, and of being taught and made our own. This is the task of science; and whilst science discovers and teaches these laws, art teaches their application. No pursuit is, therefore, too insignificant not to be capable of becoming the subject both of a science and an art." But to return to the question now before us. I understand the position of the matter to be this,—the Society of Arts is endeavouring to encourage among those who are practically employed in various industries the study of art, and an accurate knowledge of its application in each branch of manufactures. The Society will not attempt to teach the practice of these arts; their object is rather to lay a sound foundation for the principles on which this practice may be carried out to the greatest advantage. They desire to give certificates, prizes, and scholarships to those who show that to practical knowledge and skill as workmen they have added an accurate knowledge of natural principles. I am certain that all present feel the desirableness and the necessity of combining in these matters scientific principles with practice, and it seems to me a very curious thing that we are only now beginning to think of undertaking this. The machinery for these examinations already exists. In fact, the skeleton of industrial universities is ready to our hands; what we now require is funds to clothe it and give it life, to enable it to carry on its work, and to obtain sufficient prizes to encourage, to assist, and to reward the deserving youth of this country. If others would do what Sir Joseph Whitworth has done by means of his noble endowment for mechanical engineering, we might soon hope to see our most sanguine expectations realised.

The Lord Chancellor proposed the first resolution, namely:—"That this meeting entirely approves of the proposed scheme for technological examinations, and considers it well worthy of general support, with a view of admitting the great deficiency in technological knowledge of this country." He said all who had been associated for a long time with the labours of the Society of Arts must be highly pleased to see it now embarking on a new ocean of discovery with reference to the intellectual progress of their fellow-countrymen. It had at all times evinced the greatest desire to promote, by means of trustworthy and solid examinations, the true and real knowledge of those who were engaged in arts and manufactures, and it was a matter of congratulation to see his Royal Highness, not only as representing the Royal Family, presiding on this occasion, but as being himself connected with the scientific corps of the army, and having himself gone through all the necessary grades of scientific examination and technical knowledge necessary to his advancement to the highest employment in that department. It was also interesting to remark that they were indebted to an officer of the same corps for the practical development of the work about to be inaugurated. His Royal Highness had alluded very appropriately to the exertions of his lamented father in the cause of science and art. It must not be forgotten that the Prince Consort promoted and revived the activity and energy of the Society, at a time when it had somewhat sunk in public estimation, because it had decreased in its usefulness; and all were aware of the stimulating effect which his noble example and support had produced. The particular work now in hand was the natural sequence of that which had been going on for some time, namely, examinations in the scientific knowledge of those candidates who had presented themselves throughout the country to the examiners appointed by the Society. This work had been of great benefit, as he had had an opportunity of seeing in his experience, for on one occasion he was present at Halifax, when two scholars in one of the schools established by Col. Ackroyd obtained each a certificate from the Society, one in chemistry, and one in book-keeping, the result of which was that they both obtained immediate and lucrative employment, one in a large dyeing firm in Glasgow, and the other in a mercantile concern at Liverpool. This showed the advantage of young men being able to show the nature and quality of their attainments by means of the process of examinations, and how beneficial it was to them in obtaining immediate employment. There was a great probability that, by combining the two things, namely, the certainty of beneficial employment with actual merit, a degree of credit would attach to these young men through life, and this was very similar to the plan adopted in the universities, where the degrees were not valued simply on account of the professional advancement in after life which was attached to them, but also because they tended to reflect lustre on the professional employment of those who obtained them, and so tended to advance the honour and credit of that profession to which they united themselves—so in the same way, when men really skilled in science were successful at an examination, they not only received the benefit themselves, but the art or employment in which they were engaged was advanced and improved by the devotion to it of a body of men of scientific character and attainments. On the occasion of the Exhibition of 1862, he had the pleasure of meeting M. Arles Dufour, of Lyons, a man who had devoted himself to the development of all kinds of art and science. He said that he had known England for many years, and he could hardly have thought it possible that there could have been such a development in the artistic manufactures of this country in the period between the Exhibitions of 1851 and 1862. This he attributed very greatly to the schools which had been instituted as a result of the Exhibition of 1851. He had much pleasure in moving the resolution.

Dr. Lyon Playfair, M.P., in seconding the resolution, said the word Technology sometimes frightened persons who did not quite understand what it meant. It was not at all intended by the Society to teach the practice of the arts; that was not the meaning of technology, which rather meant the science which underlie the art, and on which it rested. It was with a view to teach those principles, and make the practical workers in an art intelligent beings—not working by a mere rule of thumb—that this subject was introduced to their attention. It was quite true that all arts were carried on by the application of these principles regulating the artist, either consciously or unconsciously. It was not the case, as stated in the House of Commons only last week by a distinguished manufacturer, that science arose altogether from the arts, though it was true that, in the early stages of all the arts, science was founded on the accumulation of the experience obtained in them. The arts originally arose from the necessities of man. Man who, with the intellect of an angel, had the naked body of an earthworm, having no natural tools, like the common animals, at his command, was obliged to exert himself, and supply their places by his intellect, and gradually, by the experience he thus obtained, science developed itself. But afterwards there came a time, which had come long ago in all civilised countries, when the science, originally the child of this experience, became, as children often were, able to better the position of their fathers, and science in its development aided the arts immensely. That was the position in which they were anxious to put working men now; to teach them the principles which underlay their several crafts, so that, having got proper dignity as intelligent beings, they might understand what they were doing, and be able to apply those principles to the development of the arts in which they were engaged. so that by accumulating experience, and increasing the number of intelligent observers, science in its turn might be benefited, as it had benefited them. It was a mistake to suppose that the forces applied to the production of any industry were the slaves of men; on the other hand, men were entirely the slaves of those forces, and could not turn them one hair's breadth out of their path; therefore they must understand the nature of these forces if they wished to apply them rightly. For instance, if England depended for her productiveness merely upon the brute force of her inhabitants, that would be limited by the population of about 30,000,000; but the coal excavated and applied as a productive force in this country was equal to the productive power of the whole population of the globe. It was therefore necessary to show the working classes that these forces were used, consciously or unconsciously, in the exercise of their craft, to elevate their intelligence, and to enable them to apply these forces properly to the craft which they undertook, not to make them merely manipulating animals, because in no case could a man who was not ambidextrous be so good a manipulator as a monkey with four hands. By giving him intelligence, he was raised in the scale of being, better fitted for whatever calling he was engaged in. It was this view which recommended the resolution which the Lord Chancellor had proposed to the favourable consideration of the meeting.

Mr. Saywell said amongst all civilised men there could be only one opinion as to what was called technical—though he should prefer to call it artistic—education. He regretted, however, to see that nothing had been done by the Society of Arts to recognise what had been done in this way by the City guilds. He was a member both of the Society and also of one of the City guilds, and he begged to call attention to the fact that some of these bodies had taken this matter up; for instance, the Coach-makers, Coach-smiths, Haberdashers, Joiners, Brass-founders, Paper-stainers, and Turners, and it would be unwise to ignore their efforts. He thought the object of the Society should be, not to supersede, but to endeavour to assist their efforts. For many years the City companies did occupy the position of superintending the technical education of the younger members of their trade, that being really the purpose for which they received their charters, and the ground on which they were incorporated, though of late years these functions had fallen pretty much into disuse. Still, the moral obligation was as strong upon them as ever, to apply to such purposes some of the large amount of wealth which had come into their possession. He thought it a mistake, therefore, that no particular position was assigned to them in this work, especially as where there was any lukewarmness on the subject, they would only be too glad to find another society stepping in to relieve them of the responsibility.

Major-General Eardley-Wilmot, as Chairman of the Council, said there was not the slightest intention to supersede the City Guilds in any way, and the next resolution referred especially to them.

The resolution was then put, and carried unanimously.

Mr. Daniel Watney, jun. (Master of the Mercers' Company), moved the second resolution, saying he did so on account of the unavoidable absence of the Lord Mayor. He had taken some interest in the cause of education for some years, and could not help noticing the observations of his Royal Highness with reference to the noble gift of Sir Joseph Whitworth, particularly as a mechanic in his employ had been one of the first to obtain the Whitworth fellowship. The resolution was, "That this meeting hopes the advancement of technical knowledge by the means now proposed may be viewed by the guilds of the City of London, and other like corporations, as an object well worthy of their support and material assistance." Though present as a representative man, being Master of one of the principal City companies, he must on this occasion speak his own individual sentiments, which were that the Society of Arts was eminently suited to undertake these examinations. He did not think the education of the artisan could be undertaken by the Society, but it should confine itself to rewarding with prizes or certificates those who passed a satisfactory examination. It was well known that the City companies had large funds in their possession, and it was probably with a view to obtaining some portion of material assistance from this source that the meeting had been held, and that he had been invited to propose a resolution. He was bound to say, however, that the gentleman who had last spoken did represent very faithfully the opinion of a large portion of the members of the City guilds. Not that he himself agreed with him; for, in his opinion, the Society was especially fitted for taking up the question of examinations. It seemed to him the province of the City companies was this. In old times a member took an apprentice, and was bound as his master to see to his education as a workman until he was fitly qualified to earn his own living, and even if that were continued, nothing could be more advantageous than that there should be some central association, where the apprentices could come and compete with one another from all parts of the country, and so test the results of the education they had received. Each body, he thought, should keep to its own sphere, the Society of Arts conducting the examinations, and the City guilds taking care that the apprentices were well prepared to pass them. He must say, however, there was a little jealousy on the part of the City guilds with reference to the action of the Society, though he did not believe it was well founded. The Society was known to have considerable connection with South Kensington, and it had been thought in some quarters that everything tended in that direction: in fact, South Kensington had a reputation for a power of attraction, and of grasping anything which came within its influence. Of course, it would naturally begin with objects near to itself, and at one time the National Gallery was supposed to be likely to be pounced upon. Then the British Museum was thought to be in danger, and that was coming a little nearer the City; and in this way some members of the City companies seemed to think that if South Kensington had its way, it would draw a considerable amount of their funds, if not the whole of them, to itself. A great deal had been said about the money in the hands of the City companies not devoted to any purpose whatever, the uses for which it was originally given having become obsolete; and many persons had tried what could be done towards getting a share. This was, no doubt, perfectly legitimate, because it was now only accumulating, waiting till it could be turned to some useful purpose. Mr. Rogers started the middle-class schools for the City, and drew special attention to the amount of these funds, thinking, no doubt, that he should be able to attract some portion of them to this purpose, and though he had not done so, he had succeeded in his endeavour, and his schools were now flourishing. Therefore he thought it would be no great harm if these funds remained as they were for some time to come, as they might in that way have a stimulating effect upon the efforts of other public benefactors. Still he believed the City Companies themselves would be glad to get rid of these funds when a suitable occasion arrived, as they preferred being trustees of funds which were really applied to some practical purpose; and he believed they would be perfectly ready to give of their funds to any cause that seemed worthy of their support.

Mr. Warren De la Rue, F.R.S., seconded the resolution, saying he should be glad to see some of the funds of the City companies devoted to rewarding those who came forward to show their acquaintance with the principles on which their respective arts depended. He knew something of manufactures, and had also dabbled a little in science, and could not but look with great anxiety at the progress which many of our neighbours were making in the arts which had for a long time been considered to be exclusively our own, but for which the population of those countries were receiving a more advanced education than had hitherto been obtained in England. The Society was therefore doing a vast amount of good in directing the attention of the public and of workmen to the necessity of acquiring some amount of scientific knowledge, if they wished to keep pace with their fellows in neighbouring countries. The movement would also, he hoped, have a beneficial effect upon some of the workpeople, who were rather disposed at the present time to reduce all schools to one dead level. In reading through the syllabus, he was very pleased to notice one point of the proposed examinations, which was distinctly directed to the examination of chemical knowledge, as distinguished from what might be called brute force, in the preparation of pulp or paper. In Sweden or Norway, where there was an abundance of water-power and of wood, it had been the custom of late years to prepare wood pulp by a process of grinding, and in that way they certainly got a substance which contained fibre, but it also contained other things, and was not adapted to paper-making unless mixed with other substances. There were many other points in the syllabus of equal importance. It was not intended, as had been suggested by one gentleman, to supersede the action of the City guilds in any way. It was not proposed to advance the trades individually in the way the guilds could do, but to advance the intelligence of the workmen generally, so that when they became acquainted with all the details of their work, they could then direct the power which science placed at their disposal in a more intelligent way than if they were merely the followers of other skilled workman very imperfectly acquainted with the science.

Mr. Campin said the guilds of the City of London, of one of which he was a member, had now got into this position, that they were no longer associations of men practically conversant with the arts whose names they bore, as was the case at one time. Mr. Watney, he believed, was not a mercer, although he belonged to the Mercers' Company; and he himself was not a haberdasher, nor was his father, although they both belonged to that company. There was no doubt that these companies possessed wealth, and that it was their duty to advance the education of the workmen in their respective trades, and he believed they would be willing to do so if the case were put before them in a proper way. The workmen also should be consulted, because now-a-days they were not represented in the guilds as they used to be. Formerly, a guild consisted of masters, workmen, and apprentices. It was not so now. He thought it would be well if they associated themselves with the Society in a similar way to the institutions in union. They did not consist of practical men who could deal with this question. For instance, the Haberdashers' Company lately offered a premium of £100 for the best invention in haberdashery, but they had to go outside their body to find a gentleman to decide on the inventions submitted. Now, if they had to go outside their own bodies, where could they come better than to the Society of Arts, which had shown itself well fitted to conduct such examinations.

Mr. C. J. Bloxam said he was connected with the Clothworkers Company, and had much pleasure in supporting the resolution of Mr. Watney, and gave his hearty approval to everything he had said with reference to the City companies. The Clothworkers' Company had already taken action in this matter, having a few months back appointed a special committee, of which he was chairman, to consider how far, the cloth trade having been removed from London, and now being carried on in different parts of England, they could, by certificates of merit, or in other ways, assist deserving practical artisans engaged in the trade. They had had the assistance of a gentleman connected with the trade, but now an officer of the government, Mr. Howell, of the War-office, than whom no one was more competent to give information; he had offered various suggestions one of which was, that a deputation should visit Yorkshire, Stroud, and other parts of the country, and solicit information from the practical manufacturers in those districts as to the best mode of assisting artisans in their business. He trusted that the Society and the guilds would go together in this matter.

The resolution was then put, and carried unanimously.

The Right Hon. Sir John Pakington, Bart., M.P., proposed the third resolution, as follows:—"That the Council be requested to form a committee, consisting of representatives of the City companies, leading manufacturers, men of science, and members of the Society of Arts." He said if any other argument was needed in favour the object they had in view besides that contained in the first phrase of the printed paper which was distributed, namely, "It has long been acknowledged that if this country is efficiently to maintain its manufacturing supremacy in the market of the world, the technical education of the artisans must be improved," it would be found in the expressions which his Royal Highness had read from the address of the Prince Consort on the subject. No one could hear those addresses, and carefully consider those impressive words, without feeling that the time was come when something ought to be done on a large and comprehensive scale to improve and encourage the technical education of our artisans. For a long period there had been a struggle to obtain elementary education for the people; and it was felt that it would be useless to attempt much in the way of secondary education until that was obtained; but now a great Act had been passed, which he hoped would secure the elementary education of the people, and therefore it was only right now that attention should be turned to this object, of hardly inferior importance, of encouraging the technical education of the people. He must say, amongst the many good deeds which had been undertaken by the Society of Arts, he knew of none more worthy of their attention, or of none which, in his judgment, was more likely to do credit to them, and to give permanent and real encouragement to the welfare of the people. The Lord Chancellor had spoken of the progress which had been made between 1851 and 1862, and he was not disposed to doubt the accuracy of his statements. No doubt there was progress, and considering what was done—a great deal of it by that Society during those years—it would be very strange if progress had not been made, but they ought not to rest content with that. He might turn to the various International Exhibitions which had since been held, especially the last one in Paris, and reading the various reports made by competent judges with regard to the comparative position of England, it would be found that England must not rest content with the progress made between 1851 and 1862, but must put her shoulder to the wheel, if we did not wish France, Germany, and other countries to steal ahead of us, while we were under the impression that we were regulating the manufactures of the world. Nothing was more important for this purpose than to devise a thorough scheme of technical education; and though he did not altogether approve of the word which had been introduced, which, in common phrase, was rather too much of a mouthful for most people to pronounce comfortably, they must not forget the vast importance of the thing which it represented. They had heard a great deal about the City guilds, and no one was more ready than he to admire them, or to acknowledge the noble and generous use they made of the funds at their command. They should only be too glad to count them as fellow-labourers in this, and he hoped there would be nothing like jealousy between them and the Society or the admirable institution at South Kensington.

Lord De Lisle seconded the resolution, which was put and carried unanimously.

The report of the Educational Officer, which was published in last week's *Journal*, was then taken as read, the Secretary announcing that the meeting would be glad to hear any remarks from any delegates who wished to speak upon any point mentioned in it.

Mr. Lawton (Lancashire and Cheshire Union) said he rose to state that it was the general opinion in the district he represented, that the Society had made a great mistake in deciding to discontinue the final examination. Throughout his district arrangements had been carefully made for years, with a view to preparing candidates for the special subjects in the Society of Arts' programme, and in one particular instance, the Salford Working Men's College, the teachers and the committee had given their particular attention to it for a long time. He should not forget going into that College last winter, and seeing some 70 or 80 young men, from 18 to 21 years of age, under special instruction in arithmetic, in order that they might be thoroughly prepared for the Society's examination. If the Council had been prepared to substitute something else for the subjects, which were now intended to be discontinued, the thing would appear differently, but they had been teaching the institutions to trust in them. The committees had been organising their classes with a view to preparing for these examinations, and only two years ago commercial French and German examinations had been instituted, and professors engaged to prepare pupils, and now the Society gave notice that these subjects were to be discontinued, and that in future the especial subject would be carried on by South Kensington. But South Kensington did not take arithmetic except in connection with mathematical algebra, and other subjects, neither did it take book-keeping, or commercial French and German, and consequently it was earnestly desired that the Council would reconsider the matter, and see whether or no, under the circumstances, these popular subjects might not be continued. He felt persuaded this would be done, especially when it was known that manufacturers and merchants had stamped a commercial value on the Society of Arts' certificate over and above every other in the large commercial cities. In the cotton mills and warehouses in Lancashire, any young man who had obtained the Society of Arts' certificate always had the preference given to him over other candidates; and he knew a large cotton mill in the neighbourhood, where for nearly 12 years not a single situation of trust in the counting-house had been held by any young man who could not produce a Society of Arts' certificate in book-keeping. The young men, therefore, felt the importance of the examination, and for their sake especially he hoped the Council would reconsider the matter.

The Secretary said he had received, since the notification had gone out, about 22 letters from various institutions, asking that the decision should be re-considered, and a Council meeting was therefore specially summoned for Monday next, to take all these letters and recommendations into their consideration.

The Rev. C. Mackenzie said he should be very sorry to say one word which might appear ungenerous to the Council, but he should be hardly true to himself or the Institution he represented if he did not urge upon them very earnestly to reconsider this matter, with a favourable disposition towards those who wished the examinations continued. He did not feel that he had any claim upon the Council, and should not be disposed to find fault with them, whatever their decision, which would only be acting ungratefully for what they had already done; but at the same time he did beg them to consider the matter and its importance to the rising young men of the day. He would also submit to them that in this great work they had taken a lead, which had given them a character, and made them the most proper persons to conduct the examinations, just as he conceived them to be the proper persons to conduct the technological education, because they were, from their position, the most independent and impartial. Personally, it did not so much signify to him, because there was already an organised body ready to conduct the examinations in his own institution, but he should be very sorry in any way to come into competition with the Society of Arts, or seem to invade their province. After the intimation from the Secretary he would not say any more.

Mr. Thomas Webster, Q.C., as an old member of the Society, said he could not but think, if the decision just referred to were carried out, it would be a most fatal mistake. The examinations had succeeded to a great extent, and surely they ought not to be dropped until some substitute was found for them. There was a clear field for both technological and other examinations. Every person who expected to hold any important position in society must, in addition to reading, writing, and arithmetic, know something else. What that else might be, when he had been instructed in those three elementary branches, and had added thereto some special knowledge, such as geometry, which, to his mind, was the most important feature of education, or mensuration, surveying, chemistry, or some language, then he was in a position in which he thought the Society should enable him to obtain such a degree of merit as his attainments would entitle him to. Those particular subjects were clearly distinct from technology, as it was called, which related to special knowledge in some particular art; whereas this was simply one step beyond that elementary education which every young man ought to obtain, and to have made considerable advance in. He trusted, therefore, that the Council would reconsider this matter, and would not abandon it until they saw some substitute provided.

Mr. Edwin Chadwick, C.B., said he was quite sure the Council would fully consider all representations made to them on this subject, but it was only due to them to state that, at the time these examinations were instituted, there were very few, if any, local examinations at all, and a very small amount of provision for anything analogous to that which the Society undertook. Recently, however, in Manchester, considerable local exertions were being made, by the foundation of Owens College, which was really a middle-class college, and in other institutions throughout the country, to provide technical education, and it was in view of these local examinations that the Council thought the time had come when it might devolve upon these manufacturing districts themselves to do what was so manifestly their own interest they should do. He would add that at the present time there was great difficulty in finding in and about Manchester men fitted to take leading positions in manufactories. He knew of one instance where they had been obliged, from the default of Englishmen to take positions of foremen, to employ foreigners. He said this with no jealousy of the intrusion of foreigners into England, but to show the state of things, and that local exertion to meet the case was necessary. No doubt if it was thought that it could be done better by the Society he was sure the Council would be quite willing to co-operate with them. As to the necessity of the case, he might state that in one manufactory, where 70 or 80 workmen were wanted for a scientific branch of industry, only 30 Englishmen could be obtained, but, fortunately, as it happened, some educated Germans, who were at the time driven from Paris, came in to supply the deficiency.

Mr. Levy (of the Birkbeck Institution and City of London College) said the Institutions which he represented would probably suffer less than any other by the withdrawal of the examinations referred to, inasmuch as they had competent examining bodies of their own; but still, he felt he should be disloyal to the societies throughout the country if he did not say at once that, in his opinion, great mischief would be done by the course which the Council proposed to adopt. At the same time it appeared to him it was only what might have been expected, for when, at a former period, a large number of the subjects had been withdrawn, it appeared to him only the beginning of the end, and that South Kensington would evidently absorb the whole. He thought, however, it was a great mistake for the Society of Arts to give up their examinations until South Kensington was prepared to take up the whole of the subjects in which they had been accustomed to examine; though, if they had been prepared to do so, the Council would, no doubt, do well to turn their attention to something else, for there was no benefit in two or more bodies doing the same work.

Major-General Eardley-Wilmot said, as Chairman of the Council, he could assure the meeting that the matter would receive the most careful attention from the Council, and therefore he did not think it necessary to discuss the subject more. He concluded the business of the meeting by proposing a cordial vote of thanks to His Royal Highness Prince Arthur, for his kindness in presiding over their deliberations, and for the great readiness with which he was always anxious to further the great objects which the Society had in view, namely, the promotion of art, science, and commerce.

Lord Henry G. Lennox, M.P., in seconding the motion, said that, as Chairman of the Council for the previous four years, he must say that they felt great pride in the meeting which had assembled that day to crown the edifice, the foundation-stone of which was laid amidst great difficulties some years before. From what had fallen from the present Chairman of the Council, and also from other speakers, the meeting would be aware how glad the Council were to find that their efforts had been, and still were, appreciated in the various manufacturing districts, and it would still be their anxious desire that no effort should be spared on their part to complete the good work which had been begun. He could not but look upon the presence of His Royal Highness that day as a fresh bond of union between the Society of Arts and the South Kensington Museum, and he was quite sure that such a thing as jealousy between the two institutions would be allowed no longer to exist, especially now that South Kensington had spread its wings over Bethnal-green, and been the means of giving the working men in the East of London one of the richest treats ever enjoyed in any country in the world.

The resolution having been passed,

His Royal Highness said:—Ladies and gentlemen,—As it is getting late, I will only thank you very much for the kind manner in which you have received me to-day, and beg to assure you it has given me great pleasure to have taken ever so small a part in the proceedings.

CANTOR LECTURES.

MECHANISM.

By the Rev. Arthur Rigg, M.A.

LECTURE VI.—DELIVERED MONDAY, MARCH 11, 1872.

The subject of this evening's lecture is, "Adjusting and Regulating Mechanism, Straight Line Motions, Epicyclic Trains, and Differential Mechanism."

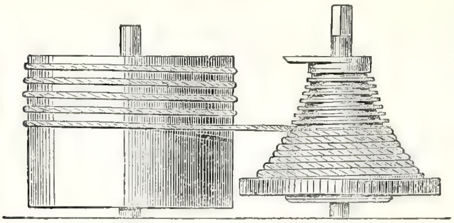
Adjusting mechanism relates to those contrivances by means of which one part of the mechanism is arranged and fitted to another part. Regulating mechanism includes contrivances by which the velocity and power of the machinery is duly adapted to the varying work put upon it.

Adjustments are generally introduced and adapted to each machine by the maker, and access to such adjustments is not often required by the user. Mechanism is regulated by contrivances, some of which are arranged by hand, and others are self-acting, called into play by the machine itself, consequent upon the work it is required to perform or abandon.

To take one example common to both, the fly-wheel of a large steam-engine is really an adjusting piece of mechanism. The fly-wheel in the striking part of a clock, which is properly called a fly, rather than a fly-wheel, is a piece of regulating mechanism, and yet they are both "flys." The fly-wheel in a large steam-engine receives any excess of what may be styled surplus power which is conveyed to it by the machinery before the governors begin to regulate the motion. The fly in the striking part of a clock determines the rate at which the blows are given upon the bell; similarly with the fly in a musical box. If the time of the music is too fast or too slow, it is brought to its proper rate by means of the fly. Therefore, we have the fly acting the part of an adjusting piece of mechanism, and we have it also acting the part of a regulating piece of mechanism. That it is not the regulator in the steam-engine is very clear, because the regulating machinery of the steam-engine is the governor. That it is the regulator in the striking part of a clock is clear, because, if you alter the angle of the blades of the fly, or if you alter the friction of the spring that holds it to the arbor on which it rotates, the rate at which the hammer falls on the bell is immediately accelerated or retarded.

Then, as regards regulating mechanism, pendulums are in clocks the regulators of the going part, the fly regulating the striking part. As an adjusting piece of mechanism the fusee barrel may be instanced. Here is a fusee barrel of a watch or clock, in which motion is caused by a coiled spring. It is apparently a cone, but, in reality, a hyperbola. The reason of the barrel being adjusted in such a watch or clock to a particular curve is, that it is moved by a spring, and the pressure of that spring varies every instant, because, when a spring has nearly uncoiled itself, it is not so powerful as when fully coiled by winding. On the table is the apparatus on a large scale. Within an open cylindrical box is a loose, uncoiled spring, and around the outside of the cylinder is a strong string, having one end fastened to the box and the other to the lower or broader part of the fusee. If the fusee barrel be so turned as to gather up the string, then the spring within will be tightly coiled.

Fig. 46.



A reference to these diagrams, representing strings pulling at the circumferences of circles of different radii, may show the relation between the box in which the spring is coiled and the fusee, through the agency of which the energy of the spring is communicated to the wheels. Now, the rate at which the power of the spring to pull at the string decreases, may be determined either experimentally or mathematically. Suppose the radii of these circles or, as they may be called, the arms, at which the string pulls, be so drawn that the power of the spring, as determined mathematically, multiplied by the length of the radius or arm, is always the same; for example, if the pull of the string were, say 12 lbs., and the length of the arm 1 in.; then if the pull were 9 lbs., the arm would be $1\frac{1}{3}$ in.; if the pull were 6 lbs., the arm would be 2 in.; if 4 lbs., then 3 in.; if 2 lbs., then 6 in.; &c. Impressing this law upon a figure which permits the string thus to act at the requisite arms, the mathematician tells the mechanician that the figure is that of the hyperbolic fusee. In a good watch or spring clock this hyperbolic form of the fusee is preserved.

Between perfection and utility there are many grades. Slight deviations from the true form of the hyperbolic cone are left to be controlled or compensated for by the action of the regulating balance-wheel or pendulum. This compensating action between carelessly adjusted mechanism and regulating mechanism has, perhaps, led to a partial negligence of the true form of the fusee-cone, and in some cases to the dispensing with the fusee, and trusting to the distribution of the irregularity of the spring by spreading it through a long spring, and using only a portion of the uncoiling power. For common watches, or so-called clocks, which are bought for ornament and not for use, and which, by going too fast when first wound up, and too slow before being wound up again, yet satisfy their owners, the money value of the fusee is saved at the cost of the owner's time, which, probably, is of even less value. In clocks this form of fusee is not required, because the energy of gravity on the weight is constant, and, therefore, the form of the barrel on which the cord or chain acts is a true cylinder. As, however, the energy of gravity is always downwards, a clock could not be in the varying positions which watches frequently occupy.

The fusee, &c., may be regarded as a piece of adjusting mechanism. It is introduced by the maker, and the user of the watch does not meddle with it. Neither the spring which acts upon it nor the form of it may be perfect, and yet the imperfections may be small.

Fig. 47.

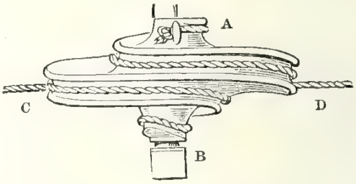


Fig. 47 is a form of fusee used in cotton-spinning machinery. In speaking of differential mechanism towards the close of the lecture, it may be needful to describe the process by which, when the thread has been twisted, it is "run in," and so supplied to the bobbins. Heavy machinery can be neither suddenly stopped nor suddenly moved. So many bobbins are now attached to one carriage, that the moving carriage, owing to its weight, must be slowly accelerated and slowly retarded. This is accomplished by a fusee, formed as in Fig. 47. Assume that the end towards C of the rope is tied to a fixture, and the end towards D attached to the carriage. If now the shaft, A B, rotate uniformly, the velocity of the carriage will be slow as the rope first begins to wind on at B; it will be accelerated as the rope embraces a circle of larger radius; it will be retarded as the rope tends towards A, and the carriage is being brought to rest.

Fig. 48.

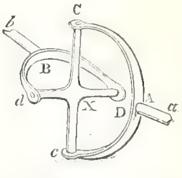
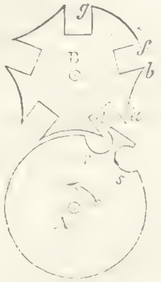


Fig. 48 is a form of adjusting mechanism called Hooke's joint. At D *d* and C *c* are joints. At A *a* and B *b* are shafts, not in line nor parallel to each other. If it be required to drive the shaft, B *b*, by means of A *a*, it may be done by Hooke's joint. It must not, however, be forgotten that the mathematician tells us that when the inclination of the shafts is appreciable the velocity ratio of A *a*, B *b* is not constant. This adjusting mechanism is generally used in turret clocks, especially those with two or more faces. Unless provision for correcting the irregularities of the velocity-ratio be introduced, it may be observed that whilst the fingers of four clock faces agree, say, at the hours and half-hours, there may be a minute or more of difference at the quarters. Hence, in regulating a watch by a public clock with more than one face, it is well to do so from the same face and at the same part of the hour.

FIG. 49.



There is here another piece of adjusting mechanism, used in watches and musical-boxes. Fig. 49 may explain the construction. In cases where there is no fusee, even with every care, the spring might be wound too far, and consequently broken. This is obviated thus:—A, Fig. 49, is fastened on the axle which coils the spring. It will be observed that if A be turned in direction of the arrow, a single tooth enters the space at *d*, carrying the concave part, *a b*, over the convex edge of A. When, however, the tooth enters the next space, as *b f*, the motion of winding the spring is stopped, because *f g* is convex, and therefore cannot pass the convex part moved by A.

Before turning to regulating mechanism, let us see how, in a clock or watch, this mechanism is influenced by the moving power. If the regulating mechanism can eliminate the defects of the moving and adjusting mechanism, the going of the watch or clock will be satisfactory. In principle, the mode of communication between the moving portion, be it weight or spring, and the regulating portion, be it pendulum or balance-wheel, is the same—simple, and yet ever receiving suggestions for improvement.

FIG. 50.

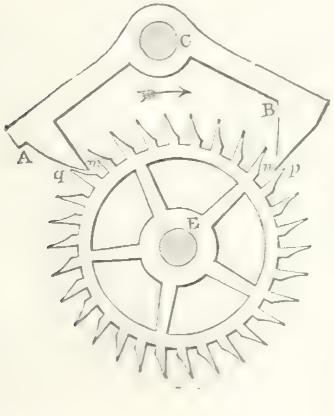
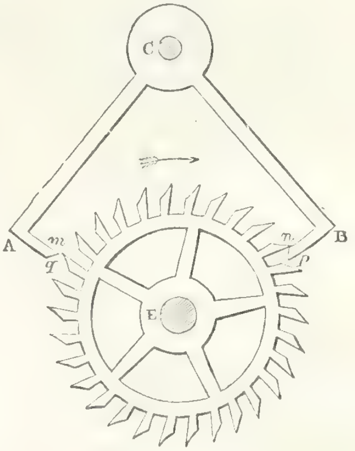


Fig. 50 shows the principle. The wheel, E, with peculiarly-shaped teeth, is being driven by a moving power in the direction of the arrow. It is, however, locked by the anchor-shaped piece, A C B, one end of which is always between two teeth. To this piece is connected the regulating mechanism—either pendulum or balance-wheel. In the figure the pendulum or balance-wheel is supposed to be swinging in the direction of the arrow, and therefore the part A *q m* has entered between two teeth, and so locked or stopped the rotation of the wheel, E. When, however, the swing is reversed, the portion A *q m* will be moved from between the teeth, and B *n p* will enter, the extremity of the tooth, *n*, falling upon the inner slope of the end of B *n p*. In this case, as the wheel, B, is pressed in the direction of the arrow by the moving power, the tooth, at *n*, presses along the slope, B *n*, thus imparting an impulse to the pendulum or balance-wheel through the intervention of the anchor-shaped piece, A C B. Thus the tooth at *n* escapes, and then the wheel is locked by the end A *m*, and the tooth falling on this end, and pressing upon the curved outer portion, gives an impulse to the pendulum or balance-wheel in a direction from right to left.

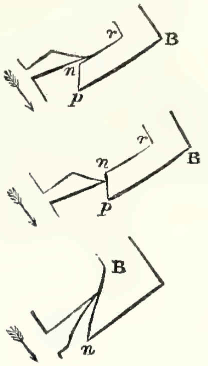
Although the contrivances as substitutes for the foregoing simple plan, which was designed by Dr. Hooke, who, in 1684, was secretary to the Royal Society of England, have been very numerous; yet time is wanting to enter, even briefly, upon the reasoning which has led to many suggestions for changes in the form both of the anchor and of its ends. There is, however, one change which is now so universally adopted as to claim a passing notice. It is illustrated in Fig. 51. A comparison of this with Fig. 50 shows a difference both in the form of the teeth and of the ends of the anchor. It must suffice on the present occasion to point out that the ends of the anchor, as at A and B, in Figs. 50 and 51, are very differently formed. In Fig. 51 these ends are most carefully outlined by a pair of compasses, one leg of which is placed on C as a centre. The consequence of this form is, that when the end of the tooth slides up the anchor, as, for example, at *n*, in Fig. 51, there is no tendency to force the wheel backwards. It therefore remains at rest, when, in the arrangement in Fig. 50, it would have recoiled. From this circumstance the contrivance illustrated by Fig. 51 is called the *dead-beat* escapement, that in Fig. 50 being called the *recoil* escapement.

FIG. 51.



The lecturer illustrated these statements by apparatus on the table, and said:—Here are two wheels and anchors; observe the change in the motion of this clock finger when the respective pendulums swing. At each locking of a tooth of the one there is a slight backward motion of the finger; this backward motion does not take place in the other. A comparison of the ends of the anchors, as in Fig. 52, may make the difference between the two more clear. The first of the small figures shows a tooth slipping off an arc of a circle, and beginning to press upon the slope, *n p*; the pressure continues as shown in the second figure. The third figure shows the corresponding end of the *recoil* escapement.

Fig. 52.



From the construction of the mechanism, it is obvious that the interval between the detents of the escapement determines, of course, the rate at which the wheel revolves, and thus there are second and half-second pendulums. The pendulum and balance-wheel have this property, that they swing, or oscillate, within the limit of a very short arc at the same rate, whether that arc be increased or decreased. If, for example, the arc of oscillation, or swing of a pendulum, be four inches, and it is increased to five inches, or decreased to three inches, no difference in the rate of the swing occurs. Hence any pressure put upon those pallets, even if the fusee barrel was not duly adjusted, would expend itself in giving a longer swing to the pendulum in a clock, or a greater throw to the balance-wheel in a watch. Though we may thus increase the swing of a pendulum or the throw of a balance-wheel (within small limits), we do not alter the time occupied in the swing or throw. It remains the same, and consequently, whatever slight error might have been made in the adjusting mechanism, the interval between one tooth escaping and the next remains constant. Thus pendulums and balance-wheels regulate the rate at which clocks and watches go.

This property of a ball swinging, and thereby regulating motion, is that on which we are dependent in more than one of our machines. Here are what are called governor balls—they are, in fact, neither more nor less than pendulums. This main shaft is driven by any prime mover, which, in this case, we may suppose to be a steam engine, and it may be driven at a varying velocity depending on the work. If that work is suddenly thrown off, then that which was being used as power becomes changed into velocity, and such velocity affects those balls. If the shaft is turned very slowly you will observe a finger pointer passing round in the direction of the hands of a watch. If the velocity is increased, the finger pointer becomes stationary. Observe, the velocity is now increased, and the pointer has ceased to travel. Now, if the velocity becomes greater than it should be, owing to more work being thrown off the engine, then the finger pointer is moved in the reverse direction. This represents the action which takes place upon the slide, or, as it is sometimes called, the "throttle-valve," by means of which steam is admitted. When moved in the one direction, the throttle-valve admits more steam, when in the other it admits less; and thus a regulation takes place dependent upon the vertical distance of these pendulum balls below the point of suspension. You may see this peculiarity by taking a piece of string in your hand, attaching a weight to it, and swinging it backwards and forwards. As the string is allowed to lengthen, you will find the oscillations of the weight become slower, and as the string is shortened they become quicker.

There are other machines requiring regulating which, although operated upon by an arrangement the same in principle with that described, is very different in its application to the machinery. On this diagram are two drawings of large water-wheels. It is quite as needful to regulate water-wheels as steam engines. Observe in the rim of the large wheel there are internal teeth, these teeth act upon a pinion, which is, therefore, driven at a much higher velocity than that at which the wheel moves. Upon this pinion there is a shaft driving the machinery, say of a corn-mill. It may be driving 50 pairs of stones, and if one, two, three, or twenty pairs of stones were thrown out of gear, that wheel would revolve so fast as to damage—probably set fire to—part of the machinery. Therefore it is necessary to regulate the sluice supplying the water. We may adopt the principle shown in the governor balls; but instead of having to deal with a light slide or throttle valve, admitting or excluding steam, we have to deal with a very heavy piece of work in the shape of a water-sluice, which is drawn as partly counterpoised by a weight. The way in which the sluice is moved is simple and ingenious. Here are two governor balls—two are used for symmetry or equilibrium; one ball, as in a pendulum, would be sufficient—acting as in the other case. If they fly out, it indicates that the water-wheel is going too fast; if they fall down, the wheel is going too slow. There is a piece of mechanism which knocks aside one or other of two clutches—these act upon cog-wheels, as shown. The governor balls of the steam engine do their own work; there is no power requisite beyond that of the centrifugal action of the governors themselves; but in this particular case it is needful that the governors should send, as it were, a telegram to the machinery, and the machinery, obeying the order, should so adapt itself as to raise or lower the sluice. Now, the governors knock aside a clutch which throws cog-wheels into gear, working in either direction, as moved to the right or left; then the machinery in mill the acts upon the sluice according to the requirements. When the clutch is in an intermediate position, neither of the cog-wheels are in motion. Thus it is that the governors in this case do not act upon the sluice, but cause machinery to do the work. The governor declares when the work is to be done; the machinery obeys and does it.

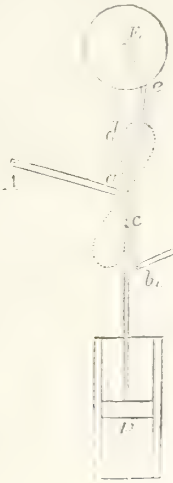
There is another mode of regulating steam machinery, called a cataract. That is done by allowing a certain quantity of water to flow through an orifice, and the engines used for pumping water out of mines are generally regulated in this way. It is the old clepsydra or water-clock principle. For an accurate measure of short intervals of time, as, for example, seconds or fractional parts of seconds, the dropping of water admits of more precise reckoning than the beats of a pendulum. Dampers are regulated, fires are regulated, and many other things, and there are regulators for the amount of fuel which is put upon the fire. These regulators are nearly all connected more or less with the pendulum principle. A mode in which the fuel is regulated is by a hopper from which certain quantities of fuel are injected, according to the requirements of the manufactory. Those who are connected with firing in the districts where steam engines are much used, find that a large amount of clinker is formed, which chokes up the fire-grate bars, so excluding air, stopping combustion, wasting coal, and producing no heat. But there is a peculiar arrangement, which was illustrated here in a previous lecture, for overcoming this difficulty. There are two parallel screws upon which the bars are laid. These bars travel towards the back of the furnace as the screws revolve, and when they have reached the end of the furnace the bars are not parallel to each other as they have been hitherto. These two screws, which, from the irregular motion produced in the bars, are called "drunken" screws, put the bars completely out of their parallelism, putting one in one direction and one in another, thus the bars being twisted, the clinkers are broken off, the current of air is kept free, and the fire burns brightly.

Now, we will come to another class of adjusting mechanism. In the steam-engine and other cases it is needful to convert a rectilineal motion into a circular one. That is done in a majority of steam-engines, or was a few years ago, at any rate, by what is called a parallel motion. It is really a link motion, and is that which upon the syllabus is called a straight-line motion. On the tables are models of the ordinary beam-engine and the ordinary marine-engine and others. If attention be confined to these parts only which are concerned in the motion we are now considering, we shall see a figure like this formed by links:—

Z

Suppose the two horizontal lines of the Z to be movable about their ends, the diagonal bar being jointed to these two. If now the diagonal piece were removed, the horizontal lines would describe arcs of circles having their convexities turned towards each other; and the question arises can the mathematical mechanician, for we are here quite dependent upon him, tell us how, out of these two arcs of circles, to get a straight line. The diagram (Fig. 53) may make the meaning more clear.

FIG. 53.



A *a* and and B *b* are the two bars movable about A and B as centres. The extremities, *a* and *b*, are connected by the link *a b*, jointed at *a* and *b*. Of this link, *c* is the middle point. If now A *a* and B *b* were cut out in cardboard or wood of equal lengths, as they are here in iron, and if they are connected as at *a b*, and placed on the paper of a drawing-board, having drawing-pins put in it at A and B; then, on placing a pencil at *c*, and allowing the combination to move into all the positions to which it can be moved, a curved line like the figure of eight, as shown in the diagram, will be traced.

The mathematician informs the mechanician that the portion of this figure eight, from *c* to *d* (Fig. 53), is a straight line or very nearly one. The mechanician, wishful to get a straight line, formed by pieces of mechanism moving in arcs of circles, gladly accept the mathematician's decision, and therefore takes the portion of the figure eight indicated. This arrangement has formed the basis of all the parallel motions applied to beam-engines of any size. It is rendered necessary in order to obviate as far as possible any oblique strain upon the piston, P, consequent upon the pressure communicated by the steam through the piston, P, and the link, *c e*, to the crank, E *e* (Fig. 53). Improvements in manufacturing processes, and the change of form now given to steam-engines, have, to some extent, relieved mechanicians from providing for the path of *c* (Fig. 53) by links or other moving parts. Bars which guide and so compel *c* to move in a straight line, are displacing the simple and ingenious mathematical mechanism of parallel motions.

There is one parallel motion which, for its beautiful simplicity and even antiquity, still claims approval and admiration by those who can admire the subtle niceties from observance of which so much that is valuable may be obtained in mechanism. In this case one extremity of the beam of the engine is carried by a long rocking bar, and therefore if this long rocking bar oscillate through a very small arc, the extremity of the beam will describe what is practically a short, straight line.

The lecturer here referred to models on the table, and added, this is a motion generally met with in a form of engine called a "grasshopper engine." Useful and modern some may consider it, nevertheless it is found in the oldest locomotive in existence, called the "Wylaw" engine, and by the people in the North "Puffing Billy." This locomotive was running about the year 1813, and "Puffing Billy" worked hard until 1862. It was then removed to the Patent Museum at South Kensington, where it is now; and "Puffing Billy" has this peculiar and scientifically ingenious parallel motion.

Epicyclic Mechanism.—Continuity and yet variety in the path of the point in which we can aggregate various mechanistic arrangements, is not usually required. Those, however, who have employed themselves in this direction have presented us with examples of marvellous beauty, simplicity, regularity, and complexity. The employment of these epicyclic combinations, for utility rather than ornament, must be our purpose.

If a circle roll upon a straight line, a fixed point in the circumference of that circle describes, in common parlance, a cycloid. If it roll round another circle, the point would describe what is called an epicycloid. Here are two circles of equal size, the lower one is fixed and immovable, but the upper one revolves round the lower one. Observe what takes place. This piece of paper, shaped as an arrow at one point in the circumference of the upper wheel, is now pointing in this direction. If the revolution round the fixed wheel be continued, you will find the arrow pointing in the same direction when it has gone half-way round, and turning it further it continues pointing in the same direction, so that one revolution of the wheel round the lower, or fixed wheel, produced two revolutions in the upper wheel. This motion is called an epicycloid motion, a wheel rolling upon a wheel. If, instead of having two equal wheels only upon the second, a third equal wheel is put on to roll, we meet with another property. That arrow pointer is now in an observed direction, and continues so although turned completely round, so that, as far as we are relatively concerned, this wheel has not moved, that is to say, this third wheel has always turned the same part towards each person in the room. Hence, without enter- into further details, there are clearly some very peculiar movements resulting from this most simple form of epicyclic motion. There are others before us here. Instead of letting the wheel roll upon another wheel, we may let it roll upon a straight line, and some curious results flow from it. Here is a model which was intended and expected to revolutionize our former modes of travelling. Here is a wheel with a cord passing round two wheels of different diameters, in this respect suggestive of the double or Chinese windlass, also of Weston's pulley-blocks. The same cord is continued round a small wheel at each end, so that by turning a handle on the axle of one of the small wheels, motion is communicated to the compound or double wheel. Fixed to this compound wheel is a third one, which is supposed to be the wheel of a carriage. The annexed diagram, Figs. 54 and 55, may make the construction of the apparatus clear to a reader. Q P is the base, carrying a plane board, P S, as shown in Fig. 55. The three wheels, W, X, Y, are rigidly connected, and move as one about the axle, A, which is not in any way attached to the back board, P S. W is a plane wheel, and is supposed to be an ordinary carriage wheel. X and Y are grooved alike, but differ in diameter. At the extremities of the board, P S (which, for an experimental purpose, may be from five to six feet long, and nine or 10 inches broad), are placed two pullies, E F, grooved, as are the pullies, X Y. The diameter of E F is equal to B C—the difference of the radii of the pullies, X Y.

Fig. 54.

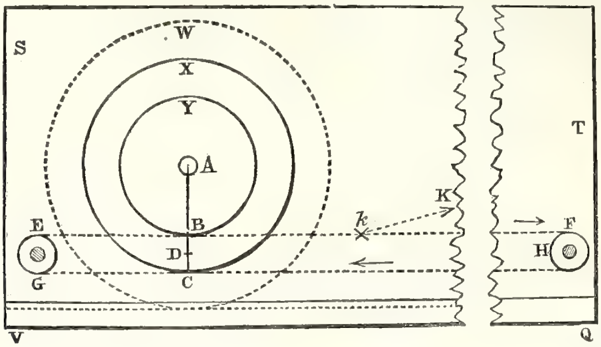
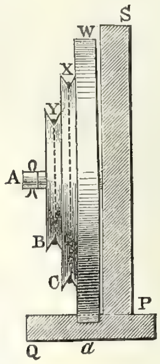


Fig 55.



An endless band or cord passes in the order of the letters thus, E, B, Y, B, F, C, X, C, G, E. Although not essential, it may be desirable to form a small groove in the base-board for the wheel, W, as shown in the section Fig. 55, and also indicated by the lower dotted line in Fig. 54.

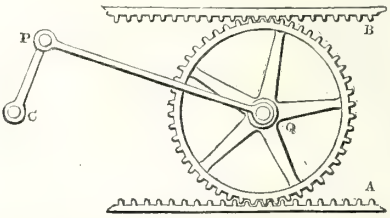
If motion be communicated to the cord in the direction indicated by the arrows at *k* K, the system W X Y, will be moved at a high velocity, and as the velocity of the axle, A, is the velocity of the carriage, the space passed through will far exceed that of the rope employed.* What great expectations were once formed of this almost forgotten mechanism may be seen from a perusal of a brief extract in the report to the British Association in 1833.

The invention is called an "admirable one," and it is suggested as a plan upon which a system of carriages should be arranged between London and Edinburgh, and the last sentence runs thus:—"In this way 388 horses, each acting at his most effective or walking pace of $2\frac{1}{2}$ miles per hour, on a mile of road, might easily drive a coach containing 8 persons from London to Edinburgh in 13 hours, or at the rate of 30 miles an hour." Railways never offered to make horses, going at the rate of $2\frac{1}{2}$ miles an hour, drag a coach at the rate of 30 miles an hour. "The coach passing from truck to truck without stopping, and the truck returning for another coach every 5 minutes, (the mile was to be accomplished in 5 minutes). 500 passengers a day for the whole distance would be very moderate labour for that number of horses."

On the wall there are some very beautiful drawings illustrating epicyclic motions, and here are the instruments by which they are designed. We are indebted for them to Mr. Perigal.

Here again is a cyclic motion, by means of which the table of a printing machine is passed backwards and forwards at a high velocity, thus showing that the top of a wheel moves at twice the velocity of the axis. Machinery by the crank, C P, and connecting rod or link, P Q, moves the axle, Q, of a toothed wheel, Fig 56, backwards and forwards; the wheel works in a fixed rack, A, at the bottom, and at the top in a rack, B, fixed to the underside of the travelling table of the machine, and you notice that this table passes over twice the distance that the axle, Q, travels.

Fig. 56



Mr. Stanley has kindly lent a series of epicyclic pens, and the mode of describing ellipses by these pens is shown in the drawings. Some years ago, Mr. Nasmyth arranged a plan for Mr. Lascelles, by which the parabolic figure of the metallic speculum of a large telescope could always be secured in polishing, and that is accomplished by an epicyclic motion. Here is another epicyclic motion, by means of which a blowing fan is driven at two or three times the velocity of the handle by which it is turned, the velocity of the air being dependent upon that of the blades of the fan. The

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* The relative velocities of the horse and carriage, assuming K to be a horse, and A a carriage, may be thus ascertained:—At each instant of motion, A moves about D as a fulcrum, the power being applied at B.

Let V be the velocity of A… the carriage.
v be the velocity of B… the horse.
$AC = R$ and $AB = r$.

$$\text{Then } \frac{\text{velocity of carriage}}{\text{velocity of horse}} = \frac{V}{v} = \frac{AD}{BD}$$

$$\text{Now } BD = \frac{AC - AB}{2} = \frac{R - r}{2}$$

$$\text{And } AD = AB + BD = r + \frac{R - r}{2} = \frac{R + r}{2}$$

$$\text{Therefore } \frac{\text{velocity of carriage}}{\text{velocity of horse}} = \frac{R + r}{R - r}$$

In the model on the table R was 3 inches, and r was 2 inches,

$$\text{Therefore } \frac{\text{velocity of carriage}}{\text{velocity of horse}} = \frac{3 + 2}{3 - 2} = \frac{5}{1}$$

Or the carriage went five miles, whilst the horse went one.

intensity of the blast depends upon the diameter of the pipe. Thus fans used with portable forges are generally driven. There are several other epicyclic combinations on the table. The one, however, to which our attention must now be directed is that which is not the least curious and important mechanism in the cotton machinery of Lancashire.

On the table is one of the most extensively utilized of epicyclic trains. A little attention on your part, and care on mine, may put all in possession of its peculiar arrangements. An ordinary bobbin of sewing thread illustrates the need for what to the eye seems a complicated machine. Suppose a hollow vertical spindle to be passed through the hole in the bobbin, and that the bobbin can be driven round upon this spindle. Again, suppose on the top of the spindle, which passes through that on which the bobbin is, there be placed what is called a "flyer." Let the thread to be wound on the bobbin be carried round by this flyer, in the same way as it is by the fingers when a hank of cotton is being formed into a ball. Let the bobbin meanwhile rise and fall, but not rotate. It is clear that if the quantity of thread supplied to the flyer is always the same, then, owing to the increasing thickness on the bobbin, the thread would first be stretched, then become thin, and then break. If now, as the quantity of thread on the bobbin increased, it were possible to let the bobbin rotate in the same direction as the flyer, less thread would be laid on. For remember that if the bobbin and flyer went round at the same speed, no thread whatever would be laid on. As a question of reasoning it is, therefore, easy to say that if the velocities of the bobbin and flyer could vary with respect to each other every time one layer of thread had filled the bobbin, then the tension on the thread might be always the same, and it would neither be stretched nor broken. This implies the want of what might almost be called a piece of intelligent and observant machinery. An epicyclic motion, called "Houldsworth's bobbin-motion," satisfies the required conditions.

Fig. 57.

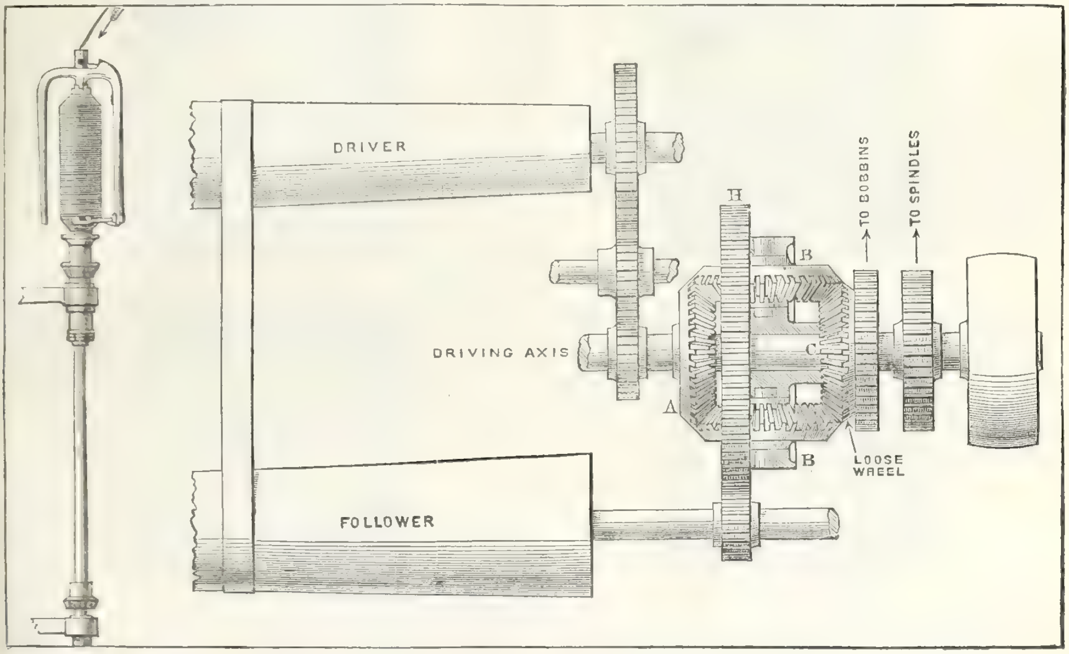
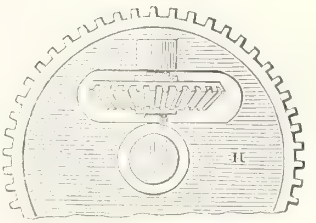


Fig. 57 illustrates this. On the rounded pulley to the right is the driving strap, which gives motion (as shown) to the long drum, or "driver," as it is named in the figure. By means of a strap, motion is transmitted to the "follower" Let us assume that all the wheels on the "driving axis" are loose, except the first, "To Spindles," that marked A, and the last small one—these three rotate with the axis. The one marked H receives its motion from the pinion on the "follower." The construction of this wheel, H, will be better understood by reference to Figs. 58, 59.

The inner bevil wheel in Fig. 58 is shown as double in Fig. 57. This doubling is only to preserve a balance, and does not affect the relations of motion.

Suppose the strap between the driver and follower to be removed, then H will be stationary, and A will, through the inner bevil wheels, communicate motion to C, which, although loose on the shaft is yet fixed to the wheel marked "To Bobbins." Under these circumstances the

Fig. 58



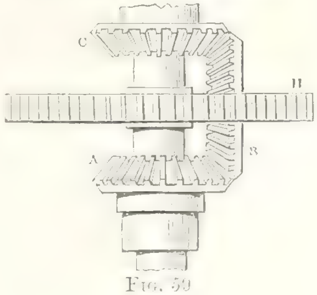


Fig. 59

bobbins and spindles will rotate at the same velocity. Restore the strap (the reader must in imagination follow that which the eyes of the audience saw), by moving the strap along the wooden cones, a varying motion may be given to H; this consequently either is additive to the motion A is communicating through the bevil wheel to C and the bobbins, or it is subtractive. Thus, any required velocity ratio between the flyer and the bobbin can be established.

In the large working model these motions were so adjusted that the bobbins and spindles, or flyers, were moving at the same speed, that is, were relatively at rest. By a part of the machinery not shown in the diagram, the strap is, at the requisite intervals, moved along the cone pullies, and so the relative speeds of bobbins and spindles preserved with such precision that in the largest bobbin the thread on the outside and inside layers is of equal thickness or diameter, and there is no stretching in the most delicate or softest combination of fibres.

As illustrative of the beauty of design, and the singular paths traced by a point in mechanism, compounded of links and wheels in epicyclic gearing, the readers of the *Journal* are indebted to the kindness of Alfred Deacon, Esq., who has lent the blocks from which Figs. 60, 61, 62, and 63 are printed. These are but elementary forms. Some of Mr. Deacon's work as utilised for preventing the forgery of bank notes, bonds, &c., is worthy of the attention, both of the artist and the mechanician.

Fig. 60.

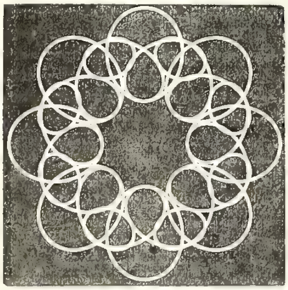


Fig. 61.

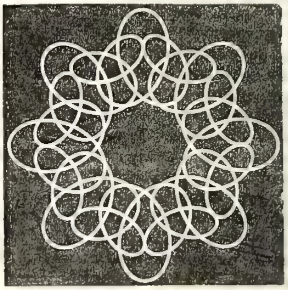


Fig. 62.

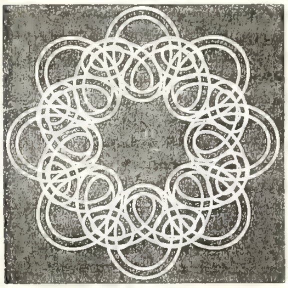
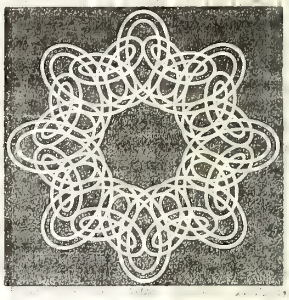


Fig. 63.



This course of Cantor lectures must now close. To myself, they seem but another contribution to a class of literature already far too well represented in England. They are a record of high aspirations and weak performances—of large designs and small fulfilments—of ambitious pretensions and humble realizations. The preparation of them has been a pleasure without alloy; and if those who heard have derived but a small per-centage of that pleasure in listening and seeing which has fallen to my share in searching and performing, we shall all be more satisfied with the work than it deserves.

To bring before those present so much of the character of the study which pure mechanism supplies as might suggest to younger minds a course of future investigation, and, in so doing, to lay the foundation on which a superstructure might securely rest — such was a first thought when the authorities of the Society of Arts proposed a course of lectures on machinery. Facilities which the kindness of others placed within reach of the Society seem to have suggested the desirability of taking the range of mechanism, and from the numerous illustrations which have been placed before you, the hope is not, I trust, a barren one, that thus may have been implanted seeds for future development. Those elementary forms in which mechanistic contrivances have been grouped necessitated the treatment of them as though they were bare skeletons. They, however, as completely misunderstand and misread them as he would do who took the dry bones of a human body and regarded them as a man complete and perfect. Great would be his error. Bones and sinews must be combined and clothed upon with flesh and blood, and when that is done the vital force must operate, ere the man is what we know him to be. Unclothed, unfitted bones have alone been before you. When clothed, and what may be called their vital force breathed in, they prove themselves to be elements of that wonderful architecture we call machinery—that living machinery to which England owes her wealth, her fortune, and no small measure of her fame. Men are often calling one or other of the vital spirits of Materialism from the vasty deeps of Nature's energies, and it comes when called. But what it is, whence it comes, and why, if summoned by different processes of incantation, it behaves differently, are unsolved problems. Call for the kinetic spirit of Gravity, Electricity, Vitality, Affinity, Light, or Heat. Each answers "Here I am." Each is a giant in energy, and patient in slavery, but wonderfully fastidious in the food it eats and the harness it wears. Neglect any minutiæ of these and the spirit withdraws into silent seclusion, casting off the yoke of man.

Let the mechanistic contrivances of which we have been speaking and reading the alphabet be still, let them die, let their life be ended, and Queen, Lords, and Commons, the titled and the ignoble, would soon meet in that sympathetic fellowship which a common sorrow creates, and from which classic lore, with all its autocratic exclusiveness, could never deliver them.

How much the people of England owe to the development of these mechanistic germs may be inferred from the statement, that if the work of machinery on this little island-home of ours for one day had to be accomplished by simple human power, the population of the whole globe would hardly suffice to do it. Where such stupendous results are evolved, many minds must have contributed to the common stock; and if what those who are competent to form an opinion tell us be true, viz., that man, in this 19th century of the Christian era, is in mental and physical power as he was nineteen centuries before that era commenced, then the conclusion is obvious, that he who would contribute new ideas to these contrivances which minister to our comforts and our wants, must investigate the contrivances that have been already made.

Investigation should never be dormant; and yet it does sleep, and soundly too, until a "strike" or a "lock-out" reminds society that machines and not men are in all respects best adapted to do much of the work now slowly and slovenly produced by manual labour. They do it too with an accuracy, a perfection, and a speed which the direct application of human skill seldom attains. In the bodily frame is mechanism for various purposes; in the machine, for one purpose only. "Strikes" and "lock-outs" often bear unexpected results in the introduction of mechanical contrivances which, in time, extinguish particular classes of manual labour.

An inventive turn of mind is, and always has been, common to a very large portion of mankind. Such minds are prone in this century, as doubtless they were in former ones, to live in isolation from that which is without. Hence, whatever seems to originate in themselves is regarded by them as a novelty, and therefore, as such, is concluded to be of value. Many a day, many a night, and many a fortune have been expended on contrivances and experiments which generations long past had emphatically pronounced to be delusions and snares. A sure remedy for this is in the study of that which has been done. It has often fallen to my lot to try to disabuse an inventor of the idea that a specific suggestion had in it either originality, novelty, or utility. The very kindest attempt to do this is as thankless an office as a man can undertake. In placing therefore before you a multiplicity of illustrations, it has been in the hope that they may may be suggestive of further inquiry. These illustrations have been supplied with such cheerful, ready, and unrestricted kindness as to claim a very emphatic expression of thanks, both from the Society of Arts and myself. Permit me to name those who have kindly assisted us in this way:—The authorities of the Museum at South Kensington; the Geological Museum in Jermyn-street; and, by permission of the War-office, the authorities of the Royal Arsenal at Woolwich; the Master of the Royal Mint; the Registrar-General at Somerset-house; the University College, London; the authorities at the London and North-Western Railway Works, at Crewe, and also the Atlas Works; Messrs. Muir and Co., Manchester; Professor Goodeve; and, I must add a word of special thanks to Messrs. Thompson and Co., of Kendal, who most kindly took down one of their card-making machines and sent here, with some of the work it had been doing. There are others who have also freely rendered such aids as were asked, and are named in the respective lectures.

Pleasant memories will, I trust, cluster round the displays of mechanistic movements which have been in this room. Other branches of science claim for their disciples intellectual development and ennobling influences. Botanists may examine, naturalists may compare, geologists may investigate, astronomers may speculate—(and they have been speculating a good deal lately)—chemists may search, physicists may discover, but whilst mechanicians do all these, there is reserved for mechanicians the still higher praise and more ennobling influence which a jury of impartial minds will be sure to award, for the mechanician alone seems possessed of a creative power. He infuses the life of motion into his combinations. Thus he dwells amongst creatures of his own forming, obeying his will, doing his bidding, ministering to the wants of others, and never becoming weary; such visions tempt the mechanician at times, when no thoughts of lucre or of gain are within his mind, to feel that Shakespeare would not have erred, either in good taste or in good sense, had he with a changed word or two written again the sentiment now contained in that beautiful expression—

> "Mercy is an attribute to God Himself,
> And earthly power doth then show likest God's
> When Mercy seasons Justice. . . ."

Let not, however, any mistake enthusiasm for knowledge, or the fancy which induces so many to run from one side of a bridge to the other, in order to watch a train passing underneath, for love and competency for mechanical work. This error of judgment is often committed. Motion, which means life, has a universal attraction for mankind, and for other animals besides man, for even a cat does not touch a mouse until the mouse begins to move. Does the enthusiast imagine that he was born a mechanician? Quiet, persevering labour can only make him one.

Surely the hope may be indulged that by these lectures some have been encouraged in the study of machinery, or in one or more of the varied branches of it which are so important to modern civilisation. Whilst, however, hoping so much, no one is more sensitive than myself to their short-comings and failures. In this consciousness, I say, receive the whole with charity,

> "Be to their merits kind,
> And to their faults, whate'er they are, be blind."

Mr. Davenport then proposed a cordial vote of thanks to the Rev. Arthur Rigg, for the very able manner in which he had treated his subject, and expressed a hope that next session the Society might have another course from the same gentleman.

The Rev. Arthur Rigg said he was obliged for the compliment paid him, and he assured his hearers that it had been a great pleasure to lecture to such a large and attentive audience.

DRILL REVIEW.

The Review of School Drill, organised by the Society, was held in the Royal Horticultural Gardens on Thursday, the 25th July. His Royal Highness the Prince of Wales, President of the Society, honoured the review with his presence. The boys, numbering over 4,000, assembled in Hyde-park at 12 o'clock, where they were inspected by Major-General His Serene Highness Prince Edward of Saxe-Weimar, C.B. After being inspected, they proceeded to the vacant ground to the south of the Royal Horticultural Gardens, where refreshments were served out to them. His Royal Highness the Prince of Wales, who was accompanied by Her Royal Highness the Princess of Wales and their two sons, Prince Albert Victor and Prince George, was received at the entrance by Prince Edward of Saxe Weimar, Major-General Eardley Wilmot, Chairman, the Members of Council, and the officers of the Society, and conducted to the dais erected in the garden. The march past took place in the gardens, at half-past three. His Royal Highness the Prince of Wales afterwards presented, in the Albert Hall the prize banners to the schools successful in the competition. The prize for training ships was won by the *Goliath* boys; the prizes offered to Industrial Schools, by the Shoreditch and Lambeth schools. The Strand school was recommended for a prize for proficiency; and the Stepney for having maintained their efficiency for three years.

The following is a return of the schools attending:—

Schools.	Boys.	Officers.	Band.	Total.
Greenwich Royal Naval School	643	21	97	761
Holborn Union	68	2	28	98
Marine Society's Training Ship *Warspite*	181	10	11	202
Forest-gate District..........................	108	6	38	152
" " (*Goliath* Training Ship)	266	12	41	319
North Surrey	100	2	24	126
North Hyde, Hounslow (St. Mary's Orphanage)	252	8	34	294
South Metropolitan..........................	272	12	38	322
Bethnal-green	64	5	36	105
Stepney Union	72	7	25	104
Central London................................	134	5	50	189
Shoreditch	101	6	33	140
Strand Union....................................	181	3	33	217
Lambeth	74	3	21	98
St. Mary, Islington............................	47	2	15	64
St. Marylebone	90	5	40	135
St. George's-in-the-East..................	33	4	30	67
Mile-end Old Town	94	4	16	114
St. Pancras......................................	83	5	30	118
Refuge for Homeless Boys of London	140	6	16	162
" " (Farm School, Bisley)	105	6	20	131
" " (*Chichester* Training Ship)	200	10	...	210
Total........................	3,308	144	676	4,128

The united bands of the schools, after the review, performed a selection of music in the hall.

1.—"God Bless the Prince of Wales."
(Bands and Voices.)
2.—Pas Redoublé....................."Evening Bells."
3.—Slow March ....
4.—Fantasia ...."United Service."
5.—Pas Redoublé....................."Royal Standard."
6.—Galop ...."Presto."
7.—Quick March ...."Ella Seene."
"God Save the Queen."

The following instructions were issued to the schools:—

1. The Schools will assemble in Hyde-park, on the plot of open ground to the north-west of the Knightsbridge-barracks, at 12 o'clock.

2. They will here drill independently, each school under its own drill instructor. Major-General His Serene Highness Prince Edward of Saxe-Weimar, C.B., will inspect the drill.

3. At 1 o'clock the schools will march down by the Exhibition-road to the ground on the south of the Exhibition refreshment-rooms, and there will receive refreshments.

4. At 2.45 they will commence to march into the Royal Horticultural Gardens by the south-west entrance, as shown on the accompanying plan, and march to the lower western terrace, where they will find the positions assigned to them. The position of each school will be marked by a bandrol carrying its name.

5. The Schools will be formed in line of contiguous close columns, right in front, as shown in the plan.

6. It is essential, from the confined nature of the ground, that no company should consist of more than 25 files. A school that has more than 50 boys must be broken up into two or more equal companies, of not less than 12 files each.

7. A Sergeant-Major of the Guards will be in charge of the Parade, and direct all the movements. He will receive instructions from the Committee as to the position of the several schools in line, which must depend on various circumstances.

8. The line of close columns will receive His Royal Highness the Prince of Wales at 3.30 p.m., the bands playing the National Anthem. Immediately the bands cease playing, three cheers will be given for the Queen.

9. The march past will then commence. The schools will, in succession, move to the right in fours till they arrive at the steps marked A B in the plan. Each school or column will then wheel to the left and take up its position as shown for marching past.

10. The schools will march past in quick time in open column, headed by their own bands, each company moving off in succession at wheeling distance. A school will not move off till the preceding school has passed the reviewing officer, and its band has ceased playing.

11. The master or the drill instructor of each school will march in front of the centre of his leading company, and salute as he passes H.R.H. the Prince of Wales.

12. Each school will be provided with a bandrol on the ground, which will be carried by one of the boys at the head of the school. When the school is in line of columns, the bandrol will be in front of the centre.

13. After marching past, the schools will march into the Albert Hall by the route shown on the plan. They will form in fours on arriving at the south end of the terrace, and continue their march in that formation.

14. The position of the several schools will be shown to them in the Albert-hall.

15. His Royal Highness the Prince of Wales will then present the prize banners to the schools which have drilled best in company drill at their inspection by the officer appointed by the Society of Arts, and presented the best appearance generally on this parade.

Bands.

16. On forming line of contiguous close column to receive His Royal Highness the Prince of Wales, the bands of all the schools will take up a position opposite the saluting point, to play "God Save the Queen." The bands will, while here, be placed under the direction of Mr. Lawson, of the Royal Artillery Band.

17. After playing "God Save the Queen," the bands will rejoin their respective schools and march them past. As soon as each school has passed the saluting point its band will cease playing. The next succeeding school, with its band, will then commence its march past, the band striking up as it opens out from close column.

18. On arriving at the Albert Hall, all the bands will be massed in the orchestra. After giving the prizes, one competed for by the Training Ship boys and two by the other schools*, H.R.H. the Prince of Wales will proceed to his box, and the bands will play a selection of music together.

The third review was held yesterday, the 25th instant, in the Royal Horticultural Gardens, under the auspices of his Royal Highness the Prince of Wales, as president of the Society, and may require some explanation as to its special, intellectual, moral, economical, and industrial characteristics.

The array consisted of upwards of four thousand children, nearly all destitute orphans, formerly reared in small parochial or poor-law union schools; but now (with the exception of the children of seamen of the Greenwich school), reared in larger schools of districts of Unions. The Central District school of the City of London comprises upwards of 1,000 orphan children from upwards of fifty parishes of the city proper, all too small to provide drill-masters or other teachers for physical training, except at excessive disproportionate expense.

The visible display was of physical attainments, and of prompt and exact obedience, quick motions that are found to add considerably to their productive power, giving to two the efficiency of three untrained boys for ordinary industrial pursuits;—besides imparting a predisposition to a higher order of recruitment in the royal navy and in the army, and showing what may be done by the general application of the like means. And further and beyond the immediate visible display, are to be noted the

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* The Royal Naval School, Greenwich, is not in the competition.

Intellectual Results.—All the schools joining in the review are on the half-time principle of mixed physical and industrial as well as of mental training. The time of school-work is not above half that of the common elementary day-schools, and yet the intellectual attainments are found to be fully equal to those imparted in long-time schools of the same size. This element of the half-time school principle is at this time of importance in the way of example, as mitigating the extent of the demands for compulsory attendance during long hours, often at the expense of productive service. The schools in question, are, moreover, graded, that is, there are in them divisions of teaching labour, by which the children are taught nearly in half the years, as well as in half the hours of the days expended in the common schools. If the circumstances of the day admitted of boys from ten to eleven years of age, who had passed through the infant school stages of the institutions, being called out of the ranks and examined, it would be found that they could write to dictation and do sums in arithmetic as well or better than boys of thirteen or fourteen years of age who leave the common schools with those attainments, but without elementary drawing given in some of the schools, and without the drill and the music that will be displayed in the review, or the aptitudes of eye and hand that is displayed by the "half-timers" in the workshop.

Economical results, as respects the cost of teaching power.—This cost averages one pound per annum per head for trained teaching, as against thirty shillings, and (for equivalent trained teaching by single masters in small schools) of two pounds per head! the head masters in these schools being paid upwards of £200 per annum, as against the single masters of small schools at £80 But the cost of the half-time schools is one pound per head per annum for the attainment of results in three or four years, or at a total expense of £4 per head for imparting elementary instruction, against £2 per head for six or seven years—usually seven years—or a cost of £14 per head. A recent report of the London School Board states the cost per head from the rates alone for the School Board establishment will be from 15s. to 16s. per head. Add to this 12s. per head from the government grant, 9s. from fees, and the total is 36s. per head. Such outlays render the administrative principle of these graded schools and their results of importance at this time, to bring under as much public notice as possible for the sake of the ratepayers, as well as of the children. The long-time schools—long in *years* as well as hours—occasion an excessive drain upon the public funds of 12s. per annum for seven years (£4 4s. per head), which, on the scale of the best graded schools reviewed would often give the whole expense for which new rates are now sought. The graded schools, as displayed in the examples of the Faversham School Union, and in the great Jews Free School, supported by the munificence of Baron Rothschild, published by the Society, and also some of those now reviewed, give a superior middle-class and secondary education within the total cost of the long-time schools in giving an inferior primary instruction alone. But for the attainment of these economical results aggregates of 250 or 300 children at the least are necessary. With such organisations as displayed and results demonstrated by local examinations and reports on sample districts obtained by the Society, it is evident that, with the addition of the funds usually worse than wasted as pauper doles, amounting, it is estimated, to one million per annum, very superior elementary teaching and training power might be obtained, without any addition to the rates whatsoever. As to the extra cost of the military drill, so important for industrial purposes alone, upwards of one hundred and twenty boys may have a drill such as that displayed, imparted to them at the usual cost of drilling and keeping one militiaman for the purpose. This cost is, however, included in the cost of £1 per head for teaching power. The extra cost of teaching instrumental music to the extent as displayed is about £1 per head.

Moral Results.—The great body of the children reviewed are orphan or deserted children. Under the old system of poor-law administration, the children of this class, brought up in the workhouse long-time school, in contact with aged and vicious paupers, were turned out at thirteen or fourteen, bodily and mentally inapt for steady industry, and not above one out of three got into a place of self-supporting industry. Full sixty per cent. went to "the bad," on the streets, as mendicants or thieves, the girls as low prostitutes, and they furnished the largest contingents to the population of the prison. These moral failures were attended by pecuniary waste, for all were supported by the ratepayers, either as mendicants or thieves, or as expensive prisoners. But now, under the improved mixed bodily and mental training of these half-time schools, the known failures and waste do not exceed three per cent. The great mass of the boys brought under review may be beheld with confident satisfaction as victims rescued from "the bad," and preserved for the good, as honest, self-supporting producers, and worthy members of the community. But although much of this success will be due to the bodily and industrial aptitudes imparted, and the work of the drill-master displayed, yet much of it will be due to the ministrations of the school chaplains, not alone in religious instruction, but secular care and service, seeing that they get fitting places (especially girls), visiting them there, advising them, and corresponding, and acting *in loco parentis* to all the fatherless and the motherless.

Sanitary Results.—It has been shown, as respects the common schools, where filthy-skinned and dirty-clothed children are often crowded together in ill-ventilated rooms, in miserable conditions, they are the common centres of children's epidemics. The old workhouse schools were subject to murderous epidemics. But now, by the application of rudimentary sanitary science, they are made normal examples of what may be done by it. Of this, one of the schools from whence the children were sent to the first review, may be cited as an example. Some years ago, the death-rate was 10 and 11 per 1,000. The drainage and ventilation was improved, and it was then brought down to about eight in the 1,000. Next more complete personal ablution and a swimming-bath was established, and the death-rate was reduced to about four in the 1,000. All the district schools, the elder of whose children will be reviewed, are to some extent children's hospitals, and many children are taken in only to die or to linger as hapless cripples for life. But, —with the exception of some remains of ophthalmia,—by better ventilation of space, by careful skin cleanliness, and by bodily exercise, the "children's diseases of spontaneous origin may be said to be banished, and the death-rates have been reduced to about three in 1,000, or less than one-third of the death-rates prevalent amongst children of the middle and well-to-do classes. With such a general death-rate, producible by sanitary science, there would be upwards of ten thousand children saved annually in the metropolis. Without such sanitary precautions, new schools may be only extended centres of children's epidemics.

It has been the general conclusion, from all the examinations conducted under the Society of Arts, that a sound secondary and technical education, so essential to our progress in arts, manufactures, and commerce—must have its foundation, and have time obtained for it—in an improved primary, elementary education, of which these half-time schools, in years as well as in hours of days, in their mixed physical and mental training, afford the best practical examples that have yet been attained.

The Council have it under consideration to propose national prizes to be given to head teachers and others charged with the management of elementary and secondary schools, for the attainment of the best intellectual and physical results in the least time, and at the least cost, and also for the best moral results in the pupils getting industrial places and keeping them.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B. secretary.

Jewellery.—Lord Dudley has consented to the exhibition of Lady Dudley's diamonds and other jewels, which made so great a sensation at the Paris Exhibition in 1867; and arrangements are being made for the reception and exhibition, during the autumn months, of such jewels of superior quality as the possessors may desire to leave in London during their absence.

Russian Paper.—A series of specimens of Russian paper, covered with all kinds of ornamental watermarks, has recently been added to the Exhibition of Paper and Stationery, and may be seen in the south galleries, near Spiers and Pond's dining-rooms.

Paper Curtains.—The application of paper as curtains is one of the features of the Exhibition of Paper and Stationery, in the south galleries, and a completely new set of patterns has lately been substituted for those first exhibited.

Indian Jewellery.—A curious gold earring, set with turquoises, has lately been sent on loan to the exhibition by Mr. F. Drew. It was made at Leh, in Ladâkh, in the Himalayas, by a native workman, and is a facsimile of those worn on one ear only by the native tea-merchants who trade between Leh and Lhassa.

CORRESPONDENCE.

ENDOWMENT FUND FOR THE SOCIETY OF ARTS.

Sir,—Your correspondent "Playfair" advocates with much justice the devotion of some portion of the funds of the Society to the promotion of its legitimate objects, viz., Arts, Manufactures, and Commerce, and points out mechanics in their relation to industry as an important field for the Society of Arts to operate in. Everyone must admit the importance of mechanism in relation to industrial operations, but, Sir, as one of the many interested in the cultivation of an extended knowledge of raw materials, their culture and properties, I think the Society would do good service to the industries of the country if it would inaugurate such a system of action as would enable travellers, captains of vessels, and brokers and merchants to obtain an impartial examination of the many raw substances which are constantly brought into this country as samples, but which fail to attract attention or to become utilised, owing to their nature and properties being unknown.

Many new gums, fibres, ores, spices, and other products of the vegetable kingdom, which substances play so important a part in our trade with foreign countries, and in the industries of our own, might no doubt be added to those at present known to us. Africa produces spices and gums not yet seen in our markets, though, if I remember rightly, Dr. Daniel, some years since, brought home small samples of many such. I should be glad to see the Society take action in the direction I have indicated, and place itself in communication, not only with residents in our colonies, but with all persons visiting foreign countries, either for trade or otherwise. Africa ought certainly to yield us many substances of interest, and I mention it as so much is being done just now to extend our knowledge of it geographically, and surely industrially it is of equal importance.—I am, &c.,

E. Johnson.

Sir,—I am glad to see that all the world is not terrified at the word endowment, and that the idea of asking the public, or, to put the matter more plainly, those who have money to spare and wish to see the level of artistic and scientific knowledge raised amongst us, to contribute to the funds of the Society, is not regarded by all as is either undignified or absurd.

It has been said that the time for endowment is passed. How is it, then, that Oxford, Cambridge, and the London Universities have deigned to institute chairs of Fine Art by means of funds specially bequeathed for that purpose? Are not the admirable Cantor Lectures the result of an endowment? Are not the late Prince Consort's, and other prizes awarded by the Society of Arts, results of endowment.

It may be said that these are specific and not general endowments, and many who object to the latter have nothing to say against the former. Now it appears to me that the endowments most likely to fail in the intended object are exactly those of the specific class. A benevolent individual, with the most admirable intentions, gives or bequeaths a sum of money, to be used in a certain manner, and for a certain object. His views may have been the wisest possible at the time they were formed, but in time, and sometimes in a very short time, and perhaps suddenly, these circumstances are all changed; the special instructions cease to be applicable, and the donor's wishes fail to be carried out.

In the old quiet times special endowments often did great service, and for long periods, but in these days, when change, and, let us hope, progress, is the normal condition of society, and means are required to act according to the circumstances of the moment, and not according to those of a century, a decade, or even a year ago.

The duties of the Society of Arts are especially of a changing class. It takes up a subject which the government and other bodies cannot or will not handle; it assumes the initiative; it sets the stone rolling; and when the proposition or experiment has passed into fact or practice the Society has done its work, and turns its attention to the next important subject that demands a foster-father. The work of the Society is that of a pioneer, or prospector, not of a regular worker, and absence of restraint of absolute rules and conditions are essential to success.

There may be good policy, as "Playfair" says in the *Journal* of the 19th, in "letting the idea lie fallow in the minds of the members for a little while before commencing active operation." I cannot say; but it must be remembered that while the corn grows the steed starves; and there is so much to be done of that kind of work which only the Society of Arts is accustomed t do that I regret there should be any delay. How long, for instance, will the English people look tamely, watching the immense efforts which are being made in Germany and France. When, for instance, are we to have an *Ecole Pratique des Hautes Etudes*, whose programme and arrangements have been often referred to in the *Journal* of the Society?

We have in our country the most magnificent examples of individual action in the world, and there are, doubtless, to use the old adage, as good fish in the sea as ever were got out of it. I am inclined to appeal directly to those who can afford it, and are willing to help the movement for the furtherance of art, science, and industry, and say, "The Society can scarcely go begging for subscriptions, take the initiative into your own hands, start a list with half-a-dozen handsome endowments, gifts, annuities, no matter what be the form; the work would then soon be done." "*Ce n'est que le premier pas que coute.*"—I am, &c., G. W. YAPP.

EXAMINATIONS IN TECHNOLOGY.

SIR,—Permit me, as one who had no inconsiderable share, more than 25 years ago, in rescuing the Society from the gulf then yawning before it, and has also watched with extreme interest the steps by which it has attained its present high position, to offer a few remarks on the proceedings of Saturday.

The movement for "Technology" Examinations by the Society, so successfully inaugurated, may be regarded as one of the most important steps in progress amongst the many already taken. I quite agree in the language of Mr. Critchett's report in the of *Journal* Friday last, that it is rather the business of the Society to initiate good objects, than to attempt to carry them out to conclusion, but I think the establishment of examinations in technology would be dearly bought by the abandonment of examinations which have been attended with such important results, unless and until the continuance of these examinations have been otherwise provided for.

The subjects and system of examinations may probably require reconsideration and readjustment; and it occurs to me to suggest whether the subjects are not too numerous. I would suggest their reduction to say:—1. Arithmetic, with the decimal, metrical, and other systems. 2. Bookkeeping. 3. Geometry of two dimensions, with mensuration and surveying. 4. Geometry of three dimensions, with plan and section drawing. 5. One living language. 6. Latin and Greek; leaving reading, writing, and other subjects to the local institutions which have recently sprung up or been stimulated into action.

The above six heads are the basis of primary education, to be supplemented by some of the other numerous branches of mathematical, natural, and applied sciences, according to the mind of the individual.

The applied sciences afford the proper field for technical examination, which, if conducted on one recognised plan and system, will have the effect of bringing into harmony the teaching of the nation.—I am, &c.,

THOMAS WEBSTER.

Temple, July 2, 1872.

THE WINES OF GERMANY.

There is no doubt whatever that the consumption of light wines is largely on the increase in this country. Not only the clarets and other wines from the south of France, but of the hocks, Moselles, and others comprised in the term Rhine wines, are beginning to figure very largely in the trade returns. Two works* recently published give together a scientific and a practical view of the same subject, and the following article is compiled from the information thus obtained·—

The vine grows on chalky, siliceous, aluminous, and magnesian soils, on granite mountains, in formations of transition, and on secondary, tertiary, volcanic, and alluvial territories. It requires for its upper and main roots a territory which must not be clogged with water, but be pervious to it, and admit air at frequent intervals. In all parts of the world it may be seen growing with predilection along the banks of rivers. The wild vine of the Rhine valley is found on the borders of marshes. The most luxuriant growth, and its richest bearing power, are met with in the paludal districts of the Gironde. This shows that, while the vine is a most accommodating plant, and will even succeed in poor land, yet its most perfect development and most profitable cultivation are dependent upon certain conditions which are not often found united.

In Rhenish Bavaria the viticultural districts are situated at the foot of a mountain range called the Haardt, which is the continuation towards the north of the Vosges, and forms the natural frontier between France and the west, and between Germany—more particularly Rhenish Bavaria—on the east. The land at the foot of this mountain is in general between fifty and one hundred feet higher than the general level of the Rhine valley, and forms, therefore, a kind of high plain, or a middle stage between the Rhine valley and the mountains. Its inclination is not very great, for the ascent from the plain to the termination of the viticultural district upon the steep inclines of the mountains is distributed over about four or five English miles. In the neighbourhood of Landau and Deidesheim, however, the district is more hilly. The valleys which run from west to east produce many undulations, and southern as well as northern exposures, but on the whole the exposures of the vineyards are east. In this respect, therefore, the Haardt resembles the situations of the Côte d'Or, and some of those of Champagne. The vines which are most planted in this district are the chasselas, called gutedel, the traminer, the so-called chatrians or sylvaner, and the riessling. During the last decennial the traminer has gained a great preponderance over the other vines; nearly all new plantations, particularly those which are made by persons of capital, are planted with it, because the wine is more sought after and better paid for. The vine does not possess any great powers of vegetation, and requires a loose, mild, and rich soil, which must contain chalk and sand. It shoots early, and in consequence is exposed to the effects of early frosts; for this reason it is particularly qualified to be grown in the upper parts of the Rhine valley, Alsatia and Rhenish Bavaria, where spring frosts are almost unknown. The chasselas ripens early, and almost every year; and although it does not give wine that has lasting qualities, it yields tolerable substance without acidity. The traminer gives wine of much body and smoothness, but its lasting qualities during the first years are not great. The so-called sylvaner yields a very fine liquid-tasting wine, without much particular flavour. The riessling, on the other hand, in bad years gives much acidity, but in good years it imparts to the mixture of the other qualities a beautiful bouquet. Without doubt this mixture is very sensible, inasmuch as thereby the best average is produced of which the changes and vicissitudes of the seasons will admit. In the direction of Worms, plantations of pure traminer and pure riessling are now becoming more common. Persons who possess property and courage to face the misadventures of pure sets, will, of course, be rewarded by a splendid success in good years.

There are in the Palatinate 33,048 morgen of vineyards. Of these three belong to the first-class, 12,756; to the second-class, 9,816; and to the third class, 10,656; total, 33,048. It is estimated that a full harvest yields between 70,000 and 80,000 fuders of wine (1 fuder = 1,000 litres).

Mr. Verkrüzen, in the pamphlet he has published with the view of making German wines popular in this country, and of pointing out that up to very recently pure German wines were almost unattainable in this country at moderate prices, and that much which was sold as first-class Rhine wine was of a spurious character, says:—The beneficial influence upon mind and body of the temperate use of the magnificent productions of the Rheingau, of the Moselle and Saar district, of the Bavarian Palatinate, of the Nahe, of the Neckar, of the Ahr, and neighbouring countries, is so thoroughly appreciated by the inhabitants of these parts, that they would consider life robbed of half its charm were they to be suddenly deprived of their wines; and there is no questioning the fact that the lively and truly joyous spirit which so strikingly characterises the people of the Rhine, is due to the daily use of their invigorating and refreshing wines; and undoubtedly the affection, amounting almost to adoration, which the German people feel for their German Rhine is greatly stimulated by the benefit they derive from the enjoyment of the splendid product which adorns its romantic banks, and which they are justly proud of having cultivated to such a high degree of perfection.

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* On Wines, &c., by Drs. Thudichum and Dupré. On German Wines, by M. A. Verkruzen.

The wonderful care and attention, amounting to actual devotion, bestowed upon the cultivation of their vineyards by the great proprietors of Germany, the almost lavish expenditure in manuring and labour, the degree of scientific study and system which is brought to bear by these agriculturist princes in perfecting the produce of which they feel so proud, give to German wines, when secured in their "virgin purity," a distinctness of character truly marvellous and interesting in the highest degree, and unapproached by the vinous products of other countries. If in Germany we have less quantity, we have at the same time a higher quality than is to be found elsewhere, and we have those remarkably delicate distinctions of character in the different wines which result from a correct selection of the kind of stock to be planted and cultivated in each particular position, and most suited to the nature of its soil, being the result of long and attentive observation and experiment.

Were the German wine countries situated in the more favoured climatical positions of Spain and Hungary, or of Southern France, there is no doubt the high standard of quality attained would be accompanied with a more profitable and regular yield; and the present superiority of German wines in real fineness is but one of the many illustrations continually forcing themselves under our notice of the superior energies, both mental and physical, and of the undaunted spirit of perseverance which are the peculiar gifts of the inhabitants of the more northerly portion of our zone, and which impel them to extort from the earth, at whatever amount of labour it may cost, and even danger it may incur, the utmost she is capable of yielding.

It seems, on first consideration, remarkable that in a country like England so little should be known of German wines, and that they should have met with, comparatively speaking, so small an amount of approval by the general public; but when we consider the difficulty hitherto and still experienced by Englishmen in obtaining these wines in their native purity, how liable Englishmen are to be taken in, and how frequently they are taken in, it is more easily understood that English notions respecting the merits of German wines are as yet somewhat undefined and incomplete.

The wines and vines of Rhenish Hesse are so similar to those of the Palatinate, on the one hand, and those of the Rheingau, on the other, as not to require any special description. The extent of vineyards in this rich and fertile district under cultivation amounts to 27,842 morgen, and their average annual production to about one stück of 1,200 litres per morgen. The vineyards of Worms include the one south of the Liebfrauen-Kirche, which produces the liebfraumilch, a riessling wine, of fine bouquet. The district of Oberingelheim produces much red wine of the character of Burgundies of the second and third-class from Burgundy grapes, and furnishes considerable quantities of these latter for the production of *mousseaux.* The wines of Laubenheim, Bodenheim, Guntersblun, Nierstein, and Selzan possess individual reputations, and are often substituted for the Rheingau. Many wines from the other villages, particularly of the Kreis Oppenheim, are sold under the title of "mersteiner," especially in England, where the name of this village is received with marked favour.

The ancient Franconia, now comprehended under the name of the lower circle of the Maine of Bavaria, contains about 70,000 Bavarian tagwerte of vineyards, which is about the same surface as that cultivated in the whole of the kingdom of Würtemburg. Most of the wine grown there is consumed in the country. There is only a small quantity which is exported, and that is grown in the neighbourhood of Würtzburg. The best vineyard is the so-called Leiste, situated on the left bank of the Maine, in a small side-valley, between two hills south of the fort. Next in quality to this is the Stein, which is situated on the right bank of the Maine, close to the river. The vineyards of the Leiste may be said to be a month or sometimes two months in advance of the general wines of the country. The area is 85 Würtzburg morgen, or nearly 17 hectares. There are here planted mostly riessling and traminer and nearly one-third of Elbling; also some so-called Franconia grapes, which may probably be an indigenous plant. There are also some chasselas and some black grapes. One peculiar grape is yet grown here, the so-called Hermitage. This grape is of a yellowish-brown colour, like the white traminer, and has an exceedingly fine flavour, the taste standing midway between that of a ripe reissling and a muscatel, having neither the fine flavour of the riessling nor the gross flavour of the muscatel. If this vine were cultivated in greater numbers, and a wine were made from its grapes alone, it might be something very excellent. The greater part of the Leiste belongs to the royal domain, and all the wine made there goes into the cellars which are underneath the royal castle of Würtzburg. The Leiste wine of good quality is mostly carried to Munich, and drunk at court. Only a small quantity enters trade.

The cultivation of the vine and the process of vinification has reached a very high development in the Rheingau, where, according to some old historical documents, the vine was cultivated even in the sixth and seventh centuries. The greatest extension, however, was given by the agency of the clerical foundations, particularly the monasteries of Johannisberg and Eberbach, the inhabitants of which planted the vineyards of Johannisberg, Steinberg, and Gräfenberg. At last these co-operations were swept away by the Reformation or the wars consequent upon the French Revolution, and their property passed into the hands of the Dukes of Nassau or the Princes of Metternich. About a hundred years ago a great expansion of the cultivation took place by the immigration of capital. Many rich merchants from Mayence and Frankfort acquired land and planted vineyards, introducing improvements in the selection of grapes and the treatment in the cellars. The prices of their products and properties continued to exhibit a continuous and almost uninterrupted rise, resulting in general prosperity. Whilst the inclination of the country is towards the south, thus protecting it against all north winds, the Rhine, which reflects the rays of the sun upon the vineyards, acts as a mirror. This conformation of the country produces a climate most favourable to the production of those particular kinds of fragrant bouquetted wines for which the Rheingau has obtained a world-wide celebrity. The reissling, unknown in Italy and France, is peculiar to the Rhine valley, where it alone attains the qualities which give high flavour to its wine. In any hotter climate, such as Hungary or Styria, it becomes excessively sweet and less acid; its wine assumes quite different qualities, being alcoholic and of fiery taste, without almost any of the bouquet which distinguishes Rhine wine. Of other kinds, there are in Rheingau a small number of the elbling, or albe, the Pedro Ximenes, of the Xeres district. This vine is used to cover railings, which form the enclosures of vineyards. In the district of Ellfield, the elbing is mixed with the reissling in the vineyard. It occurs frequently between Rudesheim and Assmanhausen. The traminer also is cultivated, but it is found to yield bad wood and to cease bearing, and is not likely to become more frequent. At the so-called Rudesheimer Berg, particularly its western and south-western declivities, the general vine is the green Orleans, or Rudeshim Orleans, or Hartheinsch, a very late grape, which would not get ripe in any except the very best and warmest situations of the

Rhine valley. From this particular grape, therefore, is derived the peculiar flavour and taste of the Rudesheim wine, which must be well-distinguished from the bouquet of riessling wine, and experience its own appreciation. The Scharlachberger wine is also made of the Orleans grape, which in latter years there has been a tendency to abandon, and to substitute reissling. The Orleans vine grows well in the rocky soil, is an abundant bearer of large-graped, massive bunches, and attains an age of 50 years and upwards, qualities in none of which the Reissling becomes its equal.

Making a slight detour to the Lower Maine we meet with the village of Hockheim, about three-quarters of a mile from the banks of that river, 100 feet above its level, and about three miles from its confluence with the Rhine. This spot has furnished the monosyllabic English term by which all Rhine wines are confused into one curious superstition. The vineyards have no particular mountain protection from the north, but are situated on a declivity rising from the Maine, and terminating at the beginning of a great plain which stretches northwards in the direction of Homburg. This area is nearly 1,000 morgen. It is difficult accurately to define the conditions which produce so excellent a wine as that in the majority of the best reputed situations. The most important share seems to be due to the proximity of the river, which reflects the rays of the sun, and acts beneficially by the masses of warm water passing by; at least the vineyards gain in quality and price by their proximity to the water's edge. The "Kohlkaute," with an indication of from 8° to 10°, is close upon the river. The "Lattenberg" and the "Hölle," with an inclination of 15°, and the "Gohltz" and "Wandkaute" are so near to the Maine that when the river becomes swollen by rains many vines are under water. In the preparation of the soil, the planting and training of the vines, it is clear that all that human skill can do has been effected to secure the condition of a fine produce. The vintage is performed with particular care, and appears to be the most important part of the whole process of viticulture. The day of the general vintage having been determined by a commission, a special inspection is held on the morning of that day, and when the grapes are free from dew, a sign with the church-bell opens the vineyards. In case it should rain, however, the vineyards are not opened at all. The vintage is not finally completed until the middle or end of October, or even the first days of November. The grapes are generally trodden by men, in pails with a perforated bottom. In this process the husks are transformed into a pulp. The stalks are never separated, as their dry state effectually prevents the extraction of any tannic-acid from them. The trodden mass is allowed to stand for twenty-four hours, and is then pressed in the ordinary wooden screw-press. The juice is put into the casks and allowed to ferment, without any peculiar apparatus or precaution. The rest of the care of the wine does not materially differ from that bestowed in other parts. The bungs of the casks are very long, and always immersed in the wine. Four or five years are generally sufficient to make the wine ripe for boiling, after which it improves sensibly for many years.

Retracing our steps to the Rheingau, we meet with the most famous vineyard of Germany, and one of the grandest establishments that can be imagined—that is, the Steinberg. This vineyard was formerly the property of the convent of Eberbach. After the secularisation it became a Nassaurian domain, and is now the public property of Prussia. Upon a hill, about three miles distant from the Rhine, is a long oval, of about eighty morgen surface, which forms one uninterrupted vineyard: when seen from a distance this appears to be an even plain, but on closer inspection the illusion is dissipated. It has various undulations and hollows, by which it is divided into districts yielding different produce. Of these, three are particularly famous, and reputed to yield the best wine—namely, "The Golden Beaker," "The Garden of Roses," and the "Planzer." The latter yielded the best piece of cabinet wine in the famous year of 1819. These hollows are situated in the very centre of the entire vineyard, are open to the south-west, and enjoy particular protection by the higher parts of the vine-bearing land. Every year, at the time in the spring when wines are usually racked from the lees, there is a public sale of Steinberger wine at Erbach. The day of this sale is a great public festivity for the people of Rheingau and the wine merchants of Mayence and Frankfort. Each stranger arriving at Erbach, whether he be a buyer or not, is treated to a dinner and a liberal allowance of good wine, cabinet wines being served with the dessert. There is consequently a great confluence of the idle and the curious, besides the actual men of business and their friends, to partake of the judicious hospitality of the government. It is judicious, for the animated people buy with more readiness, and the sale goes off amidst general merriment and satisfaction. The autumn wine is sold in pieces of 7½ ohms each = 1,200 litres, and the price bid carries the cask. But the cabinet wine is sold by private arrangement, in smaller quantities, and frequently in bottles at high prices. At the auction, the wine not only of the Steinberg but also that of other domainal vineyards is sold. As the Steinberg produce amounts in some years to 84 pieces, from 120 to 150 pieces may now and then be sold together at the auction. The price of Steinberg wine varies from £65 per piece to £600 and £700, the latter being the finest and most exceptional cabinet wines.

The Johannisberg, through wars and adverse circumstances, has changed proprietors frequently. At the time of the French Revolution, by some means or other it came into the hands of the then Prince of Orange, but it was again taken from him after the battle of Jena, and given by Napoleon to Marshal Kellerman. In 1815 the Emperor of Austria took possession of it, and gave it to Prince Metternich, with whose descendant it now remains. This property has sixty-two morgen of vineyards, which are manured by the entire produce of a farm of 450 morgen of arable and 70 morgen of meadow land, the manure wanted by the latter being bought from the small proprietors in the neighbourhood. The cultivation is that which is usual in the Rheingau; the vintages are late, the result, it is said, of an accident on the part of the Bishop of Fulda, in 1775, who, having received the report of his steward, forgot to send the customary order for the vintage. This was deferred until nearly all the grapes were rotten, when the frightened steward obtained permission through an express messenger. The wine was, against all expectation, found to be of unprecedented quality, and the lesson has been remembered ever since. The cellar is situated under the entire castle; one portion contains stone bottles, boxes, and all requisites for packing bottles which are to be sent to a distance. Contiguous is another room, in which the bottles are filled and packed. Each cork shows the brand of the Metternich arms. After it has been inserted in the bottle it is sealed over, and the wax is again impressed with the same coat of arms. A label, stating the name, year, and price of the wine, is fixed upon each bottle; the bottle is wrapped in paper, and surrounded with straw. Fifty or a hundred such bottles are then placed in a box, and packed very tightly, the packers actually jumping with their feet on the top of the straw in the boxes, and so ramming the bottles down that the spectator is afraid for the safety of the bottles and their precious contents. The quantity of wine produced varies considerably with the years. Thus 1817 gave 48; 1818, 47; and 1819, 52 pieces of wine. In 1831 only 25 pieces were obtained from 43 morgen in active bearing; whilst in 1833 the same surface yielded 57 pieces. The wines of less good years, and all inferior qualities, are sold, immediately after the spring racking, by auction, and only the select qualities are kept in the cellar. At the age of four or five years, the time of their maturity in the cask, they are bottled. The wines after that improve greatly in bouquet, and keep twenty-five years. No doubt a fine bottle of Johannisberg Castle is, by the fulness of its taste and the mass of its bouquet, the finest and most powerful drink on earth. A piece of such wine fetches from £500 to £1,000 and in some cases even higher prices have been paid. But the auction wines have nothing like that value, and vary between £50 and £200, according to the qualities which they possess for mixing.

From the Johannisberg towards Geisenheim extends a declivity with southerly exposition, the best situations of which are termed "Morschberg," "Lickerstein," and "Hoher Rech." Near Geisenheim the "Rothe Berg," a red hill, projects, much like the Johannisberg. The majority of the vineyards belong to Count Ingelheim. The products of the various parts of the "Rothe Berg" are very varying in quality. The southerly and south-westerly side of the hill produce splendid wine, while at the foot of the north-west side, within a few hundred steps of the former, there is a vineyard which yields the worst wine in the whole district. The "Rothe Berg" is connected with the district of Rudesheim by a continued vineyard, situated partly on inclines, partly in flat hollows. The vineyards of Rudesheim begin at Elbingen and terminate at Bingerloch. The direct rays of the sun fall almost at right angles upon the soil, and the heat is increased by the reflection from the broad surface of the river. The vineyards nearest to Eibengen are called the "Wüste," "Bokhaus," and "Tafel;" the higher situation towards the forest in the north the "Oberfeld." All these are planted with the riessling. The vineyards nearest to Rudesheim are termed "Henterhaus," have a purely southerly aspect, and are built upon many terraces, which at a distance present the appearance of a gigantic staircase. The greater part of the Rudesheim vineyards is called the "Rudesheim Berg." This has an area of 400 morgen, and has the best situation in Rudesheim. The best parts of the Berg are those situated between the middle of the declivity and the border of the river. The Nassau government planted some vineyards here at great expense, and Count Ingelheim possesses the vineyard termed "Katerloch." The mere plantation of a morgen of vineyard, with the grubbing and removal of the stones, costs from £600 to £700. Whatever may be the quality of the vine, it is certain that cheap wine cannot be obtained where the plantation and cultivation is so difficult and expensive. This is the highest inclination of any vineyard in Germany, being 70°, and equalled only by the steep inclines at Wissengen on the Moselle, at Bescgheim upon the Neckar, and at Wertheim upon the Maine.

The white wine of Assmanhausen has no particular qualities or reputation. It is, however, otherwise with the red wine, which has acquired somewhat of a name. In its preparation the proprietors proceed in the following manner:—

They crush the grapes with wooden clubs, and then put the entire mass into vats. Many such vats are made of piece-casks, cut in two through the middle, or entire piece-casks from which the top has been removed. During the first violent fermentation the rising husks and stalks are pushed down about twice every day, at a later period once daily. When the fermentation is complete the wine is drawn off, the residue put into the press, and all fluid is united. The stewards of the Nassau domains, however, observe greater precautions. In the first instance, the grapes are allowed to hang until they begin to shrivel a little, but they are not permitted to get rotten, for although this might make the wine more sweet and spirituous, yet it would deteriorate its colour, one of its main characteristics. All rotten grapes are, therefore, carefully kept out of the vintage. The grapes are carried to Rudesheim, and there treated as follows:—The berries are separated from the stalks by being stirred about with a stiff broom in a sieve of iron wire placed over a vat. They are then trodden in detail by men with wine-boots, or pounded with wooden clubs until reduced to a pasty mass. This mass is then put into the fermenting vats. The wine rises nearly to the top, but the husks are kept in the fluid by a perforated wooden diaphragm, which is fixed in the upper part of the vat. After fermentation the wine is drawn off through the tap at the bottom, which is guarded inside by a strainer; the husks are pressed, and the pressed wine united with the previously drawn wine. This red wine is mostly kept in smaller casks, of two and four ohms each; it is racked from the lees in March, and, after four or six weeks of rest, sold by auction.

The banks of the Rhine from Assmannausen to Coblentz have many vineyards, but no very good situations. Amongst the villages which produce wines is Bacharach. In this village there is an interesting little inn, "To the Golden Cork-screw," where good wine was sold. Some travelling artists of Düsseldorf commemorated their approval of the wine which was served them by painting a great and showy shield in oil colours upon the wall of the principal wine-room. The names of other villages producing some wine are Manuback, Caub, Oberwessel, celebrated among Rhine tourists by its echo, Steeg, Diebach, Weinsberg, Damscheid, Perscheid, Langscheid, and Dellhofen. These cultivate riessling, often mixed with the small-berried elbling; in other parts some pineau is grown.

The following instructions for storing and keeping wines have been laid down by Mr. Verkruzen, and are worth repeating:—

"Wines after a journey require at least two weeks rest (properly stored) to recover their full condition. White German and French wines should be stored in a decidedly cool, but not actually cold, place. The bottles should always be laid down immediately; they must on no account be allowed to stand up. Red German and French wines may be stored a degree warmer than the white wines. Ports and sherries likewise may be stored a little warmer, in fact ports may be stored warmer than most other wines, 'but on no account too cool.' The proper temperature for storing the different wines is as follows, viz., German white and all sparklings, 48° to 50°; German and French red, 50° to 52°; sherries and Madeiras, 56°; ports, 60°. A good wine cellar, sufficiently ventilated to keep the air pure, but free from actual draughts, in which the temperature can be equalised in winter and summer, is most important for the safe keeping and proper development of wines. No fine wine should be brought direct from the cellar to the table; it ought to be removed first to a place having the temperature of a comfortably warmed parlour at least six hours before it is intended to be used. The higher the quality of a wine the more scrupulously ought this rule to be attended to. Red wines should be drunk rather warmer than white wines. To ice superior wines is to spoil them."

THE ZOLLVEREIN.

When the treaties of peace in 1815 were concluded, there were within the Prussian dominions no less than 60 different systems of Customs' duties, with as many tariffs. Nearly every town was separated from the surrounding country by an excise; all commercial connections between different places were hemmed in by the most vexatious difficulties and supervisions. In one province, even in one part of the same province, the importation of produce and manufactured goods was permitted; in another part either completely forbidden or charged with the heaviest duties; whilst in the western provinces nearly all foreign goods, particularly British manufactures, which at that period inundated the Continent, were permitted to be imported free, or only at a low duty. The prohibitive system was the rule for the Eastern provinces, and exemption from duty for a few articles a chosen exception. And in all the other

German states it was the same as in Prussia, only with the difference that, from the small extent of these states, the customs' barriers were still more harassing than in Prussia. It was only by the greatest exertions, and in years of extreme want and distress, a common vote was agreed on, which hardly sufficed for the present moment to grant just sufficient freedom of intercourse as was actually necessary to save the confederated neighbours from downright starvation. In this manner, the German Confederation gave an example, a parallel to which is not to be found in the world's history. The German states, confederated for one purpose, politically allied as one State, carried on a commercial civil war amongst themselves, one against the other, which was far more injurious to them than actual warfare in arms would have been.

The merchants, particularly those of the smaller States, were the first who endeavoured to find out some means of counteracting the evil which threatened German trade and German industry with ruin. In April, 1817, several manufacturers held a meeting at Leipzig, to take into consideration by what means any improvement of affairs for German industry and commerce could be attained. In 1819, a society composed of German merchants and manufacturers was formed, whose object was to procure the abolishment of all Custom-house restrictions within Germany, and the establishment of a German commercial system, and to endeavour to influence the separate governments of the German Diet in this direction. Prussia, in the meanwhile, had seen the advantage of allowing its own population greater freedom of action, and already, in 1816, preparatory steps had been taken to initiate the alterations in the customs and excise laws, which was carried out two years later. By this means the second State of the German Confederation, with a population of 10,000,000 of active and industrious subjects, established a Custom-house system which afforded, as it were, a nucleus to which the greater remaining part of the Confederation, hitherto split up into so many separate systems, might in future safely adhere to.

Whilst in this manner the impulse was given by Prussia in the north, exertions were not wanting in the south to forward the same object. The result of conferences and adhesions to the new order of things was the treaty of the 14th February, 1828. By this first real Customs Union, the Prussian Union represented a total commercial territory of 5,240 square miles, with 13,295,254 inhabitants, whilst the Customs Union of Bavaria and Wurtemburg, in conjunction with Saxe-Weimar, Saxe-Coburg, and Baden, consisted of 176,319 miles, with 5,878,000 inhabitants. A further geographical amalgamation, by the adhesion of the other German states, might have been practicable, instead of which a coalition was formed at Cassel, in 1828, which may be designated the Middle German Union. Happily for Germany, this project, by the approaches made by the southern and the northern unions to reciprocity in each others duties, was quickly dissolved. In 1831, by the adhesion of several smaller states and the disruption of the Middle German element, the Prussian Hessen Customs Union was increased to 546,619 square miles, with 14,827,418 inhabitants. In the meantime, the discussions which were commenced in 1829 between the Prussian Hessian and the Bavarian-Wurtemburg Unions regarding a complete Customs Union were carried on without interruption, and on the 15th February, 1832, the Prussian government laid the plan of a commercial union before the other interested governments. The satisfaction with which the news of the treaty then concluded was received by the whole of Germany was equal to the anxiety which had been manifested during the preliminary negotiations. The Customs Union (Zollverein) had extended itself, by a combination of the three treaties of 1833, over the most industrious and populous German countries, from the Memel River to the Alps, with 773,019 square German miles, and 23,478,120 inhabitants. The states which belonged to it were:—Prussia, Bavaria, Saxony, Wurtemberg, both Hessens, the Thuringian countries, the Anhalt domains, and, lastly, both the Hohenzollern States. On the other hand, besides Austria, there remained excluded from the Union:—Hanover, Brunswick, Oldenberg, both Mecklenburgs, Baden, Nassau, Frankfort-on-the-Main, both Lippes, the Hans Towns, and the countries in connection with foreign States, Luxemburg, Holstein, and Lauenburg. Through the Union the problem of founding a better order of customs and commercial intercourse in Germany was solved, and on the 1st January, 1834, when the Union came into force, the rejoicing at the event, so long expected and of such difficulties in its accomplishment were lively and general amongst those most interested. Long rows of vehicles, on both sides of the high roads, hitherto divided by custom-house barriers, were waiting, and as the hours of midnight struck and the hindrances removed, drove through the now free passages with the greatest jubilee. In this manner German Custom-house and commercial intercourse was freed from the endless fetters and hindrances of all descriptions which had hitherto existed, to make room for a unity in customs and a freedom in intercourse which had neither been known or even imagined in previous centuries. All the trouble and labour which the construction of this great work had caused were now forgotten, and the German governments as well as the people regarded the further development of the Union with confidence, which was not disappointed.

In the next few years several more adhesions took place, so that the extent of the Zollverein was increased to 811,019 miles, with 26,448,970 inhabitants. The Union comprised:—Through Prussia, Saxony, and the Thuringian Union, the chief northern parts of Germany; through Bavaria, Wurtemberg, and Baden, the southern parts of Germany; and the Rhenish parts, through Chur-Hesse, Hesse-Darmstadt, Nassau, and Frankfort. In the meanwhile, the North German States which did not belong, Hanover, Brunswick, and Oldenberg, had concluded treaties on the 1st May, 1834, and 7th May, 1836, by which a particular Union—Duties Union—was founded, which, considering the geographical position, manners, and economical circumstances of these countries, introduced a very low customs tariff. The events of the year 1848 at first prevented the further development of the Zollverein. The jealousy between Austria and Prussia nearly occasioned the dissolution of the Union, until in 1863 a customs treaty was concluded between the two Powers, which secured its further existence for another twelve years. The adhesion of Hanover, &c., brought the Union up to 9,044 square miles, with 32,559,055 inhabitants. In the war which broke out between Prussia and Austria, in 1866, the governments of the South German States of the Zollverein sided with Austria, and this policy caused it to be feared that a dissolution of the Zollverein must take place. This was, however, not the case; and the Zollverein at this period exhibited the extraordinary spectacle that, whilst its component parts were waging open war with each other, its Custom-house authorities remained in their functions in the general name, and received and divided the revenue moneys in the general name, a spectacle which surprised nobody in Germany, but which caused general astonishment abroad, as something quite incomprehensible. German nationality, and the inner conserving power which animates the Zollverein received hereby the most glorious confirmation. On the conclusion of peace the further duration of the Union was first made conditional in future negotiations with six months' notice. Prussia wished to obtain those alterations in the organisation of the Union, which it had so long in vain striven for, by means of voluntary arrangement. In the previous constitution of the Union the possibility of the further development of the Custom-house laws had been shut out, as these were solely matters of international treaties, and any alterations of the same were dependent on the consent of every single state composing the Union, through which it had been practicable that a single, even the smallest State in the Union, could hinder the introduction of the most wholesome reforms, and in some cases had really prevented them.

After short negotiations, a convention was concluded on the 4th of June, 1867, between Prussia, Bavaria, Wurtemberg, Baden, and Hesse-Darmstadt. On the basis of this convention a new Zollverein Union Treaty was concluded between the North German Confederation and the South German States on the 8th of July, 1867. The principles are to introduce assimilated laws as to import and export duties, and transit trade, which remains duty free; likewise as to the excise on salt produced in the country, and beet-root sugar, and also on tobacco grown or manufactured in the Union. Between the individual States of the Union, freedom of commerce and intercourse is upheld, from which, for the present, only single certain articles, which are subject to local taxation (beer and spirit) are excepted. The legislature on the common affairs will be exercised by the Council of the Diet of Zollverein, as the common organ of the governments, and by the Customs Parliament, as the common representatives of the population, harmony in the majorities of both assemblages is necessary for every law of the Union. The Council of the Diet, in which the chair and the leadership devolves on Prussia, consists of members of the North German Confederation and of the South German States; in the same 58 votes are represented, of which 43 are held by the North German Confederation, 4 by Bavaria, 4 by Wurtemburg, 3 by Baden, and 2 by Hesse. From its members, permanent committees are formed for customs and duty affairs, for commerce, and intercourse and finance affairs. The Crown of Prussia has the right, in its capacity as presiding leader, to conclude commercial and navigation treaties with foreign powers, but the ratification of some is subject to the agreement of the Council of the Confederation and the consent of the Customs Parliament. This body is composed of members of the Diet of the North German Confederation (297) and of representatives of the South German States, namely, for Bavaria, 48; for Wurtemburg, 17; for Baden, 14; and for Nassau, 6; therefore, altogether, 382 members. The summoning of the Customs Parliament takes place when a necessity for legislation makes it desirable, or when one-third of the voices in the council of the district desire it. By the introduction of the principle of majority in the constitution, it has become possible to carry out a commercial policy in acquiescence with the views of the majority, without being compelled to give way before the claims of the most insignificant minority, or from time to time allowing a complete stagnation to take place. And the establishment of an executive is of no less importance, which alone has the power of concluding treaties with foreign powers in the name of the entire Zollverein, which can put a veto against any alterations in the laws. Through this new organisation, notwithstanding the shortness of its existence, considerable results have been effected, such as the promulgation of customs laws suitable to the requirements of modern times, the conclusion of new commercial treaties, &c., with foreign states.

Although the treaty of the 8th July, 1867, cannot be looked upon as the consequence of regular progressive development, but must be considered as a crisis called forth by the war of 1866, still it is an advance in political economy of the highest importance, having given free assimilated markets for the products of human industry to a territory of nearly 9,600 square German miles, with a population of 38,500,000 inhabitants. This treaty, the sole political and nationally legal tie which united the North German Confederation with the South German States, has become one of the most important documents in all the German archives. It was quite natural that the nation should look up to the Zollverein with increasing sympathy, and graft hopes and wishes on this institution, which at first appeared to have but little prospect, but which have been realised with unexpected rapidity through the establishment of the German Empire. The Zollverein has thereby arrived at its conclusion, and legislation for Custom-house affairs and home taxation of certain products, &c., has now passed into the hands of the Empire. Under the administration of the Empire and its organs, the economical development of the German nation and its industrious energy will make that further progress which was to be expected from the latest organisation of the Zollverein, which was based on purely material foundations.

GENERAL NOTES.

Coals are being imported into Great Grimsby from Belgium, for the use of the Manchester, Sheffield, and Lincolnshire Railway Company.

Social Improvements in Japan.—In Japan considerable reforms were taking place when the last mail left. The government had established a patent law. Women have been granted the same rights as men as regards visiting the temples, &c.; all indecent pictures and exhibitions are henceforth prohibited; gas will shortly be laid at Yokohama; a fine suspension bridge is being erected at Yedo; and the burnt-down part of the city is being laid out in streets 90, 60, and 48 feet wide.

Albert Memorial.—The People's Fund.—On the occasion of the opening of the memorial by her Majesty it was stated that the funds devoted to its erection consisted of the subscriptions obtained by Lord Mayor Cubitt, of £12,000 collected by the Society of Arts from the humbler classes, and of £50,000 voted by Parliament, on the motion of Lord Palmerston. The fund stated to have been raised by the Society of Arts deserves separate mention, having been collected in small sums throughout England and Wales and the Colonies. The fund originated in a letter from Mr. Henry Cole, C.B., to the *Times*, which resulted in a meeting in the hall of the Society of Arts, presided over by the then Marquis of Salisbury. Among the executive committee, besides the marquis and Mr. Cole, were the Duke of St. Alban's, the Hon. F. Byng, and Sir Thomas Phillips, all of whom took an active part in the organisation. Mr. John M. Clabon, Mr. P. Le Neve Foster, and Mr. S. Redgrave were the honorary secretaries, and Mr. S. T. Davenport, the treasurer. The Society of Arts had already contributed one thousand guineas to the Mansion House fund, and they raised several hundred pounds for a special memorial of their own. They gave the use of their building and offices to the people's fund, and promoted it in every way. The labours of the committee resulted in the collection of the above-mentioned sum from contributors amounting in number, according to the best calculations which could be made, to several hundred thousands, and the movement led to the erection of many local memorials throughout the country. As illustrating the breadth of action taken by the Society of Arts in collecting the sum of £12,000 referred to above, the following extract may be read with interest:—"Memorandum of the pence collection for the national memorial to the late Prince Consort, from the town and harbour of Seaham, the various collieries, schools, workshops, and railways, the property of the Most Hon. Francis Anne Marchioness of Londonderry, in the county of Durham. Number of contributions, 4,083; amount collected, £67 8s. 5d.; less cost of collecting, 13s. 5d.; nett cash received, £66 15s. Of this sum £2 4s. 1d. was contributed by 941 Roman Catholics, or 0·53d. of a penny each, and £65 4s. 4d. by 3,169 persons of other denominations, or 4·93d. by each subscriber.

Journal of the Society of Arts.

No. 1,028. Vol. XX.

FRIDAY, AUGUST 2, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

FINAL EXAMINATIONS.

The Council have had under consideration a number of letters from Institutions in Union, as well as from individuals, asking them to reconsider their decision in reference to giving up these examinations, and the Council have referred the subject to a Special Committee, to inquire and report what can best be done to meet the views of the Institutions in Union.

SHIPS' LIFE-BOATS.

The trial of the selected boats took place at the Regent's-canal Docks, Limehouse, on Wednesday, the 31st July, in the presence of Major-General Eardley-Wilmot (Chairman of Council), Vice-Admiral Ommanney, C.B., F.R.S., Vice-Admiral Ryder, Capt. Toynbee, Capt. Ward, R.N., Capt. Nisbet, Mr. Thomas Gray (Board of Trade), Lieut. Wilson, Mr. Seymour Teulon. Messrs. Hamilton, of Windsor Iron Works, Liverpool, sent two iron boats, large and small; Messrs. Woolfe and Sons, two wooden boats, large and small; Capt. Nisbet, small wooden boat; Mr. J. White, of Cowes, a large wooden boat.

PROCEEDINGS OF THE SOCIETY.

DRILL REVIEW

The following is a report of the proceedings that took place in the Royal Albert Hall on the 25th July, after the inspection of the Schools in the Royal Horticultural Gardens. All the bands were massed in the orchestra and played the National Anthem as the Princess of Wales proceeded to the box appropriated to her Royal Highness, and the Prince of Wales, with Prince Albert Victor and Prince George, took their places on the dais below the great organ

Major-General Eardley-Wilmot, Chairman of Council, read the following address:—

It is with the greatest gratification that the Council have the opportunity of seeing your Royal Highness among them, and again taking an active part in their proceedings. The pleasure is greatly enhanced by the kindness of her Royal Highness in gracing our meeting with her presence. The occasion is one of growing importance. The annual competition of the schools has given an impetus to the system by which physical and intellectual training, being pursued together, are bound to assist each other. The principle commends itself on all sides, and may now be accepted as well established in the opinion of the country. I am glad to be able to inform your Royal Highness the reports of the drill of the 22 schools visited are highly favourable. An officer, Captain O'Hea, well known as highly competent, has carefully inspected each school, and reports as follows:—

Royal United Service Institution, Whitehall-yard,
London, S.W., July 24th, 1872.

Sir,—In compliance with instructions received from the Council of the Society of Arts, I inspected, between the 25th of June last and the present date, in setting up and company drill, the following schools:—

1*st Division.*—*Goliath*, training-ship; *Warspite*, Marine Society's Ship; *Chichester*, Homeless Boys' ship.

2*nd Division.*—Shoreditch School, Brentwood; Lambeth School, Lower Norwood; Strand Union School, Edmonton; Stepney School, Limehouse; Central London School, Hanwell; South Metropolitan School, Sutton.

Schools of the 2*nd Division not named above, which have been Inspected.*—St. Mary's, Islington, St. Marylebone, Forest-gate, Mile-end, Farm School (Bisley), Queen-street Refuge, Holborn, Bethnal-green, North Surrey, St. Mary's Orphanage, St. Pancras, St. George-in-the-East.

3*rd Division.*—Royal Naval School, Greenwich.

I have the honour to report that in the 1st Division, viz., the schools of the training-ships, the boys of the *Goliath* stand first in merit. The physique and appearance of the boys of the Marine Society's training-ship *Warspite*, and those of the training-ship *Chichester*, are very fine, and in drill both schools are fairly proficient.

Of the 2nd Division, viz., the industrial schools, the Shoreditch School, at Brentwood, and the Lambeth School, at Lower Norwood, stand first on the list in efficiency, having each obtained an average of over 90 marks per movement out of a possible 100 marks. The "setting up" of the boys of the Brentwood School is especially creditable.

The boys of the Strand Union, at Edmonton, and of the Stepney School, at Limehouse, are well-trained (the latter on a system of drill now obsolete), and I would recommend both schools for some mark of approbation.

The Central London School, at Hanwell, and the South Metropolitan, at Sutton, also deserve special mention for the care which has evidently been bestowed on the training and setting up of the boys.

I also visited, in compliance with instructions, though it is not in the competition, the Royal Naval School at Greenwich. The splendid appearance of the boys of this school, as paraded for my inspection, was very striking. Their pliancy and precision when moving as a battalion were admirable. The manner in which this school is drilled reflects the highest credit on Captain Burney, R.N., and his instructors.

In conclusion, I beg leave to express my thanks to Mr. J. C. Tufnell, her Majesty's Inspector of Schools, as well to the several superintendents, who rendered me essential assistance in my inspections.

I have the honour to be, Sir,
Your obedient servant,
John B. O'Hea,
Late Captain 25th Foot.

To the Secretary of the Society of Arts.

Sir,—By desire of the Council of the Society of Arts, received through you, I have the honour to append the following few remarks on the system of drill adopted in the schools which I visited.

In some schools parading more than two companies of sixteen files each, I observed that battalion drill—in not a few instances of a fanciful and faulty description, unauthorised by any authorised drill-book—appeared to be the rule, and company drill the exception, the result being very unsatisfactory.

In other schools, professedly drilled according to the existing regulations, much attention appeared to have been given to train a few selected boys to act as captains and guides of companies, to the evident neglect of the more essential points—the setting-up drill, and the steadiness of the boys composing the companies.

I would respectfully suggest that in future competitions prize banners, &c., shall be given only to schools drilled according to the existing regulations. It is evident that boys trained on an obsolete principle in industrial schools will, when they enter the service (either as band boys or otherwise) not only have to learn a new drill, but, what is more difficult, to unlearn that in which they have been first instructed.

If the sergeant-instructors of schools were required to qualify, and obtain certificates as drill-instructors from some authorised military drill-school, unity of system would be ensured.

Wooden dummy rifles, as in use in the Hanwell and Brentwood schools, are of great service in rendering the boys steady in the ranks on parade, and an additional means of improving the setting-up of the boys.

In conclusion, I would suggest that one uniform elementary course of drill instruction should, if possible, be adopted in schools, such course to comprise Parts I. and II. of the latest authorised "Field Exercise," with the addition of dumb-bell setting-up motion, a simple manual exercise, abridged from the regulation manual for the short rifle, and instructions for marching past in battalion. In any school that attempts battalion movements I would recommend that Part III. of the "Field Exercise" should be strictly adhered to.

I have the honour to be, Sir,
Your obedient servant,
John B. O'Hea,
Late Captain 25th Foot.

To the Secretary of the Society of Arts.

This report has been fully borne out by the opinions of H.R.H. Prince Edward of Saxe-Weimar, to whom the Council is greatly indebted for the kind and patient manner in which he has minutely inspected school drill to-day.

It was the wish of the Council to present a flag for competition to each of the following sets of schools:—1. Greenwich and Chelsea; 2. Schools of training ships; 3. Industrial schools. But, as regards Greenwich and Chelsea, the competition could not come off because it is the holiday time at the latter, which is the reason of their not being here to-day. The Council have, however, been so satisfied with the proficiency of the Greenwich boys that they have determined to present them with a banner of honour. The following will, therefore, be the schools to whom we ask your Royal Highness to present prizes. Having read over the list, I will call them one by one, and the boys deputed to receive the flag at your Royal Highness's hand will then come forward for that purpose.

His Royal Highness then said—I beg you to accept my best thanks for the satisfactory and interesting report I have just heard, and I desire to express to you, boys, what a satisfaction it has been to the Princess and myself, as well as to my two sons, whom you see here, to have taken part in the proceedings of this day. I congratulate you on the excellent manner in which you have marched past, and I am satisfied from the report I have heard to-day that you have proved up to the mark. I hope you are as well up in your studies as in your drill. I will now distribute the prizes which have been awarded.

Two boys of the *Goliath*, the Brentwood School, the Lambeth School, and the Royal Naval School, Greenwich, then received from the hands of his Royal Highness the prize banners awarded to the respective schools.

The Prince of Wales having joined the Princess of Wales in the Royal box, a concert of the bands took place.

The *Morning Post* says:—"A highly interesting scene was enacted yesterday in Hyde-park, on the open space to the north-west of Knightsbridge Barracks. Here before noon were assembled some 4,000 boys, whose ages ranged between six and fourteen years, and who have been instructed in the art of drilling properly. They were brought together to be inspected by Major-General Prince Edward of Saxe-Weimar. The boys were drawn up in companies, each school being under the command of its own drill-master, who put the boys through their exercise for the Prince. His Highness was by no means disposed to make the review a mere matter of show, for he regularly inspected the lines of every company before calling on the drill-master to put the school through its exercise. The first school inspected was that from the *Chichester* training ship, which numbered 154, besides officers. These boys acquitted themselves in a highly creditable manner. Next came those from the Boys' Refuge in Great Queen-street, numbering 110. An excellent display of drill, including some capital countermarching, was shown by the boys of Mile-end Old-town School, who are, as the drill-master informed Prince Edward, acquainted with the whole of the new drill. Next came the boys of St. Mary's Orphanage, and next those of the Central London District, who marched admirably, and kept their distance right well. They also formed square in a highly creditable style. The South Metropolitan School showed exceedingly good drill, and next came the boys from Islington, Mitcham, and St. George's in-the-East. The Brentwood School, composed of boys from Shoreditch, were attired in a grey uniform and carried mock guns, and showed admirable training both as to their marching and the management of their arms. Next came Forest-hill and Stepney, followed by the Lambeth boys, who advanced in echelon by companies and formed a good square. The band of the Strand Union deserved notice from its taking its place in the ranks and going through the drill with the rest, who performed their work very well. The Bethnal-green School showed a strong band, and next came the boys from the *Goliath* training-ship, 300 in number, lads showing a *physique* which argued well for the value of a life on board ship. Their drill was also excellent. Next came the 200 boys of the *Warspite*, who went through their drill in the usual creditable style. Next came the boys from St. Pancras; and the last school reviewed was the Greenwich Royal Naval School, numbering 750 lads, the sons of naval petty officers and seamen. These fellows drilled in a first-rate style, keeping their line and their distance admirably, and going through the company and battalion drill remarkably well. Their master put them through their scurry drill. At a signal given all the lads scattered over the ground, and in an instant a single bugle note suddenly converted the whole moving mass into a fixed *tableau vivant.* The note was then sounded to re-form, and while running in to obey they were again in an instant transfixed by a bugle note. In conclusion they formed companies, and the band having played "God save the Queen," they marched off after the schools which had preceded them to the space of waste ground at the southern end of the gardens of the Royal Horticultural Society. Here the boys of all the schools were supplied with refreshments, and thence they marched into the gardens and were drawn up along the western terrace to await the coming of the Prince and Princess of Wales."

The *Times* says of the scene in the gardens:—"The terraces of the Exhibition were pretty well filled with spectators, and for some distance on each side of the dais a crowd of ladies and gentlemen filled a roped enclosure. The bands in the centre of the column made an imposing array of drums and brass instruments, and various uniforms, the smartest being that of the Greenwich ship, which boasted a drum-major at least five feet high, and wearing a bearskin cap. Each school had its banner, in most cases merely inscribed with its name, but in others bearing large and gorgeous emblazonments. As the Prince and Princess and their children reached the dais the bands struck up "God save the Queen," after which the boys gave three ringing cheers for her Majesty. General Eardley Wilmot conducted the Prince along the column, followed by the other members of the Council of the Society present. When the Prince had inspected the little regiments, he returned to the dais, and the march past began. Each school came with a band at its head. Huge brass instruments, which seemed to wind themselves round and round the little bodies of the players, were made to give forth their utmost sound. The schools marched well, the Greenwich boys the best, next best to them the boys of the *Goliath*, and they made a pretty show as they stepped by in their variety of red and gray jackets and sailor shirts. One of the bands wore a sort of Hussar dress, others differently braided uniforms, and each of them seemed to have been well instructed. At the head of each school walked its schoolmaster. The trees in these sultry gardens are growing large enough to give a little shade, but the lads must have been glad to get under cover.

"When each school had marched some way past the saluting point, it wheeled to the left and marched round the grounds to the Albert Hall, where the prizes were given away. The brass instruments of the band, a portentious show, were massed together in the orchestra, the Greenwich boys in their neat sailor dress filled the pit, and the other schools were ranged in the gallery. Certainly there is no building like the Albert Hall for accommodation, for it seemed yesterday to stow away 4,000 boys and about 1,000 spectators, and yet to be comparatively empty. The Princess of Wales went to her box, but the Prince took his two boys with him to the dais, where stood on high the four prize banners given by the Society of Arts. The Royal party were received by a great clapping of hands; all over the hall the boys' palms seemed to work with a quick, fanning movement, making a sharp, bright noise very much beyond the comparatively languid enthusiam of ordinary handclapping.

"The sight altogether was most gratifying. Here were 4,000 boys, most of them paupers, most of them orphans, receiving an excellent education, a training in physical aptitudes and habits of obedience as well as in mental studies. The Greenwich School is composed of the children of seamen being educated for the sea, but the 3,000 and more boys of the other schools must in large part be looked upon as so much material reclaimed to humanity. In fact, these 3,000 and more boys may, in the words of a paper put forth by the Society of Arts, 'be beheld with confident satisfaction as victims rescued from "the bad," and preserved for the good as honest self-supporting producers, and worthy members of the community.' We should say, in conclusion, that great praise is due to the energy and good management of Major Donelly, R.E., one of the Council of the Society of Arts, who bore a chief part in the organisation of this successful display."

ELEMENTARY EXAMINATIONS, 1872.

NAME OF UNION OR LOCAL BOARD.	Number of Centres.	HIGHER GRADE.				LOWER GRADE.			
		MALE CANDIDATES.		FEMALE CANDIDATES.		MALE CANDIDATES.		FEMALE CANDIDATES.	
		Examined.	Passed.	Examined.	Passed.	Examined.	Passed.	Examined.	Passed.
Aldershot and Farnham District	2	77	66	14	7	61	55	17	9
Christchurch (Hants)	1	6	6	..	..	31	24	19	13
Hertford	7	22	17	7	7	17	69	32	26
Lancashire and Cheshire Union of Institutions	48	262	144	32	7	883	464	242	131
Leeds Young Men's Christian Association	1	9	7	..	..	20	14	..	..
New Swindon	1	16	12	..	..	20	14	20	16
Penzance	1	24	3	3	2	17	4	18	13
Rugby	1	..	..	3	2	..	..	13	6
Stockton-on-Tees	1	7	5	..	..	14	1	..	..
Weston-super-Mare	1	8	3	..	..	16	6	..	..
Yorkshire Union of Mechanics' Institutions	1	61	21	..	..	223	66	20	..
Totals	65	492	284	59	25	1,302	717	381	214

ANNUAL INTERNATIONAL EXHIBITIONS.

The Exhibition was open to the public on Monday evening, and will be open every Monday evening for the future, after six o'clock, on payment of 6d.

His Royal Highness the Prince of Wales presided on Wednesday, at Marlborough-house, over a meeting of Her Majesty's Commissioners for the Exhibition of 1851. There were present H.S.H. the Duke of Teck, the Marquis of Ripon, the Duke of Buccleuch, the Duke of Buckingham, Earl Granville, Mr. Ayrton, Sir Thomas Bazley, Sir Francis Sandford, Mr. Baring, Mr. Edgar Bowring, Mr. Gibson, Mr. Beresford-Hope, Dr. Playfair, Mr. Thring, and Major-General Scott (secretary). Mr. Cole and Mr. H. A. Hunt attended the meeting.

EXHIBITIONS.

Vienna Universal Exhibition of 1873.—A meeting of Her Majesty's Commissioners for the Vienna Universal Exhibition of 1873 was held on Wednesday, at Marlborough House, under the presidency of His Royal Highness the Prince of Wales. There were present the Marquis of Ripon, K.G.; Earl Cowper, K.G.; Lord Acton; Lord Henry G. Lennox, M.P.; Mr. Henry A. Brassey, M.P.; and Mr. Philip Cunliffe Owen, the secretary. The following are the main conditions upon which this Exhibition will be conducted:—The programme and regulations issued by the Imperial Austrian Commission furnish full information as to the principles upon which the Imperial Government propose to conduct the Exhibition of 1873, and an attentive perusal of the same is recommended to all those who desire to co-operate in securing a fair representation of British industry on that occasion. The relative duties of the Royal Commission of British and Colonial exhibitors, and of the Austrian Commission, as set forth in the appointment of the Royal Commissioners, and in the Austrian general regulations are as follow:—The Royal Commission is appointed to represent the British and Colonial exhibitors, to advise as to the best mode of procuring and forwarding their objects and products to the Exhibition, and to report on the same. The Royal Commission having no public funds at their disposal, exhibitors will have to defray all expenses, including rental of space, transport of goods, and all other charges not provided for by the Imperial Austrian Commission. The Austrian Commission will communicate with exhibitors from foreign countries solely through the Commission appointed by each country for that purpose. The Exhibition will open in Vienna on the first of May, and close on the 31st of October, 1873. Lists of the exhibitors, with detailed plan of space required, must be sent in to the chief manager of Vienna before the first of January, 1873. No liability on the part of the exhibitors for ceilings, boarded floors, or the laying out of the gardens; the cost of these will be defrayed by the Imperial Commission. The motive power for machinery will be supplied gratis. The Austrian regulations state that the price to be charged to each foreign country for the entire area of space demanded, will be—in the Industrial Palace at the rate of ten florins, equal to £1 per square meter (a square meter contains about 10½ square feet), and in the machinery-hall at the rate of four florins, equal to 8s., per square meter. In the other parts of the Exhibition and grounds the rent per square meter will be—in the courtyards of the Industrial Palace, 8s.; in the park, open air, 2s.; in spaces covered at the expense of exhibitor, 6s. Exhibitors of fine arts are exempted from any charges for space. Arrangements are to be made by the Austrian Commission for the reduction of the transport charges in Austria and Hungary; other Commissions are invited to try to effect the same in their several countries. Goods for exhibition to be considered as bonded and exempt from Customs duties. Exhibitors or their agents are responsible for the packing, forwarding, receiving, and unpacking of their goods, both for the opening and close of the Exhibition, and the owner, agent, or consignee must be present. The removal of objects after the Exhibition must be completed before the 31st of December, 1873. The objects will be submitted to the judgment of an international jury. Special regulations will be issued for the fine arts, machinery, and the temporary Exhibitions. The usual prohibitions and limitations respecting the exhibition of explosive substances are notified. Objects for exhibition will be received at Vienna from the 1st of February until the 15th of April, 1873. Special regulations will be published respecting constructions, and very large objects; also for those requiring foundations. All preparations for the Exhibition of such objects must be completed by the 15th of February, 1873. The chief manager reserves to himself the right to dispose of such places as shall not be properly occupied on the 25th of April, 1873. The objects exhibited will be protected against piracy of inventions or designs. Reproductions, photographs, &c., will only be allowed with the joint consent of the exhibitor and the chief manager. Insurances against fire, &c., when considered necessary by the exhibitor, to be effected by him at his own expense. Exhibitors and their agents will receive tickets entitling them to free admission to the Exhibition. All communications should be addressed to Philip Cunliffe Owen, Esq., at the offices of the Commission, 41, Parliament-street, London, S. W.

OLD FRENCH ENAMELS.

The *Moniteur des Arts* gives an account of a most interesting discovery made some years since at the summit of Mont Beauvrey, when a considerable number of buildings, or rather the remains of them, which had been destroyed by fire, were laid bare. There were found in the ruins a number of coins, medals, and pottery, evidently of a period anterior to the Roman conquest; and it was inferred that the ruins formed part of a town destroyed about the time of Julius Cæsar. Antiquarians believe that the town in question was Bibracte, the capital and fortress of the Eduens, which before had been supposed to have occupied the present site of Autun, which was built by Augustus to replace Bibracte. The most interesting discovery was that of an enameller's shop, in which were found tools, crucibles, finished, unfinished, and spoilt work, telling the secrets of early art workmanship. There were found a number of small cubes containing raw enamel, blue, yellow, but principally red The pieces of enamelled work discovered were heads of pins, fibula, intended for the costumes of the chiefs and the female head. The designs are very simple, chiefly consisting of arrangements of concentric circles and curves, or straight lines radiating from a central or other point. The enamels are of the *champlevée* or incised kind, the bronze being cut away to receive the enamel. As in the ruins of Pompeii and Herculaneum, those of the ancient Morvan town show, as it were the workman surprised in the very act of his cunning; unfinished and spoilt pieces were found with a coating of fire-clay covering parts to be protected from the action of the fire. The head of a pin, which had passed through the furnace, was found unpolished, and with all the irregularities caused by the smelting of the enamel Another pin-head seems to have been thrown aside, because the enamel had not adhered completely to the metal. And with these, polishing stones with hemispherical cavities of various dimensions, pincers, pliers, a hammer, and crucibles. The shop was situated on an underground floor, from which it is conjectured that the art was kept secret. The one fact proved by these discoveries is, that enamelling was known and practised by the Gauls before the Roman conquest, and that the incised method, which appeared in Gaul before the Merovingian period, and which suddenly disappeared almost immediately, must have been imported from Asia by the ancient Gauls. The Romans, it is said by historians, had lost all trace of the enameller's art before the time of Augustus. Pliny never once mentions enamelling. It was after this that *champlevée* enamelling appeared in Celtic Gaul, but it had disappeared again before the time of Clovis. The discoveries made at Beauvrey seem to prove that the first introduction was at an earlier date. It may be mentioned that the excavations on Mount Beauvrey were made under the directions of M. Briellot, president of the Société Eduenne, at Autun, where the objects found are preserved.

THE CORAL FISHERY OF TUNIS.

Coral is found more or less in abundance along the coast of the Regency of Tunis, Algeria, and the Mediterranean shores of Morocco, as well as in the vicinity of Sardinia, Naples, Leghorn, and Genoa, and the coasts of Catalonia and Provence. The distance of the beds from the mainland varies from two to ten miles; there are, however, many other banks, well known to the fishermen, at from fifteen to thirty miles from the mainland, but those furnishing the best quality of coral are off the Island of Galita. It grows on rocks embedded in mud, and never on those lying on sandy and clear bottoms. There are about ninety coral fishing boats at La Calle, and twenty at Bona, chiefly owned by Italians, three or four only being the property of Maltese, who reside permanently in Algeria, and navigate their vessels under the French flag, which exempts them from the heavy dues imposed on vessels under foreign colours, and secures them many other advantages. From 80 to 100 vessels, equipped at Torre del Greco, arrive yearly at the proper season at La Calle, and 50 or 60 make Biserta their fishing station. There are two kinds of boats employed in coral fishing, the Bona and La Calle and Biserta craft; the large boats measure from 12 to 14 tons, and have crews of from ten to twelve men, and the smaller ones from 3 to 4 tons, carrying five or six men each; the former arrive on the fishing-ground early in March, and leave in October, and the latter continue their operations, whenever the weather admits, during the whole year, but return to port every evening. The small boats are generally owned, and always manned, by Italians, residing at La Calle and Bona. The seamen receive from £20 to £24 each a-year, and the masters about twice this amount. The entire cost of a paranya or large boat, in working order, including the vessel itself, nets, stores, and six months' wages of master and crew, may be calculated at about £550. A boat of this description may count upon collecting from 650 lbs. to 850 lbs. of coral in a season, and one of the lesser craft 380lbs. to 500 lbs. during the whole year. The coral found on the Barbary coasts is principally red, but white and black, as well as the much-prized pink, also exist. The latter quality is most frequently obtained on the Galita and Fratelli rock banks. The Italian republics appear to have exercised certain rights over the Barbary coral fisheries from early times up to the 16th century, but in 1520 a French company was established at Cape Negro, for the purpose of fishing for coral, with exclusive privileges secured by it from neighbouring tribes. In 1535, Charles V. landed at Gollette, and having gained a signal victory over the Tunisians, dictated a treaty of peace, in which the exclusive claim of Spain over the Barbary fisheries was stipulated, the right, however, soon reverted to France, till, in 1793, owing to the revolution, and the wars in which she was engaged, it became impossible for her to enforce her privileges, and the coral beds were consequently searched by vessels of all flags, until England assumed for some time the rights abandoned by France. The French government, from 1806 to 1824, made repeated attempts to renew its engagements with Tunis with regard to coral, but in the latter year a Mr. Thatcher, an English merchant, succeeded in obtaining from the Bey a concession of the fishery; but in 1852 a treaty was concluded between France and Tunis, by which the former obtained the exclusive privilege over the coral fisheries in the Tunisian waters for the annual payment of £355.

WORKING OF THE ÉCOLE PRATIQUE DES HAUTES ÉTUDES, FRANCE.

The École Pratique des Hautes Études, established by the late Minister of Public Instruction, M. Duruy, forms certainly the most philosophical, and, at the same time, the most practical attempt that has been made for a long time to raise the general level of education, apart from all special or professional applications.

The Ecole Pratique is divided into two sections, the historical and philological, and the scientific.

In the *Journal* of the 12th of January, in the present year, will be found a short notice of the first report on the historical and philological section; the first report on the science section has just appeared.*

The object of this school, or rather system of schools, is of such high importance, and its title so peculiar, that it is necessary, for the full understanding of the subject, to explain fully the views of its founders.

In the words, or rather in the sense of the report, books and oral teaching are insufficient for the study of the natural sciences, physics, and chemistry; practice is indispensable, hence the meaning of the word *pratique* in the title of the new school. Previous to the formation of the Ecole Pratique, the greater part of the pupils in the faculties of science had been completely without practical instruction; thus, in geology, botany, zoology, comparative anatomy, and physiology, their knowledge was at once superficial and unproductive. Such is no longer the case. At the present moment, not only in Paris, but also in many university towns in the departments, all those students who desire to cultivate science seriously can do so without any cost to themselves. They are admitted gratuitously into the laboratories, where, under the direction of able professors, they may make themselves acquainted with the employment of instruments and methods of observation; they may learn to conduct experiments and analyses, and to work out the results of observation; they thus acquire practical, solid instruction; and when they are capable of going further, of entering on the road of research, they are initiated into the work of investigation.

The following descriptions of the features of the Ecole Pratique, and of the results which have been obtained during a period of most discouraging character, deserve careful study.

The Ecole comprises two classes of students and two kinds of laboratories; those for instruction, in which students learn to manipulate, observe, experiment, and to acquire first ideas relative to the facts on which scientific views and theories rest; and laboratories of research, in which pupils assist the teacher in his investigations, and inspired by his example and guided by his advice, may pursue the solution of yet unresolved questions.

The laboratories are open also to young *savants* who have already given proofs of their knowledge, but who have not the means of pursuing their investigations. Finally, means of publication are assured to all who produce what are considered useful results in the laboratories. A special publication has been established under the title of "Bibliothèque de l'Ecole des Hautes Etudes, section des Sciences Naturelles." This work forms already four volumes, and the fifth is now in the press.

The value of the laboratories and of these practical labours is so evident, that it may seem superfluous to insist on the services which the Ecole des Hautes Etudes may render to the cultivation of natural science; but it is useful to record the fact that already the influence of the new establishment is evident, in the results of the examinations before the Faculty of Sciences of Paris for the grade of licentiate. Before the opening of the Ecole des Hautes Etudes, this grade was only conferred on two or three candidates a year at the Sorbonne, while, during the years 1868-69, which preceded the war, the diploma of Licentiate in Natural Sciences was granted to twenty-two students, twenty of whom were of the Ecole Pratique, and the examiners were, moreover, enabled to record a notable elevation in the general level of the acquirements of the admitted candidates. During the same two years, six pupils of the new school obtained the diploma of Doctor of Sciences.

The report then deals with each of the establishments appertaining to the school, in succession.

The first opened was the laboratory of Anatomical and Physiological Zoology, under the direction of M. Milne-Edwards, of the Institute, Dean of the Faculty of

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* "Rapport sur l'Ecole Pratique des Hautes Etudes. Section des Sciences, 1871-2." 8vo., 65 pp. Printed by Jules Delalain, 56, Rue des Ecoles.

Sciences, &c., with M. Alphonse Milne-Edwards, Professor of Zoology, as joint director, and Dr. L. Vaillant, formerly of Montpellier, as repetiteur. The laboratory is open every day, from eleven till four, during the collegiate terms, and accommodates twenty students at a time. The total number attending is, however, in excess, as they are not all present on the same days. The laboratory is at No. 59, Rue Cuvier, a dependency of the Museum of Natural History; it is at once a laboratory of instruction and research. The pupils are practised in fine dissections, in the use of the microscope, and other means of anatomical demonstration and zoological determinations; they study from nature the organisation of a series of animals selected as representing the principal zoological types; they are supplied with all necessary classic works; once a week the repetiteur gives a conference on the subject on which they are engaged; and in fine weather the joint-director accompanies them to the sea-coast, to study the structure of inferior creatures, which can only be well observed in the living state. Finally, the pupils are called upon successively to give oral lessons before the school, and to discuss amongst themselves questions selected beforehand. By these means the pupils, who are principally medical students, acquire sound information in comparative anatomy and the other branches of zoological science; they exercise the art of observation, and they learn to explain clearly what they have acquired.

The number of pupils admitted to the laboratory during the current session is twenty-eight. When the report was drawn up, eight experienced naturalists were pursuing their researches in the laboratory, side by side with the joint-director and repetiteur. One of these naturalists, M. Alf. Grandidier, on his return from a voyage of exploration in Madagascar, deposited in the laboratory the zoological collections which he had made in that interesting country, and is now occupied in arranging the specimens with the view of publishing, in collaboration with M. A. Milne-Edwards, a great work on the mammifers of Madagascar, which will be shortly ready for the press.

M. Onstalet, another of the naturalists referred to, and licentiate in natural science, formerly pupil of the Ecole Pratique, has worked in the laboratory for three years, and has published a memoir on the organs of respiration of the *Libellulæ;* he is now engaged in a considerable work on the fossil insects of France, a portion of which has already appeared, and on another work, on the insects of Madagascar, &c.

Dr. Jobert, another pupil of the school, after long researches in the anatomy of the nasal glands of birds, has published a memoir on the subject, and has just completed a long memoir on the structure of the organs of feeling and touch in various animals. Dr. Jobert has also published studies on the organs of many other animals, birds, fishes, molluscs, &c.

A former pupil of the school, Dr. George, has published memoirs and papers on mules and other varieties of the horse family, and on the fossil reptiles in the tertiary deposits of Sansan. Dr. J. Chatin, another pupil, has published several memoirs, the result of long and arduous work in the same laboratory. Another student, Dr. Sauvage, has published memoirs on the fossil fishes found in the tertiary deposits of Licata, and has just completed another on those of the Sarthe. Dr. Vautherin has also published the results of his anatomical studies in the laboratory. M. Bourguignat, the last of the naturalists pursuing their researches in the laboratory, had already attracted attention by numerous publications on terrestrial and fluvial mollusca, when he took up the study of the fossil-bones found in various caves in the south of France, and has succeeded in recognising the fragments of the skeleton of a large animal, hitherto unknown, to which he has given the name of *Leo Edwardsii*, in honour of the learned director of the laboratory. M. Bourguignat believes he has discovered several other unknown mammiferous animals of the quaternary period, the accounts of which are about to be published. Finally Dr. Léon Vaillant, the repetiteur, and M. A. Milne-Edwards, the directeur-adjoint of the laboratory, have been enabled to pursue most important investigations, and to publish a number of memoirs thereupon, the list of which is far too long to insert here.

It is impossible to read even the above curt abridgment of the report without recognising the importance of this, the first established of the laboratories, or schools, of the Ecole Pratique. Space will not allow of anything like full notions of the other laboratories, some of which occupy many pages of the report, but it is due to science and education to record the most salient facts in each case.

There are attached to the Ecole Pratique three botanical schools, or laboratories, as they are universally denominated. First, there is a laboratory of instruction at the Sorbonne, under the direction of M. Duchartre, of the Institute, Professor of the Faculty of Sciences, destined especially for the instruction of aspirants to the grade of Licentiate in natural science; the director is aided by a repetiteur, Dr. Cornu. Conferences take place twice a week on vegetable anatomy and modes of observation, and the pupils are instructed in making preparations and in the use of the microscope, and all other instruments and means of botanical research. Dr. Cornu has signalised himself by a remarkable original monograph, and one of the pupils, M. Bertrand, has published two or more memoirs. The second botanical laboratory, is established at the Museum, under MM. Brongniart and Decaisne, both members of the Institute, assisted by Dr. Gris; this is at once a school and a laboratory of research. In the latter capacity is open all the year, and four young *savants* have by its aid been enabled to publish memoirs on various erudite subjects. The school is at present attended by about fifty pupils. The third laboratory is attached to the Botanical garden of the Faculty of Medicine, and is under the direction of Professor Baillon. Demonstrations are made also in the garden of the faculty and in the open country around Paris. There are more than 150 pupils attending this laboratory.

The geological section of the Ecole Pratique is established in the laboratory of the Faculty of Sciences, under the direction of Professor Hébert, and is divided into sections for instruction and research. This school was first opened in December, 1868, and the report upon it is drawn up so as to show the progress which has been made from the commencement. During the first scholastic year the Laboratory of Instruction was attended by 42 pupils, who were ranked in two classes; the first comprising those who already possessed considerable knowledge of geology. Fifty-three conferences took place during the year, and the pupils were admitted at all times to study and practice, after a programme drawn up by the director. Some extra conferences were also given by M. Lory, of the Faculty of Sciences at Grenoble. Numerous excursions were made under the guidance of the director in the environs of Paris and in the department of the Meuse, and a grand one in the Alps of Dauphiny, under M. Lory. In the session 1869-70 the studies were at the same place, M. Vélain, a licentiate, aiding M. Hébert: 56 conferences took place during the first half-year, devoted to a detailed study of rocks and of the principles of palæontology applied to stratigraphy; and 32 pupils were exercised in the determination of characteristic fossils. During the second half of the scholastic year, M. Hébert directed excursions in the vicinity of Paris once a fortnight, and during the Easter recess M. Vélain headed an excursion in the Soisonnais. The current year of study commenced in December, 1871, and 20 pupils attended the conferences of the early part of the first session.

The laboratory of geological research has for its basis three collections of rocks and fossils made by M. Constant-Prevost, M. Alexandre Brongniart, and M. Hébert, the last being largely increased every year. In the determination and study of the pieces forming the collection, M. Hébert is aided by M. Munier-Chalmas, geological professor. In addition to these, there is a special library, which, it should be mentioned, is open to young geologists of all countries. The principal studies made in this laboratory to the present time have been on collections made in the East, by M. Louis Lartet, and a thesis by the same gentleman on the geology of Palestine; a thesis by M. Dieulafait, on the lower lias in the south and south-east of France; on the materials collected by MM Vélain and Hollande in the Alps; on the results of his explorations of the Corbières, by M. Cayrol; a revision of the families of the Rudistes and the Trigonies, by M. Munier-Chalmas; on the cretaceous earths, with the view to a work on the chalk of Scanie, by a Swede, Dr. Lundgren; on the discovery of a large number of flowers, crustacea, and insects at Séganne, in the Marne, in the most extraordinary state of preservation, by M. Munier-Chalmas; and on the boundaries of the cretaceous and jurassic periods in the south-east of France, founded on explorations in Dauphiny and Provence, by M. Ch. Vélain.

In accordance with the decrees founding the Ecole Pratique, four pupils of the school were sent, in 1869, to make researches with respect to some obscure points in the geology of the Basses-Alpes.

The report concludes with a considerable list of memoirs, &c., published in the various scientific journals, on studies made in the laboratory.

The study of physiology is properly regarded as of great importance for the progress of the art of medicine, as well as for the advancement of the natural sciences, and no less than four laboratories have been devoted to it by the Ecole Pratique.

A laboratory for research in comparative physiology is established on an excellent footing at the Museum of Natural History, under the direction of M. Claude Bernard, member of the Institute. This establishment has enabled a considerable number of *savants* and students to pursue important investigations, and the number of memoirs, notes, and separate publications which have resulted therefrom, of which a list is given in the report, is very large. The naturalists and assistant-naturalists of the museum have sensibly taken advantage of such means of prosecuting their researches as this admirable laboratory affords. Several doctors attached to other public establishments have done the same, and with them Dr. Ossitrowski, who was sent to Paris by the Austrian government to make researches. The rest of the members principally consist of physicians, surgeons, and medical students, while one is a professor at the naval school at Brest. Once a week, experiments are made by the director and his assistants in the presence of the pupils of the school.

M. Claude Bernard also directs a similar laboratory in connection with his chair of medicine at the College de France, Dr. Ranvier being the head of the laboratory. With the exception of Dr. Duranti, of Naples, all the students here are doctors attached to the hospitals of Paris and Lyons, who have thus the grand advantage of completing their self-instruction. The number of memoirs resulting therefrom is considerable, and they relate to the most erudite subjects in physiology.

A laboratory for instruction in experimental physiology is established at the Sorbonne, under the direction of Professor Paul Bert, who executes in presence of the pupils, and causes them to repeat as far as possible the most important experiments in animal physiology. The course this year includes the phenomena relating to the composition and circulation of the blood, the chemistry and mechanics of digestion and respiration, the action of the nerves, and the duty of the various parts of the brain and spinal cord. The professor declares that three months' attendance at these conferences are of more effect in the case of attentive and apt pupils than a whole year's course of dogmatic instruction. The only regret is that this laboratory is incapable of accommodating more than ten pupils at a time

The last physiological laboratory to be named is under the direction of Professor Marey, at the College de France, and is devoted principally to researches into the mechanical phenomena of the animal economy, the flight of birds, locomotion in man, &c.

A free school of general anatomy, under the direction of Dr. G. Pouchet, was in the first instance attached to the Ecole Pratique, but this has since been converted into a laboratory of zoological histology, under the direction of Professor Ch. Robin, member of the Institute, and Dr. Poucher. This laboratory is located in the Rue du Jardinet. There are twenty-five students entered, and the laboratory is now being extended to double its original size. The exercises, which are daily, and occupy six hours per diem, relate exclusively to the comparative study of the tissues in the zoological series.

Several other laboratories have lately been opened, but the report only mentions one specially, that of comparative anatomy, under M. Paul Gervais, Professor at the Museum of Natural History. There are two sorts of pupils in this establishment:—1. Ordinary pupils, admitted during the course of study to make dissections of the human body and animals. 2. Students capable of scientific researches, and working at theses or memoirs. The young *savants* are admitted all the year round. The following are mentioned amongst the works done by them during the current year:—A monographic study of the genus of fossil mammifers, known under the name of Anchiterium, by M. W. Kowalensky, of the Museum of St. Petersburg; anatomical researches on the hippopotamus, by Dr. Alix; anatomical examination of a little-known fish, by M. Boulard; notice of a case of malformation in the human body, by M. Gripat; and anatomical preparations made for the public collections by five of the students.

M. Vulpain, another professor, directs a laboratory of research in pathological anatomy and physiology, and is assisted by two doctors, MM. Hayem and Carville. This establishment is yet but small, but it has done considerable service, and its means are about to be increased. Its special value is expressed in the following extract from the report:—"In the hospitals, practically, the autopsies are almost entirely confined to the study of anatomical alterations visible to the naked eye, and such studies are often insufficient. When the professors or their pupils desire to certify the results of their observations, and to add histological descriptions to them, they have recourse almost always to this laboratory of the Ecole Pratique. Consequently, a large number of notes or documents are produced there each year; the number of these is said to be far too large to be enumerated in the report. They are drawn up either by the professors or one of the pupil *savants*, and most of them are published in the *comptes-rendus* of the scientific societies of Paris. Eight important papers are mentioned as recently published, and ten studies of most delicate and difficult questions in anatomy and physiology are reported as proceeding at the time of the report. The many preparations required to illustrate the lectures of Professor Vulpain are also made in this laboratory.

An anthropological laboratory, founded at the Faculty of Medicine, by Professor Broca, has been also attached to the Ecole Pratique des Hautes Etudes, and that gentleman makes a long report on the researches that have been carried on there. Like the other establishments, this was closed during the siege of Paris, and its operations afterwards interrupted by the Communal insurrection; the professor and two students alone remained, and they, while death and ruin were all around them, occupied themselves with the production of models of a large collection of cerebral preparations in spirits. This valuable series, composed of more than a hundred pieces, show the cerebral convolutions of the greater part of the monkey tribe, with some other mammifers, the principal phases of development of the human brain, with a number of varieties and anomalies of the same. These models were produced after a new method, and will replace in most cases in practice the delicate and fragile preparations from which they were taken. The collections made in this laboratory from its commencement are very numerous and important, a few of the most remarkable being eleven craniums of Guanches, twenty-two skulls, and an entire skeleton of a Nubian; skeletons of an Egyptian of the eleventh dynasty, of negroes, and of a European giant; "a collection of sixteen skulls from the cavern of l'Hommemort, near Saint-Pierre-des-Tripiers (Lozère), and having belonged to a race of troglodytes, anterior to the dolmen period. The excavation of this cavern," says Professor Broca, "was commenced by Dr. Prunierès, and completed under my own eyes with the assistance of that *savant*."

The collection of skulls and skeletons is declared to be almost complete, and the dissections of all the monkeys that die in Paris are immediately placed in spirits; these dissections are also drawn, and generally coloured, and the drawings already fill several large portfolios. A library is also formed, which is being daily enriched by books and drawings from all parts of the world.

Another curious collection, conceived and carried out by the professor, consists of specimens of all the craniometrical and craniographical instruments that have been invented by *savants*, or pretended *savants;* and these instruments are placed at the disposition of all who frequent the establishment, and, amongst others, of the members of the Anthropological Society.

The laboratory is open every day for five hours, both for study and research, and the number of students has rendered it necessary to add a special lecture-room to the laboratory. In 1870, Professor Broca gave twelve conferences on the "Comparative Anatomy of Man and the Primates," and is at present holding another course. There are also other conferences and demonstrations, at which the pupils, divided in groups of six, are able to study the preparations and models at the same time.

The work in this laboratory is divided into three orders:—1st. Continued researches by the director, the preparators, and the doctors and students. 2. Studies and observations of the collections, with the aid of the instruments in the laboratory, by other persons not connected with it. 3. Examination and description of bones, deposited for a time in the laboratory by archæologists who desire to communicate the anatomical portion of their discoveries. The laboratory is, in short, open to all kinds of investigation connected with its speciality. The list of memoirs, notes, theses, and observations resulting from the operations of this laboratory is of great length and importance. The list of *savants* who avail themselves of the collections and instruments of Professor Broca for special purposes contains some of the highest celebrities in science. Scientific travellers go to the laboratory for practical instruction, and to exercise themselves in the use of anthropometrical and craniometrical instruments.

The report of Professor Broca concludes with the following paragraphs, which must be given *in extenso*, as they embrace the whole principles of the Ecole Pratique des Hautes Etudes:—

"The summary report which is given above will suffice, I trust, to show that the anthropological laboratory of the Ecole des Hautes Etudes has shown itself worthy of approbation—that it has rendered real service to science, both by the work which it has produced or facilitated as well as the practical instruction which it has instituted. I believe that to the present time this establishment is unique of its kind. There exists in Paris another anthropological laboratory attached to the chair of the Museum; some others exist in foreign universities; but these are devoted exclusively to the researches of professors and the preparations for their lectures. The pupils are not drawn to them and initiated in practical studies. In other words, there are courses of anthropology, but not schools of anthropology; and I think I have responded to the idea which presided at the foundation of the Ecole Pratique des Hautes Etudes, in making my laboratory aid, as far as possible, in the instruction of students. The Dean of the Faculty, convinced of the utility of this complementary instruction, has aided it by placing at my disposal a very convenient locality for an anthropological museum. The already important collections of the laboratory will form the nucleus of this museum, which, I hope, will grow rapidly. Through my connections with the surgeons of the navy and foreign medical men, and thanks to the recommendations of the Minister of Instruction, I shall be able to obtain large contributions. The faculty possesses a rich museum of human anatomy, and a museum of comparative anatomy and zoology sufficient for the instruction of pupils; but anthropology, which should form, as it were, the head of the museum of comparative anatomy, is only represented by the skeleton of a negro. This sad blank will shortly be filled by the activity of my collaborateurs of the Laboratory of Anthropology."

The above relates exclusively to laboratories devoted to natural science in Paris; but others have been established in the provinces. The first of these, in the order of date, was opened by the Faculty of Sciences at Marseilles, and organised by Professor Lespès. Marseilles is particularly favourably situated for the physiological and anatomical study of marine animals, and, M. Lespès having all the necessary means at his command, the result has been fully satisfactory. The laboratory has already formed two young investigators, who have given proof of their acquirement before the Faculty of Sciences of Paris, and obtained the diploma of Doctor in Natural Science. One of these, M. Moquin Taudon, a name already high in science, has produced a valuable work on the "Organisation of Mollusks of the Genus Ombrelle;" the other, M. Marion, has made a long series of researches into the structure of the nematoide worms. These works have both been published, and the latter earned one of the grand prizes of the Academy of Sciences. These facts are sufficient to attest the value of the Marseilles laboratory.

A physiological laboratory has also been established at Montpellier, under the direction of Professor Rouget, and already in 1869 and 1870 had given rise to a list of important works.

Caen, from its proximity to the sea, and being in a neighbourhood particularly rich in fossils, was selected for the site of a laboratory of paleontological zoology, of which Professor E. Deslongchamps is director. It is at once a laboratory of instruction and research. The objects of the former are set forth as follows:—1. The study of the living animal in all the branches of the animal kingdom, an example being furnished to each student. 2. The study of the principal organs of the same animals. 3. Comparisons of the various types of animals. 4. The study of the organs of respiration, circulation, and digestion. 5. The study of the nervous system in the various groups. 6. Preparations made with the aid of the lens or the microscope. The names of twenty-six students attending the laboratory are given in the report, together with four who are described as having performed or taken part in higher studies, in preparing themselves for the degree either of licentiate or doctor. The details of these latter studies and researches are given in the report.

"Other laboratories," says the report, "devoted to natural science are in course of formation in several university towns of France, but we think it unnecessary to speak of them here, as our object is to give an account only of what has been actually accomplished, in order to furnish the public with the elements necessary for the appreciation of the Ecole des Hautes Etudes, and the part which it is destined to fill in our system of superior education."

The next section of the report is devoted to the laboratories of the physico-chemical sciences. The first-mentioned is the physical laboratory, under the direction of Professor Desains, of the Faculty of Sciences, and was opened in June, 1871. From that date, 50 pupils have taken part in the instruction there afforded. The conferences take place four times in the week, and are of two hours' duration. The pupils, in the first place, are taught to perform all the experiments required in the examinations for the degrees of licentiate and doctor; afterwards they study the management of arms, and other means of projection, the phenomena of optics, and electricity and magnetism in all their forms. Photographic and galvanoplastic *ateliers* are attached to the laboratory. The number of pupils expected and arranged for was 30, but this number has nearly been doubled. Professor Desains is assisted by an *agrégé* in physical sciences, M. Branly, who superintends the work in the laboratory.

A laboratory of research only is conducted by M. Janin, member of the Institute, and professor in the Faculty of Sciences and the Polytechnic School. As this establishment is devoted solely to original investigation, the number of students is naturally not large, but the list of important works carried out and reported on in *comptes-rendus*, 30 in number, on subjects of high interest in all branches of physics, bear witness to the assiduity of the young *savants* of this laboratory.

Of chemical laboratories, no less than seven are reported on. First stands that under the direction of M. Fremy, of the Institute, professor at the museum opened in June, 1871. Out of fifty applicants forty-three were admitted, and of these fifteen were former students desiring to complete their studies. The laboratory operations take place every day, from eight in the morning till five in the afternoon. The studies are divided into three classes. 1. Young *savants* making original researches and preparing for the doctor's degree. 2. Pupils exercising themselves in analysis. 3. Pupils who, having passed through the general course of chemistry, practise manipulation in the production of classical chemical compounds. This establishment has furnished several preparators for the schools.

The chemical laboratory at the Faculty of Sciences, under the direction of M. Schutzenberger, is both a laboratory of instruction and of research, and prepares young men either for the licentiate or doctor's degree, or for industrial pursuits. It numbers this session forty-three pupils. There appear in the list natives of Bolivia, Naples, Bagdad, London, and Russia.

The laboratory at the Ecole Normale is under the direction of M. Sainte-Clare Deville, member of the Institute, and is devoted to researches of the most elevated kind. In the limited list of *savants* attending here are several professors, assistant-professors, preparators of colleges in Paris and the provinces. M. P. Hautfeuille, Doctor in Sciences and Medicines, is the sub-director.

A similar laboratory of research in organic chemistry was opened at the college of France in 1869, the first year of the Ecole des Hautes Etudes The experiments carried on here, and the memoirs published, are of the same high character as those of the preceding laboratory, and the same remarks will apply to both cases. In this laboratory there are at present two Russian, one English, and one Swiss students.

The important laboratory of the School of Medicine, which has been for nineteen years under the direction of M. Wurtz, member of the Institute, has recently been attached to the Ecole Pratique, and continues to be conducted with great energy; and its labours were not completely stopped even during the siege, when the director and the pupils that remained in Paris devoted their time to studies connected with the alimentation and defence of the city. As in the two preceding cases, the list of researches and publications is long, and filled with important subjects.

The laboratory at the College of France, under Professor Balard, of the Institute, is small, the number of students there being but twelve, but it is being augmented by means of grants from the funds of the Hautes-Etudes.

The last-named in this subdivision is the laboratory of physiological chemistry, lately established at the Ecole Normale, and placed under the direction of Professor Pasteur, of the Institute. Here the principal investigations relate to the phenomena of fermentation, the maladies of wine, the manufacture of vinegar and of beer, and the maladies of the silkworm. M. Dumas, the chemist, has for some months been pursuing his researches here.

The remaining laboratories belonging to the physical sciences are few. First, that for the practical study of mineralogy, at the Sorbonne, under M. Delafosse, of the Institute, is small, and will only accommodate twelve or fourteen students at a time, so that two courses have to be given in the year. The students, besides measuring the angles of crystals, and being inducted into the phenomena of crystalography, are practised in chemical experiments, with the aid of the blow-pipe, and are taught the industrial value of the various minerals. The students include many superintendents and masters of the lycées and colleges of Paris, and young ecclesiastics of the Ecole des Carmes.

A laboratory for chemical and agronomical research has recently been installed at Caen, with the aid of the municipal authorities, and placed under the superintendence of M. Isidore Pierre, Dean of the Faculty of Sciences.

The city of Marseilles is busily occupied with the installation of laboratories for chemical instruction and research, under the direction of M. Favre, Dean of the Faculty of Sciences, and the demands for admission are numerous. Other chief towns are following the good example.

The last division of this long list of establishments appertaining to the Ecole des Hautes Etudes is that of mathematical science. This includes two schools, or sub-divisions, the first under M. Hermité, of the Institute, and the second under M. Serret, also of the Institute. The second half of the year in the latter sub-division is devoted almost exclusively to mechanics, which pupils find great difficulty, says the report, to study without assistance.

In order to aid in the dissemination of mathematical science, the commission of the Ecole Pratique has established a *Bulletin* which replaces the old *Bulletin de Férussac.*

The mere enumeration of the most important points in this report has occupied a considerable space; but it will be admitted that the scheme of the Ecole Pratique des Hautes Etudes, and the almost unhoped-for success it has achieved, not only deserve, but demand the attention of all who take an interest in erudition and science. No such broad and general effort has been made in France, or any other country, to elevate the general standard of knowledge, and whether one regards the standing of the professors who have been selected to direct the various laboratories or departments of the new school, or the number of *savants* and students who have flocked to them, with the long lists of researches and memoirs which have resulted, it is impossible to avoid the conclusion that a grand work has been attempted, and holds forth fair promise of success.

As the supporters of the new school say, "If care be taken to nourish and guard the body and head of learning and science, the limbs will take care of themselves."

CORRESPONDENCE.

LEGISLATION AND THE HIGH PRICE OF MEAT.

Sir,—An agitation is now springing up in the centres of industry, especially in Lancashire and Birmingham, on the question of the price of butchers' meat. This is what every one must have expected who "looks an inch before his nose" (to make use of a vulgar term). Now, of all social problems this is one—if not the one—of the most vital; what can a working man do in the vitiated air of the seats of industry if he cannot get animal food? I know by painful experience that he cannot do a fair day's work and enjoy life unless he can have at least ¾lb. a day of good beef or mutton. This, as a rule, must be assumed in arguing the question; of course there are exceptions. In order to solve this problem it is highly necessary that we should appreciate the true cause, not only the direct and immediate visible cause, but also all those collateral and indirect influences which lie at the root of the cause, but which are seldom recognised even by the greatest of our statesmen. My experience is, that when I lived in a rural district, and in my daily labour could breathe the pure air, unadulterated by the smoke and chemicals out of tall chimneys, I could do a fair day's work and enjoy life on a quarter-pound per day of animal food (judiciously prepared); but when I migrated to the manufacturing districts I very soon found that a pound was nearer the mark for sustaining life and health. I will not enter into the causes which everyone sees, or thinks he sees, viz., that the butchers are the culprits, or that the farmers are extortioners. I exonerate both. I now proceed to show the real cause of butchers' meat being so near to famine prices, and I shall have to assert that in consequence of the mode of levying taxes on the transfer of commodities from nation to nation, or place to place, the landholders of this country alone are burdened with the weight of £244,800,000 odd annually; whereas, if the taxes were levied direct, £74,500,000 would suffice, and this would enable the government to emancipate the people from the burdens which the present fiscal system subjects them to. The budget that I recommend is one by the author of "The People's Blue Book," as follows:—

1. Property tax (10 per cent.)	£36,061,525
2. Personal or householders' tax, from £1 to £10 per house according to value ..	34,500,000
5. Crown lands	447,723
6. Miscellaneous	3,205,253
Cost of collecting about one million	£74,214,501

Nos. 3 and 4 are the post and telegraph profits, but the author does not consider these legitimate sources of revenue; these profits he would appropriate to the genenal good by lowering still further the price of friendly and commercial intercourse of the peeple (and would also take the railway system, and use it for the same purpose). But to return to the point (the cause) of higher prices; it is the same thing that causes these high prices in everything else as well as butchers' meat. Well, butchers' meat is the produce of the land; ten millions of acres are thrown out of the cultivation in Ireland alone through the operation of tax upon malt. This crop is not much cultivated in Ireland in consequence of the prohibitory excise duty, which makes the Irish agriculturist pay to the State £70 out of every £100 worth of barley he malts. The result is that, instead of the most economic and scientific mode of agriculture, viz., the four-course shift, in which barley would take its legitimate place (Ireland being the best barley country in the world as to soil and climate) the agricultural operations are thrown into chaos, and the best land into grass, which does not produce anything in the winter season for sustaining the quantity and quality of the stock required to feed thirty millions of people. Under the present circumstances, malt is too dear for keeping up the flesh of the animals during the winter season, because we have not only the duty of 70 per cent. to add, but also the advanced price through the non-production of about ten and a-half millions of acres. What does this loss amount to? Now, the estimate of loss was made in 1868, and evidence given by some of the best landholders and farmers in the kingdom before the committee of both Houses that "if the malt duty were abolished butchers' meat could be produced at 2d. per lb. lower price for the whole of Great Britain." Well, now, let us take the official figures as to the consumption of the United Kingdom. Say, in round numbers, the consumption of stock is eighty millions sterling per annum, and 2d. per lb. is about 25 per cent. on this eighty millions, that is a loss to the country of twenty millions, which does not benefit any class or individual in any way. The farmer does not benefit, because he can only breed, and rear, and feed so limited a quantity that he is obliged to ask £12 for what he would otherwise have to sell in duplicate at £6, say in young stock. The butcher does not benefit, because a bullock that he could once at £12 is now selling at £24, and so on. Now let us see how the farmer and the working classes are affected in the consumption of their beer by this same malt duty, in order to put a paltry seven millions into the Treasury, in fact, how all classes are robbed—by consent, perhaps, as a rule. Taking the thirty odd millions of population in the aggegate, there are sixteen millions of adults, or persons over eighteen years of age, and allow only one pint per day to each adult—say half a pint to dinner and half a pint to supper (this, I will surmise, Mr. Bremner himself would allow). This pint per day at 2d., in place of 1d., robs the country of £27,000,000 sterling per annum; and this is not much to the benefit of any individual or class. It may make a few rich Basses or Allsops, but that is all. My experience as a common brewer enables me to assert that I agree with the author of the "People's Blue Book," when he says that "a pint of good wholesome table-beer can be produced (when the malt duty is off) at a halfpenny, and leave 100 per cent. profit to the brewer, this at the strength of four barrels of beer to the quarter of malt." Well, if the brewer could get 100 per cent. profit at a halfpenny a pint, the retailer could sell it at a penny and get the same profit, barring waste. Now, if the people would only get up an agitation for the total abolition of the malt tax, which I have put before them as an illustration of how the £244,800,000 per annum goes, they would soon have meat cheap.—I am, &c.,

T. Briggs.

NEW ZEALAND FLAX.

Sir,—Casually taking up your *Journal* of 1st March, I found therein a condensed report upon the "*Phormium* Fibre, or New Zealand Flax," which concluded with the following paragraph:—

"It is hoped that a method of preparing the fibre before shipment, that will soften and divide it sufficiently fine to make it suitable for the manufacture of textile fabrics, will be ultimately crowned with success."

From this it seems you are unaware of the fact that various descriptions of cloth have been made from this fibre during the past 12 months. samples of which have been sent to the Government, New Zealand, and also to the Canterbury Flax Association; and on reference to the "Report of the Commissioners appointed to inquire into the preparation of the *Phormium* Fibre, or New Zealand Flax," which report "was presented to both Houses of General Assembly, by command of his Excellency the Governor, at Wellington, 1871," you will notice that samples of "a very strong canvas" had been received, and were being shown at the Exhibition in Wellington, New Zealand; for, notwithstanding the very adverse reports on this fibre given by practical and scientific men, many of which are set forth in the report first alluded to, and which intimate that this fibre would never be adapted for textile fabrics (*vide* letter from Secretary to Chamber of Commerce, Dundee, to Secretary Board of Trade, London, dated Dundee, 1st May, 1871, published at page 79 of report), it was not considered to be a proved fact that this fibre could not be utilised; and experiments made by those who were unwilling to believe a thing to be impossible because it had not been before accomplished, have clearly shown that, when the *Phormium* fibre has been properly cleansed and softened, it can be profitably employed in the manufacture of the various kinds of cloth, that are made from European and Russian flax and hemp. Towards the end of 1870, Mr. David Dick, a gentleman well-known in Dundee, took an immense deal of trouble for me in endeavouring to induce manufacturers to make a trial of the *Phormium* fibre which I had prepared, and at last he succeeded in persuading one firm to experiment upon it. After passing it through the first stage, the fibre was condensed, and it was considered uselesss to proceed further. Although disheartened, I was not discouraged, and through the kindness of some London friends, I obtained an introduction to Messrs. Edward Parker and Co., Dundee. By them I was made acquainted with Mr. A. K. Forbes, of Hatton Mill, Arbroath, and by the united aid of these gentlemen, assisted by Mr. Harry Roper (in the office of Messrs. E. Parker and Co), I had the pleasure to see my fibre turned into yarn. I then watched its progress through the processes of "twice boiled" and "full bleach," both of which tests it stood well; and then sat by the jute-loom in which my first piece of cloth was woven, and on 24th July, 1871, I left Dundee with this piece of cloth in my possession. Later on, through the assistance of the before-named gentleman, I obtained cloth made from yarn composed of a mixture of 75 per cent. Riga flax and 25 per cent. of New Zealand fibre, both bleached and unbleached. The *Phormium* fibre had increased the strength of the yarn. Since that time Mr. A. K. Forbes has been giving great attention to the spinning of the *Phormium* fibre, and has made yarn for Dr. Featherstone from the native dressed fibre, which has been manufactured into fine damask towelling, fairly good linen, and strong Scotch sheeting. These are at the office of the Agent-General for New Zealand, 7, Westminster-chambers, Victoria-street, S.W. From the fibre prepared by me, Mr. A. K. Forbes has made yarn, from which coarse sheeting, travelling canvas, and cloth fit for sacks has been manufactured; the latter yarn was spun from the long tow, or toppetts, taken from fibre prepared for roping purposes—which, Mr. Forbes says, was quite easy to spin, as he ventures the opinion that such fibre would prove of much value to the colonists, as with it they could manufacture their own wool-packs, or corn sacks, and ship only the long fibre, which would meet a ready sale here for roping; or, if of a very fine character, would be adapted for mixing with Riga and other flax, and so strengthen the yarn made from it.

I have some fibre now in the hands of one of the leading Belfast houses, so that I hope before long to be able to send you a statement regarding the cloth, which I am shortly expecting from Ireland. It is a great step to find that a fibre, which little more than a year ago was deemed fitted for roping purposes only—and that on high authority, too—is now likely to take its place with other fibres adapted to the manufacture of textile fabrics. No doubt, some who read this will offer the opinion that I am some enthusiastic but "idle dreamer." Nevertheless, I feel assured that when the *Phormium* fibre is really imported from New Zealand well softened, and in large quantities, some of the prejudice existing at this time, from want of a thorough knowledge of the uses of this valuable product, will be dissipated; and many who so often express their desire to obtain a new and useful fibre, but who are too timid to try experiments for themselves, will really avail themselves of the knowledge used by others, and eventually become users of it.

On the 25th June, I applied on behalf of Dr. Featherstone, the Agent-General of New Zealand, to her Majesty's Commissioners, to be allowed space to exhibit the cloths made from *Phormium* fibre in the International Exhibition; but, I regret to say, the application was considered as coming too late. Had the necessary permission been obtained, the public generally, and the manufacturers in particular, would have had an opportunity of becoming acquainted with this branch of industry, which will ere long tend considerably to the advancement of the New Zealand Colonies.—I am, &c.,

C. Thorne.

16, Mark-lane, London, E.C.,
27th July, 1872.

OBITUARY.

W. Bridges Adams.—Members and readers of the *Journal* will learn with regret of the death of Mr. W. Bridges Adams. His numerous contributions to the pages of the *Journal*, as also of papers read at the Wednesday evening meetings of the Society, must have made his name as a writer, and his ability as an engineer, known to all. Mr. Adams was born in Dean-street, Soho, in 1797, and was educated at Madeley, in North Staffordshire. He received the name of Bridges from his maternal grandfather, who was an emigrant from the then colony of Pennsylvania. His father was the principal partner in the firm of Hobson and Co., coach and carriage builders, of Long-acre, and it was in his father's workshops, and those of Messrs. Baxter and Pierce, that as a boy he received his early lessons in carriage construction—lessons which ultimately bore such abundant fruit, and aided him in developing the principles of the construction of rolling stock. As a youth he was articled to the late John Farey, and under his tuition acquired his knowledge of mechanism, and the principles and construction of the steam engine; but, being a youth of weak health, and his life being despaired of, he sought health and strength in a warmer climate. The early part of his life was accordingly spent in Chili and other parts of South America, where he was associated with the late Earl of Dundonald, then Lord Cochrane; he returned to England, at the end of a few years, in robust health and with a well-established constitution. Soon after his return he was associated with his brother in the conduct of his father's business as a coachbuilder; but, foreseeing the great influence the introduction of the railway system was destined to have upon that business, he retired from it, and established the Fairfield Railway Carriage Works, at Bow, in partnership with his brother and his son, Mr. W. A. Adams, of Walford-manor, Salop. It was at those works he first began to develop the power of steam machinery when employed in the workshop, and the examples he there set led to the introduction of much of the machinery subsequently introduced and used in some of our dockyards. It was while conducting Fairfield works that he invented the fish-joint for rails, which is now used wherever the railway system has been introduced. But railways and their appliances, though successful in use, and of great public advantage, had in their creation never been looked upon as a whole, and to correct their many shortcomings Mr. Adams set to work to improve the methods of constructing railway carriages, of applying break power, giving elasticity to tires of wheels, and radial motion to the axles of wheels; at the same time he sought for a better and more economical distribution of the metal used in the construction of the rails themselves, so as to obtain greater rigidity, and avoid destructive wear in the plant generally. Many of the plans patented by Mr. Adams are now in general use, and it is, perhaps, not too much to say that some of our metropolitan lines could scarcely be worked at the present time had his improvements not been introduced. Mr. Adams was not a man of one idea, nor did he seek to improve the railway system alone. The lessons he had learnt while visiting foreign countries led him to do much to improve the condition of the labourer and workman both at home ad abroad, and he took an active interest in all social and sanitary questions. He contributed largely to the scientific literature of the day, and was at the time of his death advocating plans for improving the construction of trading vessels and vessels used in the Channel passage, as also improved methods of constructing the tramways now being so generally introduced into our large cities; and, with a view to relieving horses from the work in which they are at present employed, he had proposed to construct a hot-air or gas engine, of small but adequate power, capable of being used in our streets, without creating dirt or refuse. In early life, as a writer, he contributed largely to general literature both in poetry and prose; and his numerous articles on sanitary, social, and industrial questions have made his name familiar to every class of readers. To the pages of the *Journal* he contributed, among many others, articles upon "Cotton," "The Culture of Food," "Fœcal Matter, its Utilisation and Transport," "The Iron Industries of Great Britain," "Men and Manufactures in the United States," "Bessemer Iron," "The application of rails for horse transit in the streets and environs of London, and also for railway branches." He advocated on many occasions the necessity for upholding and maintaining the Patent Laws. Mr. W. Bridges Adams married for his first wife Miss Elizabeth Place, daughter of the late Francis Place, of Charing-cross, the contemporary and friend of Jeremy Bentham, James Mill, Sir Francis Burdett, and others. For his second wife he married Miss Sara Fuller Flower, the gifted authoress of many poetic effusions, but none more deservedly known than the hymn, which is now to be found in almost every modern selection, "Nearer, my God, to Thee, nearer to Thee;" and for his third wife Miss Rendall, who survives him. He leaves a son—Mr. W. A. Adams—issue of the first marriage, and a son, Walter, and daughter, Hope Bridges, by the third marriage, to mourn his loss. As a political writer, his contributions were made to the public press under the signature of "Junius Redivivus;" many of his social and economic contributions were signed "Cosmos;" but, wherever and however known, his high moral worth, his integrity, uprightness, warmth of heart, and his genial nature, earned for him the sincere and affectionate regard of all.

NEW BOOKS.

Science and Commerce: their Influence on our Manufactures (*Robert Hardwicke, Piccadilly*).—This work consists of a series of statistical essays and lectures, describing the progressive discoveries of science, the advance of British commerce, and the activity of our principal manufactures in the 19th century, and is by Mr. P. L. Simmonds, editor of the *Journal of Applied Science*. In a chaste and portable volume of about 650 pages. Mr. Simmonds, who is an active member of the Society of Arts, has brought together a large amount of valuable information, which will be fully appreciated by many. The scientific discoveries of the 19th century are touched upon, and the influence they have had on our commerce and manufactures recorded in a series of comprehensive lectures. Mr. Simmonds also includes in this volume a few of the many useful papers he has read before the Society of Arts. Although he does not profess to give exhaustive technical essays on our manufacturing industries as regards successsive processes, he yet furnishes such valuable information on each of the special trades that this work will become a ready handbook of reference on the progress and position of all our trading manufactures with science teachers, the broker, the merchant, and all interested in the advance of manufactures and commerce. An examination of the various manufactures dealt with will prove the wide range the volume takes. The cotton manufacture, the woollen manufacture, the animal, mineral, and vegetable products of commerce, the silk trade and manufacture, the iron manufacture and our mineral industries, the glass manufacture, earthenware and pottery, dyes and colouring substances, manufacture of and trade in precious metals, the grocery and allied trades, tanning substances and the leather manufacture, the paper manufacture and new paper making materials, the commerce in nuts and their various uses, &c. It should be added that the statistics of the manufactures and commerce are brought down to the close of last year.

GENERAL NOTES.

International Patent System.—On Thursday, 25th ult., Earl Granville received, at the Foreign Office, an influential deputation on this subject, consisting of Messrs. R. A. Macfie, M.P.; A. Johnston, M.P.; T. Webster, Q.C., F.R.S.; Rev. S. R. Calthorp, George Haseltine, LL.D.; W. Lloyd Wise, Assoc. Inst. E.C.; T. H. Alexander, C.E.; Baron von Jeinsen, and other gentlemen. The deputation was introduced by Mr. Macfie, who, followed by Messrs. Johnstone, Webster, and others, urged upon his lordship the importance of allowing patents only to actual inventors or their representatives, and of taking steps to assimilate the patent laws of all nations, as recommended by the Select Committee on Letters Patent, in order to remove the serious drawbacks under which inventors at present labour. His lordship, who had cordially received the deputation, stated in reply that he felt some difficulty in dealing with the subject until further action had been taken by Parliament, but requested to be furnished with a written statement of the views of those present, in order that he might lay the matter before his colleagues. The deputation then thanked his lordship and withdrew.

Board of Trade Returns.—A further but more important expansion took place last month in the declared value of the exports of British and Irish merchandise, goods of the value of £20,623,621 having been exported, against £19 258,233 in June, 1871; and to this difference of £1,365,388, only £323 820 was contributed by the chief branches of the trade, and nearly all by iron, the rest being made of miscellaneous articles, such as coal, machinery, copper, paper, jute, manufactures, &c.:—

Exports in June.	1872.	1871.
Cotton goods	£4,881,020	£4,814,891
„ yarn	1,356,153	1,404.622
Linen goods	579,918	689.876
„ yarn	148.926	219.987
Silk goods	148,976	137,799
Woollen & worsted goods	2,554,773	2,460,882
Do. yarn......	369.362	525.893
Iron	3,165,167	2,539,602
	£13,204,295	£12 880.475
Other articles	7,419,326	6,377.750
	£20.623,621	£19,258,233

During the first six months this year there was an increase in the value of the exports of £17,965,834, and of £22,494,696 over the corresponding periods respectively of 1871 and 1870, as shown by the following figures:—

1872.	1871.	1870.
£119,603,804.	£101,637,970.	£97,109,108.

SCIENTIFIC MEETINGS FOR THE WEEK.

Tues. ...East India Association, 8. (At the House of the Society of Arts.) Mr. Almaric Rumsey, on "Moohummudan Inheritance."

Journal of the Society of Arts.

No. 1,029. Vol. XX.

FRIDAY, AUGUST 9, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first published subscription list amounted to £351 3s. A further list will shortly be published.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

THIRD COURSE OF CANTOR LECTURES.

SILICATES, SILICIDES, GLASS, AND GLASS PAINTING.

By Professor Barff.

Lecture I.—Delivered Monday, April 8th, 1872.

Ladies and Gentlemen,—At the present time there is a very strong feeling for the promotion of what is termed technical science. Properly understood, this is really a most important thing. Scientific researches are most interesting to scientific men, but pure science is to a considerable extent a selfish enjoyment, for when the chemist in his laboratory discovers some new body for which he is seeking, a body which makes up probably a missing term of a series—when he has discovered that body, he is filled with intense delight at his success; delight that the chain of reasoning which has led him to such experimental conclusions has enabled him to discover the missing link. He is delighted, I say, at having overcome his difficulties; but he is still more delighted because he sees the confirmation in his discovery of the theoretical reasoning which has led him to expect the result. Now this the chemist enjoys by himself, or he shares his enjoyment, it may be, with a few others, and there it ends. There may be chemists here to-night, but those who are not chemists could not participate in his enjoyment—they can know nothing about it. But when we speak of technical science, we mean the application of pure science to those arts which are useful to us, the results of which we can all appreciate, and which we can all enjoy. This institution is first and foremost, and always has been, in extending this most useful application of science. It gives me pleasure, and I feel it an honour, ladies and gentlemen, to address you as a member of this Society. The year before last, when I had the pleasure of standing here and speaking to you about artists' pigments, I was not a member of the Society, but now I am, and I can speak with a feeling of pride in which most of you, no doubt, share. There is one thing, however, we should ever remember, and it is that there must be a solid foundation for all technical science. It is useless for a person who knows a little chemistry, or a little electricity, or a little mathematics, or mechanics, to attempt to apply his knowledge to any practical purpose. I do not say that a person requires to have an extensive knowledge of any particular science in order to be able to employ it; but he must have a perfectly sound knowledge as far as it goes—a knowledge of principles. And this is what in every place where I have the pleasure of addressing those who will listen to me I advocate most earnestly—namely, that what is known should be known well, let it be but little; and that those who study any particular science with a view to applying it, should know thoroughly, as far as may be, the principles of that science.

The course of lectures which I am now going to give is entitled "Lectures on Silicates, Silicides, Glass, and Glass Painting." It is very difficult indeed, in giving a title to lectures of this kind, to give one that is thoroughly comprehensive; therefore, simply a few of the leading points have been put down in the syllabus which has been issued. If I were to speak to you about silicon or silicates, and were to omit speaking about the composition of silicates and the nature of silicon—if I were to speak to you of the manufacture of glass and not tell you the chemical reactions which take place when glass is made, I should then be doing what I have already in the last few sentences so strongly condemned. I therefore propose to devote this lecture, and possibly part of my second, to a consideration of those substances which enter into the various reactions which I shall have to speak to you about. And more than this, I shall not only have to speak to you about these elements and compounds, but I must touch upon some points of chemical doctrine—I will not say theory,—in which I will endeavour as well as I can, and in as few words and as plainly as I can, to explain to you how it is that one substance is able to take the place of another substance —under what conditions these changes take place, and and the means which are necessary to bring them about.

You will say, no doubt, that my principal object in lecturing here is to introduce the subject of glass painting. That is true, for glass-painting is a subject about which very little indeed is known. Persons have most erroneous ideas about it, and it is for the purpose of correcting those ideas that Mr. Foster has invited me to give this course of lectures. But I cannot speak to you about glass painting, so as to make plain to you what is at present little understood, without explaining to you some chemical principles. I cannot speak to you about glass painting without speaking to you on the manufacture of glass, because, as you will see in our later lectures, the manufacture of glass has a great deal, in fact almost everything, to do with the effect which is produced and made satisfactory to us by the artist in a stained glass window. Therefore I must beg of you to be patient with me if I take you, as you may think, too deeply into what may be termed the mysteries of chemistry. I could not, however, conscientiously enter upon the latter portion of my subject without first laying this foundation, on which I hope to be able to build a safe and firm superstructure. When an author determines to write a novel, the first thing he does, I believe, is to form his plot or scheme; then he arranges the incidents by means of which he is to bring about the accomplishment of his plot; and in writing his book he devotes a very large portion of the first chapter to telling you of the characters he is going to speak about. He tells you of his hero—what he looks like, whether he is handsome, or whether he is ugly, whether he is dark or fair, and he points out to you what particular traits there are in his character which he will be able, in the after portion of his novel, to bring out, and make to contribute to the accomplishment of his plot. So with the heroine, and so with the other characters he introduces. Then, again, he describes to you the places in which the various acts of his drama are to be laid, and gives you all necessary information, in order that you may be able to understand the story, and that you may be set thinking as to what conclusion he is about to draw from all these preliminaries. I must this evening adopt somewhat the same course, although I shall differ from the novelist in this, that I shall have no sentimental incidents to show you, unless, indeed, we happen to have an explosion, which I trust we shall not. My plot will be a very simple one; my characters, probably, at their first introduction to you, will appear tame; but to me they are anything but tame. To me they possess an interest as great as the interest that one feels in the characters of the most exciting romance. I fear I shall not be able to inspire you with the same enthusiasm that I myself feel on the subject; but if I can give you a little of it, so as to interest you sufficiently in my characters to induce you to become personally acquainted with them, I shall have gained a great point, and my labour will not have been thrown away, nor will it become useless.

But there is another point which I wish to mention to you in the introduction, which is this:—Chemists are accustomed to speak to one another in a particular kind of language which they have adopted for convenience sake. I am sorry to say there is not any more unity amongst chemists than there is amongst politicians, or the members of various religious bodies. On some points we are all at sixes and sevens, and we do not agree as to our nomenclature. Some use one nomenclature, and some another. I am not going to trouble you with these differences, for I mean to use as simple a nomenclature as possible. I shall call substances by their common names, and I shall not use chemical formulæ, however much I might be tempted to do so; and I have a great temptation in the subject of which I am about to treat, for I could cover a large sheet of paper from the ceiling to the ground with formulæ that would perfectly astound you, for silicates have been classed, rightly or wrongly, in many kinds of ways. I might give you these, but I will not; for, if I were to do so, you might justly accuse me of vanity. I should be raising up in your mind somewhat the same feeling which was experienced by the auditory of Goldsmith's "Village Schoolmaster:"—

> "While words of learned length and thundering sound
> Amazed the gaping rustics standing round,
> For still they gazed and still their wonder grew,
> That one small head could carry all he knew."

My object is not to make you think that I know this subject well, but it is to endeavour to impart to you as much as I can of the small quantity of knowledge that I possess. Into the composition of glass many substances enter. We have first of all elements, or simple bodies; for by the term elements chemists mean a simple body which is capable of no further subdivision into constituent bodies. We have besides elements various compounds. The first element which we have to deal with is silicon. I believe there are many of you who may never before have heard this word silicon; you have, however, doubtless heard of silica, for years ago the illustrious Prince Consort, President of this Society, caused a pamphlet to be published, which was largely distributed amongst its members, upon silicates, and therein an immense amount of information was given with respect to silica, but little or nothing was said of silicon. Now, silicon is one of the constituent elements of silica; you should know something about silicon. I think I must introduce it to you, for it is, in fact, the hero of my tale. I must introduce it to you for several reasons, not only because it is a constituent of silica, but because it has an analogy to another substance with which it is closely allied, and with which chemists have now discovered that it can by experimental means be made to change places—I mean the element carbon. I shall have to speak to you of this subject when we come to treat of silicious painting, and also on other useful applications of silicates. I must describe to you silicon, and tell you something about its properties, and must show you in fact that it really does resemble carbon. At least, I must tell you so, for unfortunately I cannot here illustrate it by experiment. Silicon is never met with uncombined in nature; it is never in the free state; it is always combined, it may be with oxygen, or it may be with some metal. When it is combined with oxygen we call it silica, or silicic acid, and when combined with metals or other such elements, then we call those compound silicides. For example, in cast-iron there is a considerable quantity of silicon, and we speak of the compound which is formed by the iron and silicon as a silicide. There are others besides this, but I will only mention those which occur in the arts. I will not allude to others which are simply subjects of curiosity to the chemist. There are also silicides of copper which I do not think have been much used, though I do not see why they should not be, because they give to copper certain properties which it does not itself possess—properties which probably may be made use of. For example, one silicide of copper is very hard and brittle, and there are purposes for which it might be employed—not where pure copper is used, for that metal is used in a great measure for its ductility. Then, again, there are other silicides of copper, made in another way, which are perfectly ductile; and here we have a change in the colour of the copper to a beautiful bronze, a property of which artists, I think, might make use; and here there is a great difference between the compounds which silicon forms with oxygen and its compounds with other elements, such as the metals which I have mentioned; and there are many other silicides, which it would occupy too much of our time to describe this evening.

How is silicon obtained? Silicon is obtained in an indirect way. I want you to understand what is meant by indirect actions, because in chemistry the union of substances takes place directly and indirectly. For example, two bodies are combined together very strongly, and we want to separate them. Sometimes we cannot get them apart directly, and what we are obliged to do is to replace one of those bodies by another, and then turn that one out and put in the one we wish. Those are what are termed indirect actions. In the case of the preparation of silicon we have to use an indirect action. We cannot get silicon from silica. We cannot tear away the oxygen from it and simply leave it. I will, later on, speak to you about potassium, and the oxide of potassium, and how potassium is obtained, and you will see that we are able to separate the oxygen from the potassium directly. Here is a white powder, it is called fluo-silicate of potassium. It contains potassium, silicon, and fluorine. These are united in certain proportions, which I need not now mention. In order to obtain silicon from this substance we add some sodium to it. The sodium takes away so much of the fluorine as will not combine with the quantity of potassium that is in the compound. The quantity of potassium in the compound, that is 39 parts by weight of potassium, will unite with 19 parts by weight of fluorine, but then we have more fluorine left, and nothing for it to combine with. If we put some of the metal sodium to it, the metal sodium will take away the remaining fluorine, and then we have the silicon left. I cannot show you the complete reaction, for it would take too long, as it is a long and tedious process, but I will show you how the reaction is commenced, for the experiment is, generally speaking, rather a striking one. Here I have some of the metal sodium, and some of this fluosilicate of potassium. If I heat these together, the sodium will melt, and when the sodium is melted, it will be at a sufficiently high temperature to do the work which I have already told you it does in this decomposition. The heat generated will be rather great, so great, no doubt, as to crack the glass tube. The action has commenced, and it goes on vigorously, and we shall soon have a portion of silicon set free. I have no doubt there are some small portions of it to be seen on the sides of the tube now; it is a greyish brown powder. The way to get all the silicon from this is to heat it to a greater extent than I have done here, and to keep it heated for some time, and then to put these particles into water—first into cold water, when a rather vigorous action will take place, and when, no doubt, some of a compound called siliciuretted hydrogen will be given off; after that it is washed with warm water, and with a little acid, and then we get silicon. Silicon prepared by this indirect method (indirect because first of all we have to replace oxygen by fluorine, and this fluorine by sodium) is a greyish brown powder. It is called amorphous silicon, because it possesses no crystalline form. If you take it in your fingers and rub it, it is smooth, like French chalk, and a little will stick to your fingers, like that substance does. When silicon is heated for some time to a high temperature it passes into another variety, which is called graphatoid of silicon. I have here another sample of silicon, which has been lent me by Messrs. Hopkins and Williams. This is crystallised silicon. It is made by putting the same sort of mixture which I had just now in my tube into a crucible with some zinc. The mixture is heated for about half-an-hour, keeping the crucible at such a temperature that it does not volatilise the zinc. Then you allow the metalto get perfectly cold, and heat it with hydrochloric acid to dissolve the zinc, or you can volatilise it by heat if you will. Afterwards you get these crystals of silicon which were imbedded in the zinc. I am tempted here to go into a very long explanation, but I must resist it, for our time is limited. I should like to tell you how it is that silicon crystallises out from metal in the molten state, as for instance, carbon or graphite does from cast-iron? I have here a very beautiful specimen of crystals of graphite, which were given to me by the son of one of the leading gentlemen in the Cleaton Moor Iron Works. It is graphite crystallised out from cast-iron. The silicon crystallises out in a similar manner from the metal zinc. But why do I allude to this? Because here we have a form of silicon which we can compare with a form of carbon which you are all acquainted with, viz., the diamond. The graphoid silicon, which I mentioned just now as being prepared by heating amorphous silicon to a high temperature for some time, we can compare with these crystals of graphite, and the amorphous silicon with charcoal. We have, then, three forms of silicon and three forms of carbon. Why do I dwell upon this? Do not stay to inquire now, but in a later lecture you will know perfectly well, for then I shall speak of the analogy between silicon and carbon, when I shall have much to say about the action of silicon and the action of carbon in nature. We can form various compounds of silicon; for example, if I were to take some of this silicon and heat it in a tube to a high temperature, and pass chlorine gas through the tube, I should get chloride of silicon formed. It is a fuming liquid that is decomposed by water. It is used in organic chemistry, because by means of it we are able to make organic compounds containing silicon—silicic ether, for instance. If we use bromine vapour we get a similar result. These experiments are not calculated for lecture illustrations. I cannot, therefore, perform them here; but I will make a substance containing silicon, which is of great interest, because it is used in art manufactures and for decorative purposes. In this flask I have put powdered glass, some fluor spar, and oil of vitrol, or sulphuric acid. The oil of vitrol acts upon the fluor spar, decomposes it, and sets free a substance which is known as hydrofluoric acid. It is a compound of hydrogen and fluorine, one-part by weight of hydrogen and 19 by weight of fluorine. As soon as this hydrofluoric acid is set free in the presence of glass, which contains a large quantity of silica, the hydrofluoric acid acts upon the glass and destroys it, as such, and a gaseous compound is formed called fluoride of silicon, in which there are 28 parts by weight of silicon and four of hydrogen. That gaseous compound will pass over from this other flask into this glass beaker, and you will see presently a white substance will be formed in it. This white substance is silicic acid, or oxide of silicon. After a sufficient quantity of it has been formed, we will pass some of this gas into this dry bottle, and afterwards some steam, and then you will see, in a more striking manner, the formation of this silicic acid, or silica. You have noticed, no doubt, the glass windows in offices and public-houses on which there are etched various patterns eaten into the glass. These patterns are all etched by a substance which is called hydrofluoric acid, or, amongst tradesmen, fluoric acid. Hydrofluoric acid is made by acting upon fluoride of calcium with sulphuric acid. I will put in this platinum dish some fluoride of calcium, or fluor spar. I will then put some sulphuric acid to it and gently warm it, and hydrofluoric gas will be given off, which will attack this piece of glass where it is not covered. It is a piece of ruby glass, and you will see, on holding it to the light, that there is a red centre. The back of the glass is coated with a substance called Brunswick black, which resists the action of hydrofluoric acid. I will put this prepared glass over the platinum dish, and the action will go on, and, in a little while, the red colour, which is only a coating on the glass, will be eaten off, and the pattern will be left white. We will then remove with turpentine the Brunswick black, and you will see a red glass with a white pattern on it. We will perform the experiment under a glass shade, because this acid is very deleterious, and if the persons using it allow it to remain on the fingers it causes on them unpleasant sores, and burrows, as it were, into the flesh.

I will now go through the reactions which take place in the formation of this silicic acid, which you have just seen precipitated, because they are reactions which take place in the ordinary occurrences of every-day life with those who are engaged in the art-manufacture of glass-decorating, glass-painting, and so forth. The compound, hydrofluoric acid, or fluoride of hydrogen, which is being made here, contains 19 parts by weight of fluorine, and one part by weight of hydrogen. When that substance comes in contact with silica, or oxide of silicon, the hydrogen of the acid unites with the oxygen of the oxide of silicon, and you get the union of fluorine with silicon forming the gas which passes over through this tube. When that fluoride of silicon, which contains 28 parts by weight of silicon and four of hydrogen, comes in contact with water, it deposits one-third of its silicon. But the silicon cannot exist alone in the presence of water. It takes away oxygen from the water, and forms that white substance, silicic acid, or silica, and in the liquid we get a substance in solution which is used in preparing potassic fluo-silicate, from which we obtain silicon. You see, then, what a roundabout journey we have to take in order to get this element, silicon.

Let me beg of you not to be frightened at this; it will gradually get plainer to you, I hope, before we have completed our next lecture. I trust you will be able to understand the principle of these chemical actions, because if there are any gentlemen here who are engaged in glass-painting, or any who take an interest in it, if they know these principles, then they will be able effectually to apply them in the improvement of their art, for at present the knowledge of artists is for the most part empirical, and they therefore do not know what results can be obtained by the application of scientific principles. I, who have had great experience in patents, having been at the Patent-office month after month looking over specifications, have been astounded to read the absolute rubbish that men put forward in many of those specifications, showing a great ignorance of scientific principles; whereas I could see that the inventors were, many of them, men of genius, who, if they had only known the scientific truths and principles which bore upon their work, would have been able to bring out results useful to us all, and the consequence would be that there would not be so many patents abandoned after considerable outlay, and patentees would not have to complain that taking out a patent is sort of road to ruin.

I mentioned just now siliciuretted hydrogen. It is a very interesting compound, among other reasons because it serves as a link to connect carbon with silicon. You have no doubt heard of marsh gas, which causes such fearful calamities in coal mines—the miners call it fire-damp. Marsh gas is a compound of hydrogen and carbon; there is marsh gas burning here in the gas burners, for it is a large constituent of coal gas. It contains 12 parts by weight of carbon and four of hydrogen. Chemists determine the composition of bodies, which they term molecular, by the vapour volume which those bodies have at a certain temperature and pressure. I am not going now to explain how vapour volumes are determined, but I want to point out to you the analogy there is between marsh gas and this siliciuretted hydrogen, and I cannot well do so without referring to the vapour volume of gases. Marsh gas occupies what is called the normal volume. Two pints of it measured under the same atmospheric pressure, and at the same temperature as two parts of hydrogen, weigh sixteen times heavier than it, and two pints of siliciuretted hydrogen weighs thirty-two times as heavy as two pints of hydrogen. In marsh gas there are twelve parts by weight of carbon, and in siliciuretted hydrogen there are twenty-eight parts of silicon, so that, you see, both gases, in equal measures, contain the same quantity of hydrogen. And so we conclude that there is an analogy between marsh gas and this hydride of silicon or siliciuretted hydrogen. Then, again, chemists have discovered another most interesting fact with regard to silicon, namely, that a body analogous to chloroform can be made, containing it in the place of carbon. Chloroform is a substance well-known to you all by name, and some of you may have had the misfortune to be put under its influence during some painful operation. It contains 12 parts by weight of carbon, one of hydrogen, and 3 times 35½ by weight of chlorine. A compound is made by passing dry hydrochloric acid gas over silicon heated to redness which is exactly the same in composition, only it has 28 parts by weight of silicon instead of 12 parts by weight of carbon. You see, then, that these facts go far to prove the analogy that exists between carbon and silicon, and that there is this analogy I wish to make clear to you, because I have much to say to you about it afterwards, in my later lectures.

On the table are some specimens of calcic fluoride, or fluor spar, the substance which we used in the platinum dish, in preparing the hydrofluoric acid. You can, if you desire it, examine them carefully after the lecture.

We now pass on to another element (I have, I fear, taken up too much time in describing my hero). I must now briefly treat of another body which plays almost as prominent a part in my story as my hero itself, and that is oxygen, and not only in my story, but in almost all the operations of nature. It may be that there are some here present who have hardly a notion of the vigour with which oxygen gas unites with substances for which it has an affinity under certain conditions. I shall, therefore, now show an experiment illustrating this. I shall not prepare oxygen gas. I have some here ready for use. These experiments may seem irrelevant, but they are not so, as what takes place when the substances which best illustrate my point—viz., carbon and phosphorus—are burnt in oxygen, also takes place when silicon is acted upon by that gas at a proper temperature, and the burning in the case of carbon and silicon will still further show you the analogy between these substances. I cannot burn silicon before you this evening, for I have not sufficient here for the purpose, and the specimen which I have shown you does not belong to me; but I will place a piece of glowing charcoal into this vessel of oxygen. You see when it is ignited and plunged into this jar of gas, it burns with great brilliancy, much more so than in atmospheric air. We will also burn some phosphorus in another jar of oxygen, and here again you notice the extreme brilliancy with which it burns, the carbon with the oxygen forms carbonic acid, the phosphorus, phosphoric, and the silicon, silicic. In the manufacture of glass, silicic acid plays a most prominent part; but there are also other elements which play parts as important. I am able, through the kindness of Messrs. Hopkins and Williams to show you two of perhaps the best specimens of these metals of sodium and potassium to be found in the kingdom. This specimen of sodium is sealed up in a tube in an atmosphere of hydrogen gas. If oxygen were present with it, it is so oxidisable that it would immediately become converted into oxide on its surface, and gradually the oxidation would extend through it, and instead of this beautiful metal you would very shortly see only a white substance, called soda. In this other tube is potassium. This has a still greater affinity, if I may use the word, but I must use it under a sort of protest—which protest I shall explain by-and-bye—for oxygen. It is more oxidisable than sodium, and you may notice the different colour of these two metals. When I perform experiments with them presently, you will also notice that the flame produced by burning the hydrogen gas in contact with sodium is different in colour from the flame of hydrogen gas burning in contact with potassium. These two metals—sodium and potassium—were both discovered, I think, by Sir Humphrey Davy. He obtained them by electrolysis, but they are now obtained in a much more ready manner. Potassium is not so easily obtained in the metallic state as sodium, for there is a considerable amount of danger accompanying the preparation of potassium, whereas the preparation of sodium is free from this inconvenience. Both of them are obtained in a similar way, and although these metals have such a power of uniting with oxygen, and form such firm and stable compounds with it, yet we are able to separate the oxygen from sodium and from potassium by means of a simple element, and we have not to go to work in the round-about way that we had to do in order to get silicon from silicic acid. Sodium is made in this way, and potassium in much the same manner, though there are slight differences in the operations, which I need not call your attention to. Sodium is made by taking dry carbonate of soda—what is called the normal carbonate, for there are two carbonates of soda, one the bi-carbonate, which has some hydrogen in it, whereas the normal carbonate contains no hydrogen. The normal charcoal is mixed with finely-powdered charcoal, or carbon. These are heated together to a tolerably high temperature, and then the metal sodium, being volatile, distils over the carbon uniting with the oxygen and carbonic acid of the carbonate of soda forms carbonic oxide. I shall have to show you an experiment by-and-bye in which I shall explain to you, and illustrate how it is that the character of the compounds formed determines the nature of decompositions which take place. At a high temperature sodium is volatile; it can be driven off in a vapour, and so it is that the chemist is able to remove the oxygen from the soda, and to set free the sodium in a gaseous state. Sodium passes over as a gas, is condensed in a cool receiver, and the cooled metal is then put in bottles under naphtha, because naphtha contains no oxygen. If it did contain oxygen the sodium would probably take the oxygen from it and become converted into soda. The difference in the manufacture of sodium and potassium is this, that the potassium has a bad habit of forming a compound with carbonic oxide, which compound is extremely dangerous, for it is very explosive, so that serious accidents are sometimes occasioned by it. Potassium is worth about 7s. an ounce, whilst sodium can be bought for about 6s. a pound. The difference in price between these substances is not all equal to the difference between the price of potash salts and soda salts in the market, but it arises, I suppose, from the danger that attends the preparation of potassium.

I will take some small pieces of this sodium, and show you with what energy it acts upon water. When I throw them on the water they begin to run about, and some of them ignite. This sodium in my hand is now oxidising rapidly, and so much heat is being evolved, that it becomes uncomfortable to hold it. I will now throw some pieces of potassium into the same dish, they catch fire immediately, and burn with a violet flame, whereas the sodium burnt with a yellow flame. The potassium burnt when it was thrown into the water, because the energy with which the potassium unites with the oxygen is so great that the hydrogen which is set free catches fire, owing to the heat which is evolved by the union of the potassium with the oxygen and part of the hydrogen of the water. The sodium is not so energetic in its action, and the consequence is, there is not sufficient heat evolved at any particular point to set the hydrogen gas which is evolved on fire. If I place this piece of filter-paper on the surface of the water, and then throw on it a piece of sodium, the gas will then catch fire immediately. That is simply because I have localised the sodium, by preventing it from running about and so distributing its heat, and, therefore, at that particular point where it has been decomposing the water, heat enough is caused to set the hydrogen on fire. In these two reactions sodium has set free half of one of the constituents of water. Water is composed of oxygen and hydrogen, 16 parts by weight of oxygen and 2 of hydrogen. I throw in potassium, and 39 parts by weight of potassium act upon the water, and set free one part of hydrogon, so that we have a compound left behind dissolved in the water, which compound contains 39 parts of potassium, one of hydrogen, and 16 of oxygen. The same thing takes place in the case of sodium, only that the weight of sodium which acts is 23 instead of 39. We have now here a liquid which is what is termed alkaline, and one of its properties is to turn red litmus paper blue. Testing it in this way with litmus paper shows we have got an alkaline liquid. The same action takes place with potash or soda, no matter which; and when I use the term soda I do not mean washing soda, because that is carbonate of soda; this is simply a compound of oxygen, hydrogen, and potassium, or oxygen, hydrogen, and sodium, and we call the one potash and the other soda. This soda and potash are both subjects largely used in the manufacture of glass. In fact, glass is nothing else but a potash salt, in which the acid of the potash salt is turned out and replaced by silicic acid. The same with soda-glass. Now, you see the necessity that I am under of explaining to you the properties of these substances before I come to speak to you about the manufacture of glass. One of the peculiarities of these substances, potash and soda, is this, that they readily unite with what are termed acids. Next Monday I shall have to speak to you about acids. I will only use the term now without explaining it, but there is one acid with the name of which I have no doubt you are all familiar, carbonic acid, which I may mention. If I were to leave this basin exposed for a night in this room, to-morrow morning it would not contain simply soda or potash, but it would contain what is falsely called soda in the laundry—carbonate of soda—and carbonate of potash. There is carbonic acid in this room; we are breathing it out now in large quantities, and it will unite with the soda and potash, forming carbonates. Here is some of this alkaline substance prepared in the same way, *i.e.*, by the action of sodium or potassium on water. Some carbonic acid gas shall be passed into it, but in the meantime I will pour into a foot-glass a little of this liquid, and show you the action of hydrochloric acid upon it. You remember that it turned red litmus paper blue. Now I will put a little hydrochloric acid to it, and we shall find that now, though there is no alteration in its appearance whatever, the two liquids having mixed together quietly without any disturbance, that the piece of blue litmus paper put into it will be turned red. The hydrochloric acid which I have put into it has neutralised the alkali, and formed what we term in chemical language a salt. I qualify the word in that way, but I cannot stay now to explain why I do so. Here, again, the same sort of thing is being done, only we are acting upon the potash here with the gaseous acid—carbonic acid—which is an acid just the same as hydrochloric acid is—I don't say the same acid, but similar in its effects. Here we shall get a carbonate formed when I add some hydrochloric acid to it. I have no doubt that effervescence will take place; but if you do not see the effervescence you can have a further proof of the presence of carbonic acid, for I have placed this tube into lime water, and whenever carbonic acid comes in contact with lime water, a white precipitate called chalk, or carbonate of lime, is formed. The alkali will take up readily this carbonic acid, and this is important for you to understand at the commencement of our course, that carbonic acid gas unites readily with potash. I shall have to show you later on that silicic under certain conditions is more powerful than carbonic acid, and sets it free again. I shall show you on another occasion that carbonic acid is able, under certain other conditions, to turn out silicic acid. The knowledge of the manufacture of glass and the understanding it depends upon grasping these principles.

Here is a strong solution of caustic soda, and here is some oil of vitriol. Pouring them together, you will see a perfect boiling going on, causing the glass to become quite hot. Here we have a union between the oil of vitriol and a portion of the caustic soda, and a substance formed which is called sulphate of soda. This sulphate of soda is one of the principal materials used in glass manufacture. For a long time it was not used, but of late years it has been. It was not used, I believe, for some time, because it was thought that the power of silicic acid was not sufficient to eject sulphuric acid from compounds with soda or potash. However, whether that was the reason or not, I am not absolutely certain. Now it is largely used, and samples of it we shall have from the Thames Plate Glass Company, as well as the other materials which they employ in the manufacture of plate-glass. This sulphate of potash is made largely in the manufacture of what is termed alkali in alkali works. Alkali is made from common table salt —chloride of sodium. This chloride of sodium is heated with sulphuric acid, or oil of vitriol. If I heat them together in a glass flask, you get this decomposition, hydro-sulphate of soda and hydrochloric acid, given off. Then, if you heat them to a higher temperature in a reverberatory furnace, in different proportions, you get sulphate of soda. That is the sulphate which is employed in the manufacture of glass. I had hoped to have gone into the composition of these sulphates more fully, but I think I have said enough to prepare you for what I shall have to say in a future lecture about them.

Now, I have only one or two more remarks to make, in conclusion. The next experiment will take at least ten minutes, and therefore I will leave that to the next lecture. I will only recapitulate and endeavour to show you how I connect together these various facts, which I have been obliged to give you in a somewhat isolated manner. First of all, we spoke of silicon and its compound with fluorine. I think I told you then why I dwelt upon that, simply because the compound fluorine with hydrogen is used in the arts, and when used in the arts acts in such a way as to set free that gaseous compound, fluoride of silicon, and that gaseous compound fluoride of silicon is decomposed, so that silica is produced, together with the substance hydrofluo silicic acid, which, when neutralised with potash, makes fluo-silicate of potash, the substance from which, in the first instance, we obtained silicon. You should know this, because, in etching this ruby glass, these decompositions and changes have taken place. If you examine this glass, you will see that a white rosette has been produced on a red ground; it looks dirty, but when cleaned properly it will be white. What has just been scraped off is the same substance as was deposited in the glass beaker at the commencement of my lecture, viz., silica. The knowledge of this fact will lead some of you, no doubt, if you practice these matters, to understand why it is that you sometimes meet with certain defects in your etching. I have often heard practical etchers say that they have a great difficulty to contend with in the deposit that takes place on the glass. They do not know at all what that deposit is. If they knew about it they would see their way pretty clearly to remedy the difficulty. There is a habit, also, of using liquid hydrofluoric acid (a solution of it in water) for etching purposes, but the best way to etch is by means of the gas—you can regulate its action much better, and you can produce an effect, when you want it, with great rapidity. By the liquid process, this etching would have taken probably three or four times as long as it has done. I have also mentioned to you the energy with which oxygen combines with various substances, because, as I told you, and as I repeat now, in my later lectures I shall have to speak to you again very often about the compound of oxygen with silicon, called silica or silicic acid; and I want you to appreciate the fact that oxygen is a most energetic and active agent. What I have said of potassium and sodium, and of their salts, is but preparatory to a further description of their uses in the art which I have undertaken to lecture upon. I must, ladies and gentlemen, leave my conclusions to future lectures, and when I draw them I will revert to these the premises on which they will be founded.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

PAPER, STATIONERY, AND PRINTING.

This division of the Exhibition is at once the largest and that which contains the greatest number of novelties, while the processes exhibited have great commercial and general interest.

From the nature of the exhibits themselves, as well as from the form and arrangements of the exhibition buildings, the sections of this division are separated from one another. The heavy machinery used in the manufacture of paper will be found in the shed near the Queensland-court, in the grounds, on the east side of the building, which also contains the *Times'* printing press and other machines; the machinery used in the various operations of working up paper into stationery, as well as the printing machines and presses—shown in action —are in the long ground floor galleries on the British, or western, side; the materials for paper making, models of paper-making machinery and apparatus, the large collection of manufactured stationery, the making of sealing-wax, striking of medals, hand operations in the stationery and fancy printing trades, as well as the splendid collection of printed work from all countries, will be found in the southern and south-eastern galleries, commencing a little westward of the dining-rooms, and extending to the entrance of the Horticultural Gardens and the French Court.

As the engineering and other trades are just now suffering severely from the high price of iron and coal, so the paper trade has been for a long time suffering, not only from the high price of the requisite materials but from their absolute scarcity. Fine rags were always a rather scarce commodity; all rags have lately become so. Esparto grass, for a time, met the enormous increasing demands of the paper-makers, and a variety of it, the Algerian *Alfa*, helped to eke out the supply, but these as yet are wild products, and many of the fields seem to be exhausted; straw is not sufficient of itself to make good paper; wood has been called into requisition with advantage; but now the grand object of the paper-maker is to find some substitute for rags and esparto grass, the only known materials which produce good and economical paper.

Considering that the diminished supply of the raw material is accompanied by the most extraordinary increase in the consumption of paper for all purposes, it will be seen that the discovery of new fibrous material, or the application of those already at hand, is a matter of great importance. This subject was well discussed at a meeting of the Society of Arts on the 20th of December, 1871. The collection of new fibres and of the pulp and "half-stuff" derived from them and from old materials, treated by improved processes, is not large, but it is well deserving of attention. It will be found in the two sections of the southern gallery, immediately adjoining the dining-rooms, on either side.

In the small portion of the gallery, west of the dining-rooms, will be found a fair collection of paper, pasteboard, &c., made from wood-fibre, together with samples of the raw material, and of the "stock" and "half-stuff" as it is rendered to the paper maker. Here, besides a few samples from British makers, will be found specimens of pulp, half-stuff, paper, pasteboards, pressing, and shawl boards, mill-boards, &c., exhibited by Messrs. Kuipuers and Company, Holland; the Rosendahls Company, Gothenberg; the Munksjo manufactory, Sweden; the Djnpafors Company, Sweden; M. Heinrich Hoebon, Germany; the Regen Manufactory, Austria; the Sörstafors Company, Sweden; Messrs. Jos. Lustig and Company, Austria; Messrs. Ullmann and Company, Prussia; Fialkowsky Brothers and Twerdy, Austria; and perhaps some other foreign manufacturers. These samples are all open to the visitors, who may judge for themselves of the quality and durability of the various specimens.

In this same room are two cases which deserve, and cannot fail to attract, the attention of the naturalist and the paper manufacturer; they contain specimens of the following Indian fibres:—Punjab flax (*Linum usitatissimum*), Rheea (*Bœhmeria nivea*), Puya bark (*Bœhmeria puya*), Puya fibre (*Bœhmeria puya*), Puya fibre softened (*Bœhmeria puya*), Nilgiri nettle (*Urtica heterophylla*), from young wood; Nilgiri nettle (*Urtica heterophylla*), from old wood; Mudar (*Calotropis gigantea*), Bedolee Sutta (*Pœderia fœtida*), Jute (*Corchorus olitorius*), Sufet bariala (*Sida rhomboidea*), Ambaree (*Hibiscus cannabinus*), Roselle (*Hibiscus sabdariffa*), Indian mallow (*Abutilon indicum*) Bun Okra (*Urena lobata*), Himalayan hemp (*cannabis sativa*), Sunn hemp (*Crotalaria juncea*), Jubbulpore hemp (*Crotalaria tenuifolia*), Dunchee (*Sesbania aculeata*), Pine-apple fibre (*Ananassa sativa*), Marool (*Sanseviera zeylamea*), Agave (*Agave americana*), great Aloe (*Fourcroya gigantea*), Adam's needle (*Yucca gloriosa*), Plantain (*Musa paradisiaca*), Screw pine (*Pandanus odoratissimus*), Screw pine leaves (*Pandanus odoratissimus*). Red bast, from Pegu; Shaw Nee, from Burmah; Shaw Young, from Burmah; Shaw Laybway, from Burmah; That Pootnet Shaw, from Burmah; branch of Nepal paper shrub (*Daphne cannabina*), bark of the same (*Daphne cannabina*).

With these are samples of half-stuff from paper made from pine-apple fibre (*Ananassa sativa*), Bun Okra (*Urena lobata*), wild Rheea (*Bœhmeria sp.*), Sunn fibre (*Crotalaria juncea*), Aloe (*Agave americana*), jute (*Corchorus olitorius*), Ambaree (*Hibiscus cannibanus*), plantain (*Musa paradisiaca*), Aloe (*Agave americana*).

These specimens of raw and semi-prepared material are accompanied by samples of paper made in England from the following fibres:—*Crotalaria juncea*, unsized and sized; *Agave americana*, unsized and sized; *Urena lobata*, unsized and sized; *Hibiscus cannabinus*, unsized and sized; *Corchorus olitorius*, unsized and sized; *Musa paradisiaca*, unsized and sized; *Agave americana*, unsized and sized; *Annanassa sativa*, unsized and sized; wild rheea, unsized and sized; and samples of Indian paper made from leaves of *Pandanus odoratissimus*, plaintain fibre, made at Meerut Jail; gunny bags, at Cuddapah Jail, (two specimens); gunny bags (second quality), Madras; refuse gunny, Madras; old gunny bags and fishing-nets; old gunny bags, Chingleput Jail; old records, at Meerut Jail; Bamboo paper, from the Nepal frontier; Bamboo paper, from Pegu; large sheet of paper, made from *Daphne cannabina*, at Nepal.

There are also specimens of paper made from Ma-Heine, from Rangoon, and from Snow-sedge (*Lepidozurma*), from Victoria.

On the eastern side of the dining-rooms will also be found samples of wood-pulp, and articles made from it, from Hanover, and some interesting collections of foreign fibres; rag and other pulps, with the chemicals employed in the bleaching of the pulp, and manufacture of paper by British exhibitors.

To the west of the first-named room will be found models of two paper-making machines—one made to the scale of $\frac{1}{8}$ and the other to scale of $\frac{1}{4}$ the real size; the motions of the former, though not the effects, being exhibited by the aid of a small turbine placed beneath the case. With the latter of the above is also a model of a beating engine for reducing rags to pulp. In the same section of the gallery is a very fine collection of paper moulds, dandy rolls, and other wire-work, upon which paper is formed, and from which it takes the peculiar grain known as "woven" or "laid," terms representing the manner in which the wire is worked, and also the water-marks which, in the case of bank-notes, form one of the greatest securities against forgery, and in other cases stamp the special make of the paper.

The machinery and appliances used in paper making must be looked for, as already stated, in the shed in the garden to the east of the building. Here will be found, and mostly in action, glass pumps for conveying pulp and bleaching liquids in paper-mills; several apparatus, one of a very costly description, for recovering pulp and soda from the refuse water; a machine for cutting up the rags, jute, and other substances used to make paper, and, lastly, an immense apparatus for boiling and washing the rags or other material. This is an extraordinary looking machine for the performance of such an apparently simple operation; a huge spherical iron vessel, nine feet in diameter, is mounted upon iron standards, and driven round by steam at the rate of one to two revolutions a minute; on one side, or rather face, of the hollow sphere is a large circular feeding hole, which, when the apparatus is charged with rags, is tightly closed by a cover. Opposite to this feed-hole is a circular perforated plate, which forms a chamber between it and the minor surface of the spherical boiler; steam is introduced by means of a pipe, which enters by one of the axes of the boiler, passes along its sides to the chamber just mentioned, in which it discharges its steam; from this chamber passes another pipe to the opposite axis of the boiler, which carries off the superfluous steam. The two central portions of the interior of the boiler, at right angles to the charge-door and pierced chamber, are furnished with between twelve and twenty iron stakes, planted in two rows, and with their points curved in the direction of the revolution of the boiler. These serve to separate the masses of rag as they revolve within the boiler. The extent of the operations of a great paper mill could not well be better illustrated than by the exhibition of such a huge and costly machine for merely washing rags.

Next to the machinery and apparatus used in the production of paper may be noticed those other machines and apparatus which are employed in cutting and finishing paper for writing and other purposes, or in forming it into those numberless objects which come within the denomination of stationery, paper, and pasteboard work. These may be seen in action daily in the western galleries, on the ground floor beneath the English fine art galleries.

One of the simplest operations in the world would appear to be that of cutting up continuous strips of paper into sheets of any given size; this is effected, in fact, in some cases, before the paper leaves the machine in which it is formed from the pulp. This arrangement is not, however, applicable to general purposes. In the exhibition will be found a large and powerful machine, driven by steam, which cuts twelve sheets of paper at a time. The paper is supplied on rolls, called in the trade "webs;" and each of these is between one and two miles long, and five or more feet in width. Frm one to six of these webs are mounted on bearings at one end of the machine, all the ends of the paper are taken together, and passed between wooden rollers, which exert the necessary amount of tension upon the paper, and carry it on to the revolving cutter bars, where it is divided longitudinally into two or more strips, according to the number of cutters, two outer cutters at the same time trimming the edges. These cutters, which divide the paper without the least apparent effort, are shears, formed in each case of two small steel cylinders, the lower edge of the face of one just overlapping the upper edge of the face of the other cylinder, whose axis is beneath. The strips thus severed from each other continue to advance till they arrive at a steel edge, when a revolving frame, carrying one or two cutters, very nicely adjusted to the fixed edge already mentioned, chops off the sheets in the most perfect manner. An advantage of such machinery is not only that several webs are cut up at a time, but also that all the sheets are of necessity perfectly rectangular, and thus there is very little waste made in after trimming, and work is turned out true and neat. But sheets of one size may be required to-day and of another to-morrow; in fact, the necessities of business may require the change to be made almost instantaneously. As already hinted, the number of longitudinal slips can be altered by adding or taking away a pair of the cylindrical scissors, but the length of the sheets to be cut off the slips is regulated by the speed of the circular cutter-frame, as compared with that of the web of paper through the machine, as well as by the number of cutting edges on the frame; the speed is regulated by a very neat adaptation of the conical pulley arrangement, in which the driving belt, instead of running awkwardly on a cone, runs on a cylindrical pulley, which expands or contracts according as a cone enclosed within it is forced forwards or withdrawn. Another feature in the arrangement is that the two cones are connected together by an endless chain, so that as one advances the other recedes, and half the time is saved in making the change. Modifications of this kind are especially valuable as objects of study for mechanicians and engineering pupils, and therefore it has been thought right to describe this one at some length; and it is almost unnecessary to say that such a motion is applicable to any machine requiring the rates of speed to be altered from time to time.

There is another kind of paper-cutting machine, of which there are three varieties in the Exhibition; these are called guillotine machines, though improperly, as they all cut with knives that have horizontal edges, whereas the guillotine knife has an oblique edge. These machines are in great use for cutting the edges of books and other similar purposes, and require to be constructed with great strength. Formerly, machines for this purpose had knives with oblique edges, but these were soon replaced by straight-edged knives, because with the latter the sheet or strip, the instant it is touched by the knife, is separated from the mass, and the friction is reduced to next to nothing. Now, the system is to give a straight-edged knife a drawing or oblique movement in addition to the vertical one; this makes the machine very effective. One, if not all, of the machines in the Exhibition can be worked with or without the oblique action. These machines cut the edges of the largest volumes as if they were made of cheese.

The stationery process, which is most fully represented in the exhibition is envelope making; and the various machines in use, and the amount of aptitude called forth for the production of this modern necessary, are well deserving of study. When the paper has been cut into sheets by the first-mentioned paper-cutting machine, it is laid between smooth millboards and metal plates, and with them passed through metal rollers under heavy pressure; this produces a fine smooth surface, fit to write upon.

The paper now being all ready, the actual formation of the envelope commences. Twenty or more sheets of paper being laid on the bed of the press, a steel cutter, the exact shape of the envelope when open, is laid first on one part of the paper and then on another, the press being brought down on the cutter each time, till the whole of the paper is cut up into pieces of the required form. The flap of the envelope is then gummed in a very simple and rapid manner, the gummed pieces being laid at the same time in trays to dry, so that the gummed parts shall not touch each other, with marvellous dexterity.

The next operation is that of folding and finishing the envelope. This is done with the aid of extremely ingenious machines, of which there are several varieties in the exhibition. Some of these machines are entirely self-acting, and others are fed by boys with the paper blanks. To the eye inexperienced in machine work the action of these machines is rather difficult to follow. In the first place, gum has to be placed on those parts which are to be fixed to each other, that is to say, the lower flap and side pieces; this done, the piece of paper is carried on to a die, the central opening of which is of the shape of the envelope when finished, and pressed down in such a way that the lower flap and sides are brought down upon each other with great precision. The envelopes when thus formed are received in a trough, in which they travel forward in close file one after the other, and may be taken up and placed in boxes, or at once made up into packets by means of small paper bands. Most envelopes, however, have to pass through other processes. One of these consists in embossing upon them crests, cyphers, or any ornamental device, with or without colour. This is done with the aid of small presses and dies, in the same manner that medals are struck. Mourning envelopes have their edges blacked before they are folded. A very ingenious little machine enables a workwoman to lay them with great accuracy, each blank covering the other entirely, with the exception of the narrow edge to be blackened, when, being held down in their places by leaden weights, the black is laid on with a brush.

There are many other interesting processes to be seen in action in this same gallery, such as the pasting of paper by machinery for card and paste-board making, the separating of playing cards from each other when finished, cutting labels and tickets by machinery, the fabrication of paste-board boxes for envelopes and other stationery by hand, ruling sheets with blue and red lines for account books, and other work by machinery. In another part of the Exhibition, near the Indian Court, a number of workpeople will be seen engaged in operations connected with the stationery trade which require no steam or other but hand power, and the application of machinery to pencil making; while in the long South Gallery adjoining the process of sealing-wax making is fully exhibited.

The South Gallery contains an immense collection of all kinds of articles that come directly or indirectly under the denomination of stationery, which has of late years taken in a wide range. The great mass of the articles here exhibited tell their own tale, but there are many important items which demand a few remarks. Commencing with the catalogue numbers at that part of this long gallery which touches the eastern side of the dining-rooms, there will be found, against the windows, an interesting collection of bank-note and other water-marked papers; a web or roll of paper about four miles in length, as supplied for the *Times* newspaper; a sheet of very superior paper called "parchment paper," supporting ten half-cwt. weights; a curious collection of papers and ornamental articles made therefrom, showing the admirable use made of paper in Japan; a little machine for showing the weight of a ream of paper by weighing a single sheet; specimens of telegraphic printing-paper used with the Morse instruments; specimens of Bank of England notes from 1699 to 1872; water-mark paper for the said notes, from 1725 to 1825. There is also a collection of specimens of paper from Russia, with a great variety of ornamental water-marks; paper for photographic purposes; articles manufactured out of paper, such as reversible lamp-shades from Bavaria; *soufflet* and other cups, much used in France, to contain delicate confectionery for evening parties, and protect the gloves of the guests from being soiled; watch-pockets, cash-bags, patterns for ladies, and even paper dresses for evening wear; foreign bonbon boxes, fans, and many other objects.

On the walls will be seen a large and good collection of tinted papers, and innumerable specimens of stamped work in the form of cyphers, monograms, and ornamental devices, illustrative of the arts of die-sinking, embossing, and illumination.

England is famous for drawing-papers, and all the materials employed in the arts, and the collection of Bristol boards, block-boards, mounts, pencils, colors, and other artists' necessaries is extensive and interesting.

Among fancy stationery, valentines occupy a large space, and the amount of fancy, invention, and labour bestowed upon these curious productions is surprising. The valentine is beginning to rival the famous Easter eggs and *étrennes* of France and other countries, and the cost of a single specimen in either case often amounts to four or five guineas, and in some cases to 100 guineas, or even more. The valentine, like the Easter egg or bonbon box, has become the mere excuse for a costly present.

The collection of photographic and other albums and scrap-books will appeal to a larger public than valentines, and there is no branch of the stationery trade, perhaps, in which so much ornamentation, some of it of the best class, has been applied. These fancy articles must, within the last few years, have afforded a vast amount of employment, especially to women, and many of the specimens exhibited are in excellent taste, and perfect as regards workmanship.

The most remarkable productions of the stationery trade, from an artistic point of view, are probably in playing cards, in the ornamentation of which much taste and great skill are employed. Many examples by the best makers will be found in the exhibition.

Another branch of the stationery trade, peculiarly English, is well illustrated—namely, that which includes diaries, pocket-books, and all that useful, time-saving class of ruled and headed books for warehouse, counting-house, and domestic purposes. This class of stationery exhibits constant improvement, and is equally remarkable for the ingenuity evinced and the comparatively low price of many of the most useful articles. Here we have good examples of the effects of machinery and mechanical aid in a common manufacture.

The collection of stationery is certainly admirably arranged, but it is greatly to be regretted that a more severe system was not adopted respecting the admission of articles. In many cases the value of the superior specimens exhibited is almost destroyed by masses of goods which have no claim whatever to admission on the score of novelty, and, in many cases, none either on that of quality. From an instructive point of view this is one of the most unfortunate errors that can beset an exhibition, and it applies particularly to the ordinary products of trade which are to be seen in shop windows. The collection of machines and processes used in the stationery trade is highly instructive, for even such as have been employed in the trade for years are new to the public generally; but nothing is to be taught by the exhibition of hundreds of sealed packets of note or other paper, with nothing visible upon them but the name of the paper, its price, and the address of the dealer.

The doorways of the galleries near the Indian Court are hung with paper curtains, which have attracted, and still attract, considerable attention, from the closeness of their resemblance to chintz, the designs being after the style of the Japanese. The fabric is not ordinary paper, the material being a mixture of various fibres, a fine description of which appeared in *Journal* 1016, p. 545.

(*To be continued.*)

The Railway Companies have determined on issuing a railway ticket, at reduced fares, to include admission to the Exhibition.

EXHIBITIONS.

Vienna Exhibition.—It is proposed to organise, during the period of the coming universal exhibition at Vienna, but separate from it, a special exhibition illustrative of the history of the city of Vienna. This collection is to be divided into two groups—the first to include plans and views of the city, and of its various quarters and most interesting edifices, prints recording the most remarkable events that have occurred there, portraits of notable persons, and engravings illustrative of the habits, customs, and fashions of various periods; the second division is to include monuments and other objects in stone, wood, and metal, historical products of Viennese industry, and medals referring to historical facts and personages of interest in connection with the Austrian capital.—The French commission appointed to the exhibition announces that it will establish at Vienna an office for the special aid of French exhibitors. The duties of this bureau will be to receive and attend to all complaints, to facilitate the stay of exhibitors in Vienna and their relations with the public there, to manage the sale of works of art and products of industry, to receive and collect monies, &c., the whole of the services of the bureau being gratuitous. No agents will be allowed to act for French exhibitors who are not authorised by the same commission.

Report on the Paris Exhibition of 1867.—The commission appointed to direct the Universal Exhibition of 1867 has lately made its final report, and has been dissolved. The following are the results now officially made known:—The total receipts amounted to a sum equal to £1,050,160, but this includes £480,000 subscribed by the State and the city of Paris. The expenses amounted to £937,000, leaving a balance on the account of £110,640, with, however, an actual cost to the State and municipality conjoined of £369,360. An association was formed at the outset of the plan to raise a guarantee-capital, which reached the sum of £412,000; but the subscribers were not called upon to deposit more than 20 per cent. of their subscriptions, and this has been paid back with interest. The balance on the account has been divided according to arrangement between the State, the city, and the guarantors, with the exception of £1,880 reserved for unforeseen expenses. There also remains in hand a sum of £1,680, due to various persons, but not claimed; this sum belongs to the guarantors.

French Provincial Galleries and Exhibitions.—The directors of the Bordeaux Museum have recently given 20,000 francs (£800) for one of the last works of the late Hippolyte Bellangé—"The Charge of the Cuirassiers at the Battle of Waterloo," which appeared at the *salon* in 1865, and at the Universal Exhibition of 1867. This work is of small size, but full of originality and power; the best picture, perhaps, that the artist ever painted. The moment selected is that when the English officers begged their gallant foes to surrender, and received in return shouts of indignant refusal, when the famous reply was said to have been uttered, "The Guards die; but never surrender!"—The authorities of the charming watering-place, Aix-les-Bains, have determined to form a museum of works of art, and have appointed the Vicomte Lepic, a well-known connoisseur, as conservator. The town has provided good rooms, elegantly decorated, for the purposes of the museum; but not having sufficient funds for the purchase of works, an appeal is made to artists and the public, which will, doubtless, be productive. The number of visitors during the season of Aix averages about 20,000, and includes many of the richest families of France and Italy, besides many of our countrymen and countrywomen, and a good gallery of pictures would be a valuable addition to the amusements and resources of the place.

Paris Municipal Museum.—The doors of the new museum, established in the famous Hôtel Carnavalet, near the Place Royale, was, it is said, to be opened on the first of August, though the announcement was not official. This museum, which was commenced some four years since, is devoted to the history and topography of the city of Paris; and the collections are already large, and rich in illuminated manuscripts, maps, plans, and old prints of all kinds, including very curious examples of the early industries of the city. The donations to the museum have been already large, and when more attention is drawn to it by publicity, there is no doubt that accessions will flow in rapidly. A considerable portion of the present contents has been derived from the municipal stores themselves, consequently thousands of interesting and important objects, which have for ages been shut up in old cabinets and corners, will not only be brought out into the light, but, by being well arranged and classified, will practically be multiplied in value a hundredfold. It is surprising that Paris has never before had its exclusive museum, but now the work is fairly commenced there is no doubt of success, or of the good effect which such an example will have on other ancient capitals and great historic towns in Europe.

Paris Exhibition of Articles of Domestic Economy.—This exhibition opened its doors, at the Palais de l'Industrie, on Sunday, the 28th of July. It was very incomplete; but when all the exhibitors have finished their installation, there is no doubt that the collection will have a certain amount of interest. Forty choral and instrumental societies gave life to the inauguration.

The New Artillery Museum, Paris.—The new Artillery Museum at the Invalides was opened on Sunday, the 28th of July. It includes a grand *salle*, devoted to arms and armour; another devoted to models; and an artillery park. At present the museum is only open on Sundays, and this is complained of as evidently insufficient.

COAL, IRON, AND LABOUR.

The following article is taken from the *Builder* of August 3rd:—

The remarkable inflation which has taken place, and which shows as yet no signs of having attained its maximum, in both the price of coal and the price of iron, will hardly have failed to recall to the memory of many of our readers some of our recent remarks on the prospects of these important industries. In January last, in considering the very unreliable and optimist report of the Royal Commission on the Coal-Supply, we said:—"There are many reasons to lead us to expect an immediate increase in the price of coal. To say nothing of the nominal increase, due to the steady influx of gold, we may remark, on the one hand, the uneasy feeling among the coal miners, and, on the other, the mode in which winning is becoming more costly and hazardous." One alternative, indeed, only presented itself to the thoughtful mind, after carefully weighing the facts that were rather obscured than brought into full light by the report above cited. The menace of the approaching diminution of our coal supply could only be counterbalanced by the no less formidable menace of increase in price. "Between the two assumptions," writes the author of an article in the *British Quarterly Review*, for the past month of July, "of the total exhaustion of all our coal by the year 1945, and of the duplication of the present price by the year 1886, lies the curve that will determine the future consumption and price of this important mineral in this country." The limiting dimensions have shown an increase more rapid even than here indicated. "During the past few months," observes a writer in the *Daily News*, "fuel of all kinds has increased in price to such an extent that serious apprehensions are now entertained, especially by those chiefly interested in domestic consumption, lest next winter should bring us a great dearth of coal, and prices so high that the whole British public will be put to no small inconvenience, and to enormous expense for fuel alone." It is reported that, almost within sight of collieries raising large quantities daily, it is often impossible to obtain supplies for local consumption, unless after considerable delay, and at prices that would have been regarded as purely visionary a few years ago. "It may be safely asserted that, as a general rule, coal of all kinds is now nearly double the price it was a year ago."

We hold it to be extremely undesirable to indulge in predictions of misfortune, or to seek either to produce or to aggravate panic. But undue optimism is a far more frequent and a far more disastrous cause of ultimate panic than is undue anxiety. We were profoundly convinced, long before the attention of the public and of the legislature was directed to the subject, of the ominous gravity of the question of our future supply of coal. We endeavoured, to the utmost of our power, to call attention to the mischievous spirit of making things pleasant which, as it appeared to us, characterised the report of the Royal Commissioners. The movement of the last few weeks has been more rapid than there was any precedent to lead any one to expect, but it is only to be encountered by looking the matter full in the face.

There are several distinct elements that influence the great augmentation in the price of coal and of iron. The general depreciation in the purchasing power of gold, not in this country alone, but throughout the world, due to the large supplies of the precious metal which are steadily poured in from the New World and the antipodes, is one important element of this rise. It is, however, an element of almost infinitesimal magnitude, if regarded as influencing sudden rise, or variation from month to month. But none the less it must be steadily regarded, not only as a definite value in the equation that we have to solve, but as one which will prevent, in any contrary rebound of the tendency of prices, their fall to the low quotations which formerly ruled in periods of depression.

More rapid, and no less certain in operation, has been the result of the time movement. Whoever may benefit by the reduction of working hours (and that great benefit may in some cases result we are not about to deny), it will not be, for the present at all events, the country at large. It is undeniable that a reduction in the hours of labour is equivalent to a reduction in the productive power of the country. We are not comparing spasmodic effort with steady work. We do not forget the result of a long experience, which has convinced us that one main reason why a French workman does so much less work in a day than an English workman is, that the former insisted on working seven days in the week, and the latter on not exceeding six; and we would give every man the means of occasional recreation; but we have gone far beyond such limits as these. We shall not be thought to exaggerate if we say that we are witnessing a general reduction of the normal working day in England from ten hours and a-half to nine hours. That is a reduction in the producing power of the country to the amount of one-sixth—a loss to England of a day in every week. Do not let us be met with the reply that more hands may be employed. One great object of the movement has been to compel the employment of more hands; but that is a consideration entirely beside the mark. Our workmen are limited in number —whether employed or unemployed. Our time is bounded by yet more rigid lines to be used or wasted. Our productive power consists of our full amount of labour of man, and beast, and machine, employed for our full amount of time. That is our power, employed or not; and the reduction of either element—by the emigration of our workmen or by the non-employment of our daylight—is a reduction to that extent of our productive power.

Another point of extreme importance to the workman, which, we think, has never been fully brought to his attention, is the following. The actual cost of labour, as we have recently shown, forms but a portion of the price at which any article of consumption is retailed; but it bears a definite relation to that selling price, whether it be two-thirds, a-half, or any other value. Let us call it a-half, which is not far from the mark.

Now, it follows that, for every increase in the labour price, a double increase takes place in the selling price. This is not matter of calculation; it is matter of fact. We have seen it in action within the past few days. Is there an advance of 1s. 6d. per ton in the winning of coal, the sellers instantly advance it by 3s. In fact, the advance of the market price of coal in London (which may be increased even during the interval between the writing and the printing of these words) may be taken at fifty per cent. already—say from 22s. to 33s., with a steady tendency towards 40s. It must not be thought that this difference goes to the miner; but it is the action of the miner which has, to a great extent, set the stone rolling. So with the ironmaker; so with the engineer; so with the carpenter; so with every combined and organising trade.

It must be evident to every workman, of every class, that any advance which he obtains in his wages must, sooner or later, be balanced by an advance all round. But he may think that, in such general advance, each trade will benefit. Let us look at that view of the case seriously.

Suppose, for the sake of illustration, a law were made by which, on a given day, the value of every coin were reduced to one-half. What would be the result? First, of course, every one who had a certain amount of coin in his possession would be the loser of half that amount. That is simple. Then, every person who had neither coin, nor engagement to pay or be paid in coin, would, at the very best, be no better off than he was before. Whether he would be worse off we will presently inquire, but in no way could his position be thought to be improved. Thirdly, the persons who were under engagements to pay or to be paid in the old coin would be thrown into a state of perplexity and confusion; and though some might for a little while appear to gain some advantage, no gross average advantage could result, and the usual distressing effects of disturbances in business relations would rapidly become manifest.

When the confusion had subsided, the following would be the result:—Every one who had a fixed income would be impoverished. Every one who had no fixed income would be free to earn what he could, but the money to pay his earnings would be diminished by great loss of custom from the persons of fixed incomes. The tradesman would re-adjust his profits. The man whose revenue is derived from his brain,—the literary man, the lawyer, the physician,—would be driven to demand higher salary or larger fees. He would suffer more than the tradesman, because it would be more difficult for him to raise his charges. The fundholder, the rentholder, the bondholder, would be mulct in half his income. With regard to a species of property which we are accustomed to regard as more solid than such artificial property as funded debt, the result would be even worse. For not only would every £100 of railway dividend be reduced to the purchasing value of £50, but the working expenses would be so increased by the rise in the price of coal, the price of iron, and the price of labour, that the dividends would be materially reduced even in their nominal amount.

Now, no one who has the slightest acquaintance with the lessons of industrial history, can doubt that a terrible stagnation in all branches of trade would follow. We have put, let it be said, an extreme case. But the principle holds good whatever be the amount of displacement of value. When such displacement takes place in consequence of great natural causes, working over long periods of time, as in the case of the increased yield of the precious metals, the whole framework of our social relations will accommodate itself by degrees to the change. But when any artificial proceeding, such as the class action of any trade or body of men, alters the natural relation of prices, the result is sure to be disastrous to some, if not to all.

Now, it is a fact, that at this time when, owing to causes which we cannot control, prices are rapidly rising everywhere, the action of organised associations is directed to the restriction, as before shown, of the productive powers of the country. It does not need any very unusual foresight to see that the result must be mischievous.

To return to the topic which now comes so closely home to every householder, to every employer of machinery, to every one who—with limited means—has to cook or to warm himself, or to raise steam for any purpose whatever. Political writers tell him not to be alarmed, to wait a little, to remember that ups and downs occur in all human events, and that as prices rise, so do they fall. "The existing state of things," says one of the writers whom we have above quoted, "will be only temporary in its character. The iron trade has been many times before in a highly inflated state, but prices have afterwards receded to an exceptionally low point." It is natural for public writers to take that tone. Many will do so from party motives alone, others from that general cheerful turn of mind which is acceptable to the public, and which we would be the last to undervalue. But it is not too much to say that all these comfortable anticipations blink those facts which we have endeavoured to bring into daylight. They lose sight of the fact that, besides those causes which fluctuate from year to year, those recurring changes which drove the price of bar iron down to 111s. per ton in 1851, and raised it to 198s. per ton in 1855, or that raised the rate of discount from 3 per cent. in June, 1865, to 10 per cent. in May, 1866, there exists now positive elements of increase in price; which the leaders of the social movement of the day are unwisely doing their utmost to aggravate.

There is, however, a mode of relief open to the consumer, whether of coal or of iron, to which it is extraordinary that public attention has not been hitherto more steadily directed. The collieries of the United Kingdom have been the pioneers of the coal getting of the world. But they do not form a larger proportion of the area of the known coal fields of the world than the pioneers of an army do to the rank and file. They cover 4 per cent.—one twenty-fifth part only—of that area. Moreover, the English coal fields have, to a great extent, exhausted their most easily-extracted beds. In other parts of the world the upper strata are still virgin. Now, of the increase which has already taken place in the market price of coal, so much occurs in the distributive process, so little goes to the miner, and so much to those who buy of the miner and sell to the consumer, that we must be near upon the limit when freight will cease to be a barrier. In other words, it will soon be cheaper, if matters go on as they do at present, to import coal than to burn our own. We will not attempt the details of a calculation at which, we do not doubt, shrewd brains and keen intellects are already at work. But we should not be surprised any morning to see an announcement of the arrival of foreign coal in our ports.* We may yet see a new meaning given to the proverb, "Carry coals to Newcastle."

From a purely philanthropical point of view, such a new feature in our trade may be highly admirable. In fact, we shall only witness the operation of one of those laws which political economy attempts to define and explain. We shall see that the level of price can no more be permanently disturbed than that of water. The barrier which keeps prices at different levels, in fact, may be said to be ignorance. As soon as the merchant is certain, or even adequately hopeful, that he will make money in a new course, his ships will steer in that direction. As soon as the speculator is clear that he will obtain a sale for a certain product, he will find the money for its development. If labour in one part of the world costs more than its proportionate value, surplus labour in other parts of the world will flow in to supply its place. If our colliers, or our iron-workers, will only work two-thirds time, and expect full pay, or more than full pay, for so doing, it is only a question of time, and of no long time either, before colliers in other parts of the world, where men are content to work full time for moderate wages, will be called into active and remunerative operation.

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* Since this was written such an incident has occurred. (See *Journal* of July 26th, p. 752).

The case of iron is even more serious than that of coal. The activity of our collieries intimately depends on that of our ironworks. The present state of the latter is unexampled. We have just seen an award fixing the price of Staffordshire bar-iron, for three months, at £16 10s. per ton; £16 are quoted for several of the best-known brands. In 1851, as we have said, the average price of bar-iron was £5 11s. per ton. During the twenty years from 1845 to 1866, the extreme fluctuations were about 30 per cent. on the highest price, which was £9 18s. in 1854. In 1861 and 1862, the price was £6 5s. per ton. Thus the present rate is exceptional. Now, in coal there is no doubt that we possess an article of unsurpassed excellence. We have, of course, all sorts. We are not speaking of everything that is black. But we have, in the best bituminous coals of the northern district, and in the pure anthracite of the Welsh basin, natural products which are respectively among the best of their kind. Secure in this excellence, we may allow inferior qualities of coal to contend in price with one another, there being always a means of balancing, more or less exactly, the commercial with the chemical or heat-producing value; and the difference in the price of labour must be considerable before foreign coal can permanently compete with English coal in our own ports. That it may, almost immediately, have the effect of reducing any undue inflation of price we have intimated; but it is a great step from that to a permanent and successful rivalry.

This is not the case with iron. We have before mentioned the fact, that it is due to moral or political reasons alone, not to commercial and mechanical reasons, that Russia has not already become the great iron mine of the world. Charcoal-made iron, of the best quality, can be produced in Russia at a less cost than inferior coal-made iron in the United Kingdom. Now, a certain amount of profit is enough to overcome almost every obstacle; that is the whole secret of the smuggler. Such a price as iron now commands in this country is almost certain, humanly speaking, to kindle furnaces in Russia. The government of that country is liberal and enlightened in matters relating to the development of the national resources. Such an opportunity can hardly fail of being seized. And there is this difference between the two industries, that of the winning of coal and that of the smelting of iron. The latter is harder to establish, but when established it takes a firmer root. The best colliery is at best but a temporary arrangement. The finest seam will be exhausted; the limit to be won from a given shaft will be reached, sooner or later. But a thoroughly well-appointed ironworks, resting for its supply of fuel on the sixty years' division of the forests within easy tramway distance of its forges, is an establishment which, when once it gets command of the market by the low price of a good brand, may be regarded as very permanent in its position.

We confess to be among those persons who believe that, as charity begins at home, philanthropy, to be genuine, must first germinate as patriotism. The neighbour whom we ought to love as ourselves need not be one of our kith and kin, but he is not a yellow or a black imaginary sufferer at the antipodes, who is no neighbour at all. It will be but little consolation for us if we hear that for a furnace blown out in Wales a better-appointed furnace is kindled in Russia. It is poor comfort to be told, if we see hundreds of our English fellow-subjects with straight backs and wan faces, that their suffering is economically active in equalising prices throughout the world. We own, in these matters, a selfish motive. We believe it to be a just and enlightened selfishness. We prefer to do good by acting, rather than contribute to possible good by suffering. We have, or had, in many important industries, the lead of the world. We do not wish to forfeit any advantage we have before it is unavoidable. We regret, and do our best to fight against, whatever in our judgment tends to throw away that advantage. We are convinced that the present tendency of artificial trade combinations for at once losing time and increasing the cost of working must handicap us in the great race. And we know that it is on the owner and producer of labour that the first brunt of misfortune will fall. It is easy for the man of capital to displace the scene of his operations. It is far more difficult for the workman to do so. In fact, when the times comes that labour is freed from local ties, and able to flow, like water, to the vacant place, prices will be close upon an universal equality. But a good deal of work, and, we fear, a good deal of suffering, must be gone through first. What we are chiefly anxious to show is, that artificial steps taken in order to raise wages and to increase the number of hands employed cannot be of any real or permanent service to the workman, but that, on the contrary, by disturbing the relations of commerce, they run the terrible risk of changing its course, and of inflicting an injury on the productive character of this country from which it may never recover.

UTILISATION OF ANIMAL REFUSE IN AUSTRALIA.

The large accumulation of bones and other animal refuse from butchers,' boiling-down, and meat-preserving establishments has created extensive factories for converting these waste products into valuable manures. The manufacture of these artificial manures is now conducted on a very large scale, and a considerable local and export trade has resulted therefrom. About eight different kinds are usually made, consisting of bone-dust, bone-meal, animal guano, superphosphates, half-inch bones, potato manure, phosphoric potash manure, and special manure for sugar and coffee. The chief ingredient in each of the above is bone, which varies in value thus:—"Green," or butchers' bones, in consequence of their containing the largest proportion of fat, reach the highest value, viz., from £3 10s. to £4 per ton. Marine-store bones consist of a mixture of household and other bones, which are picked up by collectors; value, £2 10s. to £3 per ton. Boiled or steam bones vary greatly, according to the time they are boiled or steamed. If only partially boiled, with some fat left in them, they are worth about £2 10s. per ton; if over-boiled, their value is about £2 per ton; if steamed and perfectly dry, they fetch from £2 10s. to £3 per ton. There are also the bones of sheep's heads and trotters. If collected when fresh they are worth about £2 10s. per ton; when dried, their value is reduced to £1 or £1 10s. per ton. The above quotations are subject to the laws of supply and demand; they may, however, be taken as the average ruling prices in Victoria. The next most important source for manure is the refuse of boiling-down and of meat-preserving establishments. These differ, in so far as the first contains less bone but more meat than the second. At the boiling-down works, the sheep are steamed in close vats of wood or iron, for the purpose of gaining the fat or tallow. The following plan is adopted at the Australasian Manure Company:—A large three-storey building is close to the sheep-yard, from which an inclined stage is constructed to the top floor, and up which the sheep are driven. The killing is done on this floor, on which are placed three vats for holding respectively 550, 350, and 300 carcases. When the vats are filled, steam, at 25 lbs. pressure, is forced thereinto for a period of eight hours, by which time all the fat is separated from the flesh and bones. Water is now pumped into the vat, which causes the tallow to float on the surface, and it is then run off through the tallow cock into a large cooler on the ground-floor, where it is allowed to cool, and any water or other matter to settle at the bottom. The tallow is then run into casks, care being taken that it should not be hot, and that it be well stirred before the casks are coopered-up, and also that the gravy comes off before the tallow is run in. What is left in the vat is the refuse. In the manufacture of bone manures, the bones, in whatever state they come, are hoisted by engine-power to the top-floor, where they are filled into vats and steamed. Green bones require 40 lbs. pressure of steam for three and a-half hours; dry bones, sheep's heads, and trotters from two and a-half to three hours. In all cases the bones must be turned out white and brittle. After the process of steaming, the tallow and gelatine extracted from the bones are blown off through the bottom cock. The gelatine comes out first, and is run into a large wooden tank; the tallow follows, and is conveyed into a wooden vat on the bottom floor, where it is re-boiled with a little sulphuric acid, to separate the fat from the gelatine; the latter is preserved, as it forms a valuable addition to the manure. The bones having been steamed, are drawn from the vat on to the second floor, where they lie in a heap till they become mouldy and perfectly dry, which occupies from one to three weeks. Gelatine, the principal source of ammonia, is thrown upon the heap, by which the value of the manure is enhanced. The bones are now taken to a mill, containing a pair of rollers with large teeth, by which they are partially crushed. They are then hoisted by a chain of iron buckets into the "centrifugal revolving mill," which discharges its contents into a sieve or dresser, also revolving, and allows the stuff which is fine enough to fall into a shoot, which carries it to the bottom floor, from whence it is conveyed to the store-room. The stuff which is not fine enough empties itself again into the buckets, which carries it a second time to the upper mill; and so on till it is crushed fine enough to pass through the holes on the "dresser." These vary in size for every kind of manure, but average about three-sixteenths of an inch. The bones thus manufactured yield a good saleable bone-dust. In some instances sulphuric acid is added to the dust for making the phosphates soluble. The value of this manure is £6 10s. per ton. Bone-meal is made the same as bone dust, only the holes in the dresser are covered by a fine wire gauze, which makes the meal much like flour; its value is £8 per ton. Animal guano is entirely manufactured from the refuse of the boiling-down and meat-preserving establishments, and has only to be perfectly dry to be fit for the mill. Value, £5 10s. per ton. Half-inch bones are manufactured by sending the residue which empties itself out of the dresser through a sieve having half-inch holes. Value, £5 per ton. Phosphoric potash manure, potato manure, and special coffee and sugar manures are manures of which the manufacture is a trade secret, and are scarcely important enough to be particularised. Superphosphate is an addition of sulphuric acid to bone dust. This manure is of great importance in Europe; but owing to the high price of sulphuric acid, it cannot at present compete with the home manufacture. Its value is about £10 per ton. All these manures should lie in a heap for nearly three months before they are sent out, as the natural heating process they then undergo greatly increases their quality and value. It is well, in the steaming of bones, to classify them, as the tallow of each kind of bone gives a different market value. The average price for bone-tallow is from £26 to £28 per ton, casks included. The harder and lighter the colour of any kind of tallow, the more it will be worth. The tallow from fresh sheep's heads is worth from £30 to £31 per ton. Sheep's trotters should always be steamed by themselves, or, better, boiled in an open copper by placing a steam pipe therein, and adding enough water to cover them. The oil will come to the top, and should be carefully skimmed off, and then passed through a clean cloth into casks to settle. The oil, known as neatsfoot oil, is worth about 5s. per gallon. It is used for tanning and saddlery purposes, as well as for machinery. The first exportation of bone-dust from Victoria commenced in 1865, and was valued at £79; in 1870, 3,353 tons were exported, valued at £22,691; and manure, valued at £10,303.

OBITUARY.

Francois Forster.—The famous engraver, Forster, member of the Paris Academy of Beaux Arts, whose death occurred recently, was born at Locle, in Switzerland, in the year 1790, went to Paris at fifteen years of age, and finally became naturalised in France. He won the second Grand Prix de Rome for engraving at nineteen years of age, and the first Prix five years later. He was elected a member of the Academy in the year 1844. His great ambition was the reproduction of the works of Raphael, and amongst his most important plates are "The Three Graces," "The Virgin and the Legend," and the two portraits by that artist. Of his other works the following are amongst the most famous:—"The Virgin," in bas-relief, after Leonardo da Vinci; "Eneas and Dido,' and "Cephalus and Aurora," after Guérin; "François I. and Charles V.," after Gros; "St. Cecile," after Paul Delaroche; portraits of Albert Durer and Henri IV., after Porbus, of the Duke of Wellington, after Gérard, and of Queen Victoria, after Winterhalter. Forster was an indefatigable worker, and, while compelled in his early period to stoop to ordinary work for his living, he never was without a grand subject in hand. He had studied painting as well as engraving in Paris, but found his true vocation in the latter.

Jules Schnorr.—This artist died recently, at the age of 78. He was a native of Leipzic, but studied at Vienna. From 1817 he spent ten years in Rome, generally with Cornelius and Overback, and on returning to Germany he was appointed professor in the Munich Academy, and employed by King Louis to decorate his new palace with five large subjects from the Niebelungenlied. He afterwards decorated the *Salle des receptions* with five immense paintings, representing episodes in the lives of Charlemagne, Barbarossa, and Rudolph of Hapsburg. In 1846, Schnorr—his full name, by the way, was Jules Schnorr von Karoldsfeld—was made professor at the Dresden Academy, and eventually Director of the Royal Museum there. Schnorr painted also a great number of religious works, and furnished illustrations for a magnificent edition of the Bible, for Cotta's "Nieblungen," and for other works.

NOTES ON SCIENCE.

The frequent occurrence of thunderstorms renders the observation of lightning by the spectroscope a matter of comparative facility. Mr. Procter, writing from Penrith, records in *Nature* some observations made by him during a thunderstorm in Patterdale. Among other lines in the lightning spectrum he saw one repeatedly near D_1, and about the centre of the bright yellow band between the two masses of atmospheric absorption lines in that neighbourhood. He also saw the line near *b*; besides which he repeatedly saw a continuous spectrum with bright bands, which might have been the low temperature nitrogen spectrum, although of this he was uncertain. He conceives that there is no doubt that lightning gives two different spectra, one of bright lines, and the other continuous. It is, however, possible that the latter is identical with the former, the lines being much expanded; but, so far as he has been able to perceive, he does not think this is the case. A subsequent observation causes him to doubt if the band spectrum above referred to be the ordinary nitrogen band spectrum. There is no doubt that this topic will be fully discussed at the forthcoming meeting of the British Association.

The large telescope, "The Great Melbourne," made by Messrs. Gruble, of Dublin, for the Victorian Government, is now reported to be doing valuable work in the southern hemisphere. It had much to contend against during its infancy. The reflectors, two of which were furnished with the instrument, having received a coating of shellac varnish to protect their delicately-figured and polished surfaces during the voyage to Australia, were on their arrival subjected to a kind of treatment that would cause opticians to shudder, being first treated with methylated spirit, and afterwards swabbed with water, in order to effect the removal of the protecting varnish. After this it was scarcely to be wondered at that the surface of one of the mirrors was hinted to be imperfect in respect of polish. The eye-pieces, too, were reported to have received some alterations suggested by the observer, but which, in the estimation of the makers, seriously affected their efficiency. These difficulties appear now to have all been successfully overcome, and at a recent meeting of the Royal Society, under whose auspices the telescope was constructed, it was reported that some photographs of the moon had been obtained by its means better than any of which they had previous knowledge. Some exquisite photographs of the moon, taken with this telescope before it was despatched to Australia, are for sale, at a small price, as transparencies for the magic lantern, at the shops of several philosophical instrument makers and opticians in London, and so exceedingly sharp are these pictures, that they bear to be magnified by the lantern to twelve or fourteen feet in diameter.

Microscopists will be glad to learn that the capabilities of the microscope have been greatly developed of late. Mr. Wenham, whose invention of the binocular microscope, and whose improvements in the construction of object-glasses have afforded so great facilities for microscopic research, has, for the past few months, been engaged in a further simplification of the object-glasses of this instrument, especially those of the higher powers. The great improvement formerly effected by Mr. Wenham consisted in substituting a single lens for the triplet which had hitherto formed the anterior element of the three combinations which went to form a first-class microscopical objective. The anterior glass had its aberrations corrected by the centre one, which was over-corrected for this purpose. In this way the anterior lens, or group of lenses, was reduced by four surfaces, one element now taking the place of three, the errors of construction being reduced in a corresponding degree. Mr. Wenham's more recent efforts have been directed to a still further simplification of the objective, and he has now succeeded in doing with the posterior element of the combination, which up to this time has also been a triplet, what he formerly did with the anterior one—viz., discarded two of the lenses of which it was composed, and making a single lens answer instead. Thus, by having a single front and back lens, a great degree of simplicity has been imported into the construction of object glasses, with a decided improvement in their defining powers, the result of which will be that not only can they be constructed at a lower price, but with greater excellence than heretofore. Mr. Wenham has also just introduced a mode of illuminating opaque objects, so as to permit of their being examined with the highest powers of the microscope. The light from the mirror is transmitted through the usual sub-stage condenser, but between that condenser and the object there is placed a small cylinder of glass, one side of which is so bevelled that the rays which pass upwards are reflected away to one side, and enter the slide in a very oblique manner. Some of these oblique rays are transmitted upwards through the slide and are lost; others, however, are reflected from the surface of the thin glass cover, and thus illuminate the upper side of the object. It will thus be apparent that as the object is illuminated from below, an object glass of the shortest possible focus may be used. Hitherto the examination of opaque objects has been conducted with low powers; by this invention the highest powers now constructed may be used.

Various expedients have been had recourse to in order to neutralise the vapour of mercury, with which it is now well known every part of the atmosphere in rooms and workshops where operations requiring mercury are conducted is saturated. In even the best ventilated establishments for silvering glass, the skin, hair, beard, and clothes of the workmen are thoroughly impregnated with these invisible fumes. To neutralise the vapour of mercury, sulphur vapours have been proposed, and, to some extent, used, the two vapours combining, and forming a third innocuous compound. As experiments conducted with these vapours have proved fatal when applied to some of the lower animals, it is now proposed to substitute chlorine for the sulphur formerly used. The most convenient way to apply this element is to sprinkle chloride of lime over the floor of the room infected, when the chlorine will immediately combine with the mercury, forming sub-chloride of mercury, or calomel. It is believed that the very small quantity that would be formed would have no ill effects on the lungs of those who breathed an atmosphere containing such an amount of mercuric chloride, but experience will be required to decide this point.

An invention, or more properly a new application of a well-known fact, has recently been patented in America. The originality of the special application will strike most readers. Every person knows that when an electric current is transmitted through a fine platinum wire, the wire becomes red hot. The patent in question is for the utilising of this principle for the purpose of cutting wood. Hence we may now have the sawing of timber effected without a saw. Dr. Robinson, the patentee, was led to this novel application of electricity by observing the facility with which a platinum wire, when raised to a white heat, effected the removal of tumours, and cut its way into the living flesh. It is anticipated that by means of this invention, which requires only a simple quantity battery, trees will be felled and divided into logs, and other operations of a similar nature performed.

GENERAL NOTES.

New Zealand Flax.—In the letter of Mr. Thorne's, published in the *Journal* last week, the word "condensed," in line 13, p. 763, should have been "condemned," and the word "travelling," line 41, should have been "towelling."

Telegraphic Education.—The directors of the telegraphic lines of France have recognised the absolute necessity of improving the theoretical and practical knowledge of its clerks, and with this view elementary courses of telegraphy have been arranged in all the chief towns, at which the attendance of the employés is obligatory. In addition to this, a superior course of instruction is to be opened in Paris, and those clerks who have most distinguished themselves in the provinces will be sent to the capital to complete their instruction. The courses are all to commence on the first of October.

Sir Richard Wallace has, it is said, offered to erect fifty drinking-fountains in the city of Paris, and has sent photographs of the model prepared for the purpose to the Municipal Council.

Economy in the Consumption of Coal.—A correspondent of the *Builder* says:—"Will you allow me to ask some of your readers in the cooking-stove line, if it would not be possible to retain and utilise the large amount of gas usually allowed to go up the chimney? I confess that I do not understand all the process of gas-making, but it strikes me that the coal burned in an ordinary kitchener ought to light the house; and if any one would produce a stove to accomplish that end, I think his fortune would be made."

The Colony of Victoria.—Further returns of the census of the colony of Victoria, taken on the 2nd of April, 1871, have been laid before the Parliament at Melbourne. From them it appears that, of the total population of 731,528 in the colony on that date, 401,050 were males, and 350,478 were females; the Chinese numbered 17.905, of whom 17.899 were males and 36 females; and the aborigines 1,330, of whom 784 were males and 546 were females. There were 150.618 occupied and 6,997 unoccupied habitations in the colony, and 866 in course of erection. Since 1861 the males increased by 22 per cent., and the females by 56·13 per cent. The number of electors of the Legislative Assembly electorates is put down at 127.568, and of the Legislative Council electorates at 22,368. The population in the cities, towns, and boroughs was 374,150, the males exceeding the females by 6,700. The increase of population in the mining districts since 1861 is 42,247. There were 38.588 occupiers of land, who held 36,928,104 acres, of which 28.694,312 were returned as rented from the Crown, and 1,853,404 as rented from private persons; while the freehold occupations were returned as amounting to 6,380,388 acres. Nearly 20,000,000 acres were still unoccupied. There were under cultivation 804,508 acres. The number of holdings from 1 to 5 acres in extent was 5.595; from 5 to 15, 4.770; from 15 to 30, 4,253; from 30 to 100, 10.112; from 100 to 350, 9,795; and from 350 to 1,000, 2,574; and there were 51 holdings of 100,000 acres and upwards, containing 11,294,150 acres. Of the 804,508 acres under cultivation 646,326 were in holdings from 50 to 1,000 acres in extent. The proportion of the gross area of land under cultivation to the gross area in occupation was 2·18 per cent. There were in the colony—209,025 horses, 212.193 milch cows, 564.534 other cattle, 10,477,976 sheep, 188,109 pigs, and 122.164 goats. The live stock numbered 6,641,023 in 1861, and 11,643,837 in 1871. Between the two periods the number of sheep was almost doubled, having been 5,780,806 in 1871. The increase in cattle has not been very marked. Horses and pigs have increased in even greater proportion than sheep. The number of geese was 83,025, of ducks 137,355, of fowls 1,636,782, and of turkeys 62.756. The table showing the religions of the people gives 257.835 Episcopalians (including 5,997 Protestants not otherwise defined), 112.983 Presbyterians, 94.220 Wesleyan Methodists, 18,191 Independents or Congregationalists, 16.311 Baptists, 10,559 Lutherans and German Protestants, 3.540 Christians (Church of Christ), 93 Moravians and United Brethren. 1,432 Calvinists and Calvinistic Methodists, 333 members of the Society of Friends, 1.016 Unitarians, 1,028 other Protestants, 170,620 Catholics (including 3,152 Catholics not otherwise defined), 278 Catholic and Apostolic Church, 332 Greek Church, 285 Israelites and Christian Israelites, 97 Mormons or Latter Day Saints, 3.571 Jews. 18,392 of other sects (including 17,650 Pagans), 2,737 of no denomination, 2,150 of no religion, 5,560 unspecified, and 9,935 who objected to state their religion. From the table showing the birthplaces of the people it appears that 329,597 were born in Victoria, 28,669 in other Australian colonies and New Zealand, 164,287 in England, 6,614 in Wales, 56,210 in Scotland, 100,468 in Ireland, 3,870 in other British possessions, and 16,637 in Continental Europe and the French colonies (of whom 8,995 are from Germany).

The Euphrates Valley Railway.—The report of the Select Committee appointed to examine and report upon this subject has been issued. The Committee state that the evidence which they have taken has satisfied them that there is no insuperable obstacle in the way of the construction of a railway from some suitable port in the Mediterranean to some other suitable port at or near the head of the Persian Gulf; that there is more than one port which might be selected at either end of the line; that there are several practicable routes; that there would be no difficulty in procuring the necessary supply of labour and materials for constructing a railway; and that there need be no apprehension of its being exposed to injury by natives, either during the process of its construction or after it shall have been completed. They find, too, that there is reason to expect the sanction, if not the active concurrence, of the Turkish Government in any well-conceived project that may be presented to them. The Committee have arrived at the conclusion that there is no probability of any line being constructed by unassisted private enterprise, but they observe:—"There can be no doubt that if the Government of England were to give its support, in the form of an adequate guarantee, the Turkish Government would give its general countenance to the undertaking, whatever might be the route that was chosen. It is the opinion of many very competent witnesses that it would be worth the while of this country to give such a guarantee, even though it should involve a considerable pecuniary sacrifice. Others are of a different opinion; and, though admitting that England would derive certain advantages from the opening of a railway through Mesopotamia, do not consider that these advantages would be of sufficient importance to justify a serious national expenditure." The committee quote a correspondence laid before them by Sir George Jenkinson, which took place between that gentleman and Musurus Pasha, from which it appears that the Turkish government would be disposed to entertain favourably any proposal which her Majesty's government might make for the construction of a railway under the control of a mixed committee appointed jointly by the two governments, with funds to be raised by a loan contracted by the Turkish government, and partially guaranteed by the government of England. The Committee are decidedly of opinion that, if any steps are to be taken towards the construction of a line, the best course will be for her Majesty's government to place themselves in communication with the government of Turkey, with a view to some arrangement of the nature proposed. They think that £10,000,000 would cover the expenses of the shortest route proposed. In conclusion, the report says:—"Speaking generally, your Committee are of opinion that the two routes, by the Red Sea and the Persian Gulf, might be maintained and used simultaneously; that at certain seasons and for certain purposes the advantages would lie with the one, and at other seasons and for other purposes it would lie with the other; that it may fairly be expected that in process of time traffic enough for the support of both would develop itself, but that this result must not be expected too soon; that the political and commercial advantages of establishing a second route would at any time be considerable, and might, under possible circumstances, be exceedingly great; and that it would be worth the while of the English government to make an effort to secure them, considering the moderate pecuniary risk which they would incur. They believe that this may best be done by opening communications with the government of Turkey in the sense indicated by the semi-official correspondence to which they have already drawn attention."

The Joiners' Company and Technical Education.—The prizes awarded to the candidates in the competitions organised by the Joiners' Company were distributed at a court, held at Guildhall, on Thursday, the 1st inst. The master, Mr. J. Johnston, jun., presided; and the wardens present were Mr. Wynter, jun., and Mr. H. L. Phillips. In presenting the first prize to Mr. W. Hodges, of the Spitalfields School of Art (for original design), the master said he had to express the gratitude of the court that such beautiful specimens had come before them. They had offered these prizes to induce those who were training for skilled trades to do all in their power, not simply to raise themselves to distinction in their own branch of art, but to raise the national character. The other prizes from this school were to Messrs. T. Russ and W. Shuter. The first prize, in building construction, was awarded to Mr. W. G. B. Lewis, student at the Charterhouse School of Art for two and a-half years. These designs were sent by ten students. The other prize for this school was gained by Mr. F. Ansell. There were three prize-takers from the Birkbeck School of Art, Messrs. T. V. J. Sennett, W. H. Sweet, and R. C. Miller, the latter being for mouldings applicable to ceilings. The prizes consisted of books on architecture and cases of mathematical instruments. The master addressed a few words of encouragement to the candidates on their leaving. He said it would be for them to show to all around that they were industrious and persevering, and would make the best of surrounding circumstances. Nothing good and nothing great could be achieved without these qualities. They should show they were determined not to "scamp" their work, but raise each one his branch of industry in the eyes of the world. Mr. Bedford thanked the master for distributing the prizes, and said that he himself had never felt prouder of their old company than now, when he saw it engaged in the work of that day. The master replied, hoping that all succeeding masters would take as great pleasure in such a work as he had. He thought that they were well carrying out in it the principles on which that company was formed.

Trade of Monte Video.—Consul Monro, in his report on the trade of Monte Video for the year 1871, which has lately been issued, states that with the constant means of communication with Brazil, Europe, the United States, and the Pacific ports which the Republic now enjoys, affording abundant markets for its produce, with plenty of individual capital, and no want of men of talent and practical experience to carry out enterprise, uniting the advantage to the country with their own, it is truly deplorable that party interests should paralyse its resources and prevent its prosperity. As an illustration of the employment of capital directed by practical talent, he takes the example of the important establishment of Liebig's "Extractum Carnis," at Fray Bentos, on the river Uruguay. This business has exported, in the eight months of the working season of 1871, 570,000 lb. of the essence of meat, produced from the slaughter of 122,075 cattle, and of the value of £330,000. It has also, in addition to the principal object of exportation, sent away 124,000 hides, 300,000 horns, 1,000 tons of bones, 6,252,000 lb. of jerked beef, 2,000 tons of tallow, and 25 tons of hair, besides a great variety of other Saladero produce. The amount of salt used in these works in the season was 3,000 tons, and the consumption of coals 3,000 tons. The number of ships employed in the exclusive carrying business of the company was 52 in the year 1871. An English enterprise at Colonia, a small port of the Republic, has comcommenced (the past year) the exportation of meat preserved in the same manner as the Australian preserved meat, of which about 1,000 cases, containing 72 lb. each, have been sent to England, and if sold at the rate of 4d. the pound, will, it is said, be a remunerative trade to the exporter. The experiment of exporting live cattle to England has not been repeated, the mortality suffered on the voyage from overcrowding having rendered the venture an unprofitable one, though, with properly adapted steamers, it is still believed that the trade would succeed, and it is probable the experiment will be repeated when the state of the country will admit of the gathering the cattle with greater safety.

Topography and Antiquities of Paris.—A few years before the fall of the Empire, Baron Haussmann commenced the compilation of a complete history, geological, topographical, and antiquarian, of the city of Paris, and ten or eleven volumes, containing the topography of old Paris, the history of important manuscripts, and the geology of the Seine, were published before the breaking out of the war. It is now proposed to complete the work, which, it is estimated, will make forty or more volumes, and cost between three and four thousand pounds. The mass of materials is very large, as the work is to include, in addition to the topography and history of the city, the seals, arms, insignia, liveries, and other memorials, from the earliest date to the present day. It is highly creditable to the authorities, who, surrounded with difficulties of all kinds, thus find time and money for the completion of historical and artistic records like the work in question.

Technical Instruction and Protection.—The *Chicago Tribune*, of the 8th July, has the following:— "A generation ago it was our boast that American working-men were the best educated, and hence the most skilful, artisans in the world. The child who has grown to manhood since then has seen them outstripped, in one speciality after another, by their Prussian, and French, and Dutch, and English rivals. The latter are now fearful that they may fall behind their Continental competitors. They are founding and endowing technical schools, after the German model. In these a boy is taught the rudiments of an education, and is then, at a very early age, put into practical training for some particular trade. If the English think that they are behind others in the progress of industrial knowledge, it is evident that we are a score of years behind them, and, weighted with the purblind policy of protection, have the least provision for the education of artisans in Christendom. The men themselves have done what they could; but when technical schools are not, and protection is, what can they do?"

The Conservatoire of Paris.—The male and female pupils of the pianoforte class, *classe de l'étude du clavier*, especially for execution, compete with each other, which is not the case in most of the classes of the conservatoire. This is one of the most important and largest of the classes; and, this year, the female pupils have carried away the whole of the prizes. There were 29 competitors in all, and 11 medals. The occurrence of the annual examinations has brought out the following history:—Last year M. Delle Sedie resigned his professorship in the Conservatoire, and a singing-class, composed of six or seven female pupils, was offered to Madame Pauline Viardot, and accepted without hesitation, at the desire of M. Ambroise Thomas. At the last quarterly examination, six weeks or so before the public competitions, Madame Viardot sat down to accompany her pupils, who, after going through their exercises to show the mechanical proficiency attained, attacked some of the finest morceaux of Gluck and Handel, but principally the latter. The committee were enthusiastic at the success of Madame Viardot's teaching, but the lady professor asked as a special favour that her pupils should not compete this year, as she did not wish to see them leave the Conservatoire until both their execution and style were perfected. There have heretofore been many complaints of the insufficient teaching in these and other classes, especially as regarded the selection of the pieces placed before the pupils; and it is evident that Madame Viardot is quite determined that such things, if said in future of her class, shall not be true. The examining jury perfectly concurred in the views of Madame Viardot.

Journal of the Society of Arts.

No. 1,030. Vol. XX.

FRIDAY, AUGUST 16, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

SHIPS' LIFEBOATS.

The Council have received and approved the following report of the Committee appointed to consider the models sent in competition for the prize offered for Improved Ships' Lifeboats, consisting of—Major-General Eardley-Wilmot, R.A., F.R.S., Chairman of Council; Vice-Admiral Sir Edward Belcher; Right Hon. G. J. Goschen, M.P.; Mr. Thomas Gray; Lord Henry G. Lennox, M.P.; Mr Richard Lewis; Captain Nisbet; Vice-Admiral Ommanney, C.B., F.R.S.; Mr. E. J. Reed, C.B.; Admiral Ryder, C.B.; Mr. Seymour Teulon; Captain Toynbee; Capt. Ward, R.N.; Lieutenant C. P. Wilson, and Captain H. Tyler.

The actual trials of the boats built in accordance with the selected models took place on the 31st of July, in the Regent's-canal Docks, Limehouse, in the presence of Mr. Thomas Gray, Captain Nisbet, Vice-Admiral Ommanney, C.B., F.R.S., Vice-Admiral Ryder, C.B., Mr. Seymour Teulon, Captain Toynbee, Captain Ward, Lieut. C. P. Wilson, R.N., and Major-General Eardley-Wilmot, F.R.S. At a subsequent meeting of the Committee the following report was unanimously agreed to:—

The Committee on Ships' Lifeboats have now to make their final report and recommendations to the Council of the Society of Arts.

Before proceeding to estimate the relative degrees in which the five competing lifeboats meet the pre-arranged requirements, the Committee beg to observe that the trials on the 31st July sufficiently established the following rules for their guidance:—

1. That to meet the first requirement above referred to, viz. sufficient buoyancy to be manageable after being filled by a heavy sea, it is indispensable that a much larger amount of extra-buoyancy, by enclosed air, be provided than exists in ordinary ships' lifeboats at the present time.

2. That to meet the fifth requirement, viz., lateral stability, and also to promote steadiness in a heavy sea, it is indispensable that as large an amount of that buoyancy be distributed along the sides of the boat as is compatible with the efficient management of the oars and ample accommodation for passengers.

3. That, for similar reasons, to give longitudinal stability, and prevent the water shipped in a heavy sea from rushing to either end of a boat, and thereby submerging it, as large an amount as is practicable of end-buoyancy should be provided.

4. That, in order to check as much as possible the motion of all water, and to confine it in the centre of the boat, where, to a great extent, it acts as ballast, and promotes steadiness, the inner sides of the side and end cases or compartments should be perpendicular.

5. That, arising from the foregoing conclusions, if a lifeboat be expected to meet the 3rd requirement, viz., "fitness for ordinary use," the Committee consider that it should be attained, not by either omitting or reducing in amount the side air-buoyancy, but by having it contained in portable water-tight cases or boxes, conforming to the shape of the boat's sides, and fitting close to them, and so fitted that they might be readily and quickly removed should the boat be required to carry cargo when in harbour, and as easily and quickly replaced on a vessel proceeding to sea, in readiness to meet any sudden emergency, such as wreck, fire, collision, or the springing a leak.

6. Lastly, the Committee are of opinion that, although necessarily at an increase of cost, they see no difficulty in vessels of every size, from the small coaster to the great ocean steamer or clipper ship, being provided with boats adequately possessing all the requirements originally laid down by them. And they earnestly hope that the Board of Trade, in fulfilment of the trust committed to it by the "Merchant Shipping Act," and looking to the importance of the subject, may feel able to enact some rules, such as the enforcement of a given proportional amount of side and end air-buoyancy in water-tight portable cases, as compared with the width and length of a boat, so as to effectually secure to all who travel on the seas in British vessels really efficient lifeboat protection.

The Committee now come to the consideration of the special qualities of the competing boats, and to the assignment of the two medals offered by the Society.

The five competing boats naturally fall under two heads: the three larger ones, viz., those of Messrs. Woolfe and Son, Messrs. Hamilton and Co., and Mr. White, being essentially passenger lifeboats; whilst the two smaller ones, viz., those of Captain Nisbet and Hamilton and Co. (No. 2) are mere dingies, and can only be considered suitable for the smallest class of coasting vessels.

The distinction, however, is only one of size, since the trial of these boats has shown that to be worthy of the name of lifeboats, capable of contending with a heavy sea, the full proportional amount of side-buoyancy, is even still more necessary in the smaller boats than in the larger ones; and the same principle being common to all, the Committee have only to decide on the best design which will at once be applicable to lifeboats of all sizes and for all classes of vessels, which it is evident much simplifies the question of selection.

The two boats which rank first as regards the seaworthy requirements of extra buoyancy, lateral stability, and steadiness in a sea-way, are those of Messrs. Woolfe and Messrs. Hamilton and Co., which are nearly on a par. The former having $20\frac{1}{4}$ inches and the latter $20\frac{1}{2}$ inches free-board with crew on board and water admitted to the outside level, and respectively 12 inches and $14\frac{1}{4}$ inches with fifteen passengers in addition; whilst Woolfe's boat required eight men, and Hamilton and Co.'s nine men, to stand on one gunwale to bring it awash. The steadiness also of each when rocked, was equally good.

As regards the third requirement, viz., "fitness for ordinary use," the accommodation for passenger traffic is perfect in both, providing seats completely round each boat; whilst for goods traffic, the side air-cases in both being easily and quickly removable, the full amount of space which exists in an ordinary boat could be at once provided, in the only manner possible, without vitally affecting the essential lifeboat properties.

The seventh requirement, "relief of water," was superior in Woolfe and Son's boat to Hamilton and Co's. boat; but that in the latter is easy of alteration.

With the last exception, the difference between the two boats is, therefore, practically one of material, involving weight, cost, and facility for repair.

The third boat on the list, Mr. White's, has less proportional buoyancy than the preceding boats, until very deeply immersed, a large portion of its side air-compartments being above the level of the thwarts, whilst their width, in proportion to the width of the boat, is much less. Its stability and steadiness are good, and it has the advantages of being both lighter and cheaper, in proportion to size, than either of the preceding. It has, however, the fatal objection for a merchant or passenger ship's lifeboat, that it has insufficient accommodation for either passenger or cargo, arising from the circumstance of the side air-compartments being fixtures, and rounded at the top to gunwale height. It is, nevertheless, an excellent lifeboat for the use of yachts, and for the Coast Guard service, and is far superior to any of the ordinary ships' lifeboats at present in use.

The fourth boat, Captain Nisbet's, was shown, on its trial, to be wanting in the essential properties of "extra buoyancy," "lateral stability, with water shipped," and "steadiness in a seaway," in consequence of having no side air-buoyancy.

The fifth boat, Hamilton and Co's. No. 2, being on the same principle as their No. 1, may be coupled with it.

Reviewing the above facts, and after giving full consideration to them, the Committee beg to recommend that the gold medal of the Society of Arts for the best wooden lifeboat be awarded to Messrs. Woolfe and Son, of Shadwell, London; and that its gold medal, for iron lifeboats. be given to Messrs. Hamilton and Co., of the Windsor Ironworks, Liverpool.

The Committee, in conclusion, desire to add that, feeling satisfied that the whole efficiency of a lifeboat in a heavy sea is dependent on the amount and disposition of its air-buoyancy, they recommend that all merchant ships' lifeboats should be provided with "side air-buoyancy" to the thwart level, in portable water-tight cases, which shall, on each side, be equal to one-fourth of the width of the boat, and therefore, combined, to one-half; and with "end air-buoyancy" at bow and stern, which, combined, shall be not less than one-fourth of the boat's length. That they should be provided with not less than two relieving holes, with plugs, having in the larger boats at least 3 inches diameter, and in the smaller ones at least 2½ inches. And also, that a small wooden rail or batten should be bolted along the centre of the boat, from the foremost to the aftermost thwart, to prevent persons sitting on the windward side from being thrown over to leeward by a heavy lurch, or by a sea breaking into the boat. Also, that at least one bucket, for baling, should be kept, secured by a lanyard, within the boat.

By order of the Committee,
P. Le Neve Foster, *Secretary*.

7th August, 1872.

The Council therefore, in confirming this report, award the two Gold Medals as follows, viz.:—One to Messrs. Woolfe and Son, for their wooden boats; and one to Messrs. Hamilton and Co., for their iron boats.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first published subscription list amounted to £351 3s. A further list will shortly be published.

THE LIBRARY.

The following books have been presented to the Library:—

The Official Reports on the London International Exhibition of 1871.

Reports of the Inspectors of Factories for the year ending 30th April, 1872.

The following work has been purchased for the Library:—

Science and Commerce: their Influence on our Manufactures. By P. L. Simmonds.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

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THIRD COURSE OF CANTOR LECTURES.

SILICATES, SILICIDES, GLASS, AND GLASS PAINTING.

By Professor Barff.

Lecture II.—Delivered Monday, April 15th, 1872.

At our last meeting I tried to give you, in the short space of time which was allotted to me, as good an idea as I could of the chemistry of the elements with which we have to deal in glass-making and in glass-painting, and I mentioned to you some few of the compounds which these elements form with one another. I tried as well as I was able to make those who were ignorant of chemistry understand how certain bodies unite together, and also to give some clear and definite notion of the nature of a chemical union. It is not easy to realise without experiment, and even without oft-repeated experiment, how the powerful forces which are at work cause the union of elements, and also the decomposition of compounds which are formed by those elements, chemically united together. I dwelt at length, therefore, perhaps almost to prolixity, on this subject, because glass is a chemical compound—not absolutely definite, perhaps, but a chemical compound in which we find reversed many of those chemical actions which take place under ordinary circumstances. I shall have this evening to continue the same subject which I commenced last time, for it would not be right to leave any one of you without the means of understanding clearly the chemical processes which take place in the manufacture of glass, in the colouring of glass, in the manufacture of enamels, and of all those substances which we have agreed to treat of.

The experiment with which I concluded my last lecture was this:—I poured some sulphuric acid into a solution of caustic soda. I thereby formed a salt which is called sulphate of soda. I do not mean to say I absolutely neutralised the potash, or that I had not acid in excess, but I have specimens here of sulphate of soda, which have been carefully made in the way I shall point out to you presently, and I want you to see their behaviour to one particular re-agent, that is, blue litmus paper. I do not know whether I showed you that the sulphuric acid which I used before, was acid, and that it turned blue litmus paper red. Here we have a salt of potash and sulphuric acid—perhaps a chemist would say that is not quite correct, but I will explain it presently—we have a salt which is made, at all events, by some union which takes place between potash and some other constituent. You will notice that this now reddens litmus paper. This other one only reddens it slightly—it ought not to redden it at all—but that only shows that it is not quite pure. We start with the substances, caustic potash and sulphuric acid; we mix them together, and we obtain these two products, according to the proportions in which we take the substances. Sulphuric acid is strongly acid; potash is what is called an alkaline substance. When these are mixed together they form two salts. If we have more of the alkali, or sufficient of alkali to neutralise the acid, we get a liquid, or rather a crystallised substance dissolved in the liquid which does not redden blue litmus paper, whereas, if the acid is in excess, then we get the blue litmus paper turned red. You see, then, we have two salts of sulphate of potash, one commonly called bi-sulphate (and I am trying to keep as clear as possible from using merely chemical names), and the other is called normal or neutral sulphate—that is the one which does not act on blue litmus paper. This sulphate of soda is a most important substance. It is one of the products which is made in the conversion of common salt, or chloride of sodium into washing soda, or carbonate of soda. The way it is made is this:—A quantity of sulphuric acid is put with common salt, they are heated together to a high temperature, the hydrochloric acid passes away, and the sulphate remains behind. We have not the means of performing the experiment here, but I can show you one step of it. Here is some common salt which we have fused, to make it perfectly dry and dense, in order that there may be no frothing in the retort; sulphuric acid has been added; it is now being heated; gas is passing over, which is being absorbed in this bottle; it is hydrochloric acid, and the salt left behind will be, not the normal sulphate of soda, but the other one, which is called the bi-sulphate. Chemists call it hydrosodic sulphate. Now, sulphuric acid unites readily with caustic soda or potash, and they form very stable compounds. You may heat them together to a high temperature, and you do not decompose them. Sulphuric acid, then, is an acid which we call an extremely powerful acid. It is a strong acid in uniting with alkaline bases, and forms what are termed very stable salts, which are not easily decomposed. I want you to remember this, because sulphate of soda is one of the materials which is used largely in glass-making. I have some specimens here on the table, which I shall show you later on—specimens from the Thames Plate Glass Works.

I shall endeavour, before I conclude this evening, to show you how an acid so weak as silicic acid is able to expel this strong sulphuric acid from sulphate of soda, and you will then be able to appreciate scientifically this most beautiful of manufactures, namely, glass.

I will now take a colourless solution, and I will add to it another colourless solution. One is a solution of common salt, and the other is a solution of what is called nitrate of silver. When I put these two together, you will see a white precipitate will be formed. This white precipitate is chloride of silver. If I filtered off this liquid I should have nitrate of sodium in solution, and chloride of silver on the filter. You see, then, that something has determined a change in the constitution of these two liquids. Now, what has determined it? Simply the insolubility of the substance formed. Because chloride of silver is very insoluble in water, it has determined the decomposition. Now, I will show you another experiment of the same kind, which is very instructive. Here I have a solution of common smelting-salts, or carbonate of ammonia. I will put to this—not chloride of sodium—but chloride of calcium; that is, a salt formed by the union of chlorine gas with the metal calcium, not chloride of lime or common bleaching powder, but chloride of calcium. You see here I get a white precipitate. Now what is it? It is a precipitate of chalk. Here has been an interchange again, and I have a chloride of ammonium in solution, and the precipitate is carbonate of the oxide of calcium or carbonate of lime. Now here again the insolubility has determined the decomposition. I will put these into a flask and boil them. It will take some five or ten minutes to boil them, but the result will be that the liquid will become clear, the precipitate will dissolve up, the carbonate of ammonia will be re-formed, it will volatilize, for it is a volatile salt, as all who use it as a smelling-salt know, and so in this case heating reverses the action that took place in the first instance. Insolubility determines the first decomposition, the heating and the volatility of one of the compounds that can be formed determines the decomposition in the second case. You will, perhaps, remember that I alluded to this when speaking of sodium in my first lecture, and I want you to clearly understand it, for I shall have to refer to it continually when I speak of the manufacture of glass.

Now we will pass on to the consideration of silica, or silicic acid, as it is called. Some persons call it silica, others call it flint, but flint is only one kind of silica. There are many kinds of silica occurring in nature, some of them exceedingly beautiful. We use them for ornamental purposes and in jewellery. Here we have some specimens of beautiful agates. These are silicates. Then again we have calcedony in various forms. Then we have opals, and other specimens of quartz and crystals, some of them very beautiful. These have been lent to me by Mr. Roberts, the chemist of the Mint, who, with the late Professor Graham, carried on a number of researches on this interesting subject. I shall have to refer to some of the results of their experiments later on. There is here one specimen in which silica exists in two forms—crystalline on the inside, and on the outside in what is termed the colloidal form, and these are specimens well worth looking at. Then here I have a very beautiful specimen of quartz, lent to me by Mr. Ladd; it is a part of one large crystal. Quartz crystallises in six-sided prisms, and on the top you will see a six-sided pyramid. This is a material which is used very often for making spectacles, as also are some kinds of silica, which are termed amorphous, and which are often found in large masses, perfectly hard and transparent. One great advantage belonging to glasses made out of this silica or crystal is that they do not scratch, and it is also said that they have a better effect than glass in preserving the eyes—that they are cooler. That may or may not be, but at all events they do not scratch, and therefore they last longer, and are clearer and better. Of these forms of silica which are before you some are called amorphous, and of these some are what is termed hydrated. These I want to make you acquainted with before going further. Amorphous, as you will see by the derivation, means without form, that is, without crystalline form. It is applied to bodies which have no crystalline form. I spoke of amorphous carbon and silicon last week, if you remember—silicon and carbon not crystallised. Some of these are amorphous and some are not. The agate may be crystallised or not. Calcedony, opal, onyx, and other of these substances are amorphous silica. Some of them are hydrated silica, that is to say, they contain water of hydration. If I were to take a portion of that quartz, crush it up, and heat it to a high temperature in a platinum crucible, I should then find, on weighing it, that the quantity of quartz had not lost weight in the least degree, but if it were hydrated silica, I should find, after treating it in the same way, that it would lose weight, and the weight it would lose would be the weight of the water chemically combined with the silica. I shall have to speak again of hydrates of silica, and I shall show you some hydrated silica presently in the gelatinous form. There are many kinds of silicates found in nature. Meerschaum is a silicate of magnesia, and there are various other silicates which my time will not allow me even to mention, for, as I told you the other night, if I were to write their names down it would form a column reaching from the floor to the ceiling. I will now describe the preparation of silica.

You will remember that we did produce silica last Monday in one of our experiments. I made a gaseous compound called fluoride of silicon; passed it into water, which decomposed the fluoride of silicon, and there was a white deposit formed. Here is the silica resulting from that experiment. It is pure silica; and this is the liquid that was filtered off from it. This liquid contains an acid substance, which is called in common language hydro-fluo-silicic acid. It contains fluorin, hydrogen, and silicon. If I add to this some ammonia, I shall precipitate more silica. So that if I wanted to get from a mineral all the silica it contained, I have only to powder it up, put it with some fluor spar and sulphuric acid into a flask, carefully pass over the fluoride of silicon until it ceases to come over, and then I shall have a portion of my silica precipitated, and the rest will be in the liquid, and I can precipitate it through the re-agent, ammonia. I now add ammonia; you see the white precipitate, which is a precipitate of silica identical in its composition with the other specimens of silica here. Then, if I filter off this white precipitate, I have a liquid in which I have fluoride of ammonium. This must not be put into a glass bottle, or it will eat away and destroy the glass. You will remember that this is a property of hydrofluoric acid, and this substance acts in the same manner. However, it may be put into a bottle which has been waxed all over on the inside, and it may then be kept for a length of time. If anybody here is engaged in etching glass, I would recommend him to try this, as it is an easy and convenient method of keeping the fluoride in the form of fluoride of ammonium, and by dabbing it, when moist, on the glass it etches the glass very well indeed and very regularly.

Here is another experiment I should like to show you, which is very interesting. You remember that last Monday evening I tried to obtain silicon. I put sodium along with fluo-silicate of potassium. The fluo-silicate of potassium is made from this liquid—hydro fluo-silicic acid—by the addition of a potash salt. Here I have added a potash salt, nitrate of potash, or saltpetre, and I do not know whether you can all see this precipitate, for it does not appear opaque; it is beautifully opalvescent. Even this light may not show it you, but the colours are exceedingly beautiful. The precipitate of fluo-silicate of potassium has about the same refractive power on light as water has, so that you will not see it until it settles at the bottom. When dry it is a white powder, such as I used the other night.

I have now shown you two ways in which we may obtain silica in a state of perfect purity. But we do not always wish to take the trouble to prepare this liquid for the purpose. For instance, in manufacturing operations it would not pay to go to the trouble, and, therefore, if you want to get silica pure for any art or manufacturing purpose, you would have to adopt this other method. Silica, as it occurs in nature, is slightly soluble in water, and in certain other substances, and only in these. It is not soluble in any of the acid liquids that we use, such as sulphuric acid, hydrochloric acid, or nitric acid. It is, of course, as you know by this time, soluble in hydrofluoric acid, but then it is decomposed. It is soluble in caustic alkalies, and that is why I spoke to you so much about the formation of these caustic alkalies last Monday evening. Here I have some lime, I hope perfectly pure, and I will put some water to it. It is unslacked at present, but it will now go on slacking. Then I will add some hydrochloric acid, and I want you to notice there is no effervescence here. That shows there is no carbonate present, that this is really pure caustic lime. But I will take some carbonate of potash, and I will add to it some hydrochloric acid, and you will see that a violent effervescence will take place, showing that carbonic acid is present. Mr. Lewis will now put some of this lime and some of this carbonate of potash together, and will boil them for a certain time. After he has done that we will test the liquid and the solid, for there will be a liquid and a solid left behind, and then you will see that an interchange has taken place. The lime will take away the carbonic acid from the carbonate of potash, and the potash will be left behind. When you want to make potash caustic, as it is called, this is the operation which you have to perform. You boil the carbonate (and the same is true with regard to carbonate of soda) along with caustic lime. The caustic lime takes the carbonic acid, and lime carbonate being insoluble, remains behind, the caustic potash or soda is set free, and is in solution.

Now I will call your attention to the former experiment. You remember that this is the liquid which contained chloride of calcium and carbonate of ammonia. You remember we had a precipitate; that precipitate is now entirely gone, and the liquid is perfectly clear. The carbonate of ammonia is gone away and we have a chloride of calcium in solution. That, you see, is a proof that the volatility of one of the compounds formed determines the decomposition.

Now, returning to our caustic lime, it will dissolve silica. If I were to take some common sand and boil it in caustic lime and water for a length of time, I should find a certain quantity of the sand had united with the lime, forming silicate of lime. It is in this way that what is called soluble silica is often made, but for this purpose soda or potash is employed, as silicate of lime is not soluble. In order to facilitate the operation, and to make it more rapid, the caustic alkali is boiled with the silica, or the sand, or the crushed flint (for they are all silica in various forms), under pressure, in digesters, so that the temperature of the water can rise much higher than it can in the open air, for when water is boiled under pressure you can raise the temperature almost at pleasure, as long as the digester is sufficiently strong to stand the tension of the aqueous vapour. At a pressure of about 60lbs. to the square inch, it is found that flints will "run down," as it is technically called, very rapidly indeed in caustic-soda, and then we get a solution of a soluble silicate. The silica is dissolved, and forms a salt with the soda or potash, whichever is used.

There are certain forms of silica which are much more soluble than others. For instance, hydrated silica is more soluble in alkali than silica which is anhydrous. A specimen of silica in a most beautiful form has come into my possession lately. Seeing an account in the *Engineering* journal of some silicate paint company in Liverpool, I wrote to the company for information about it, and I received an answer from Mr. Griffiths, who was kind enough to send me some specimens of this silica, and they are well worth consideration. Under these microscopes there are specimens of it, set up for your examination. Here is a lump of it in the rough state, and here is a lump of it which has been carefully washed. It is beautifully white and soft; it is almost an impalpable powder. If you rub it with your fingers it adheres to them like French chalk. It was supposed that this was calcined silica, but from its behaviour under heat and by testing it in other ways, I immediately saw it was not calcined at all. It is infusorial silica. It is silica resulting from organic beings; but perhaps I am wrong in using the word "beings," because I believe zoologists are not quite agreed as to whether diatoms are animal or whether they are vegetable. But this deposit is made up, I think, of diatoms, fragments of diatoms and sponge *spiculæ*. Under these glasses you will see some species of diatoms most beautifully marked, and some sponge *spiculæ*, so that this silica has an organic origin. It is hydrated silica, and it dissolves very readily in caustic soda. I have here in a test tube some of it which was dissolved in our laboratory. I will add to this a precipitant for silicic acid, and you will see we shall get a precipitate. This precipitate is silica. It was dissolved up from that deposit by means of caustic soda or potash boiled in an open vessel, at the ordinary pressure of the air, and not for a very long time. It, therefore, is very soluble as compared with other forms of silica. I wish you, if you please, to bear this in mind, because, in these two first lectures, I am simply stating the principles and facts which I shall have to apply in after lectures, and shall have to re-call then to your recollection. For instance, this fact I am speaking of has recently shown to me that we have got a substance which I have been looking for for some years, which is one of the most beautiful materials for art purposes. In this little furnace there is a platinum crucible containing carbonate of potash fused. Into this I will pour some dry sand. You perceive a violent effervescence. Carbonic acid gas is being given off. In this glass there is lime-water, and some of the carbonic acid given off in this action has come in contact with the lime-water, and has proved its presence by turning the lime-water turbid, or milky. You can all see that the water is turbid—that there is a white precipitate in it, whereas before it was clear. You remember last time my showing you that lime-water is a test for carbonic acid. If I were to draw the air of this room, for only a minute, through lime-water, I should get a precipitate of carbonate of lime, owing to the presence of carbonic acid in the room. Now, you see here the silicic acid has been able to turn out the carbonic acid from the carbonate of potash at a high temperature; and before we part, I will show you the reverse, that in the cold carbonic acid it is able to turn out silicic acid. Then you will see the connection that this experiment has with the statement with which I commenced my lecture this evening, and you will also see how it bears upon the subject of glass-making, and I will apply these principles to the details which I shall give you of the process of glass-making in our next lecture.

You have doubtless heard of petrifying wells, in which silica is deposited upon organic matter, and you get those organic substances, as it were, petrified, for they become infiltrated with silica. In the geysers silica exists in solution. They are at a high temperature, and their waters are alkaline, containing carbonates of potash. Now, when you have a solution of carbonate of potash and put into it some, what is termed, gelatinous or hydrated silica, then the carbonate of potash dissolves up that silica. Here we have a liquid made artificially which resembles the water of these springs. If you were to allow this to drip upon paper, or any porous substance, you would get silica deposited in it, or in any ornamental porous article you would get silica deposited all through, and that would be a species of petrifaction. I will test this liquid in the same way in which I tested my other solutions before, to show you that there is silica dissolved in it. You notice that this is carbonate of potash, from its effervescence with hydrochloric acid. I will now add some ammonia to it, and you will see we shall get a white precipitate of silica, which is gelatinous. This is very interesting indeed to those who are studying geology—I do not mean to geologists, who are well-up in the science, because they know all about it—but to those who are studying the subject. Many of the beautiful mineral forms which we see in nature, some of which are on the table, both crystalline and colloid, are, perhaps, formed in this way, but I must not go into this subject at present.

Here is a solution of silicate of potash, such as is generally used. It is made, not as I described to you just now by the process of boiling the silica, in the form of flint or sand, with caustic alkali, but by fusing the silica and the alkali together, so that a sort of glass is made—a glass like any other glass, only that it is soluble in water. When crushed up, and boiled in water even at the ordinary temperature of boiling water, 212° Fah., you get that silicate dissolved, and you get a liquid like this. It is afterwards evaporated down till it gets to a sort of a syrupy consistency. This is a very strong silicate; if I add some hydrocloric acid to it the whole mass will then gelatinise at once, and we shall get gelatinous silica. Now, I will take a diluted solution, and will add hydrochloric acid to it, and it will not gelatinise. This proves to us that silicic acid, in the hydrated or gelatinous form, is soluble to a certain extent in hydrocloric acid. It will require the addition of ammonia to precipitate the silica from this solution. I will add some ammonia, and you see it soldifies at once. So, then, hydrated silicic acid is soluble in certain other acids—in hydrocloric acid, for instance; that is a fact to be borne in mind, but I will leave the further explanation of it until I come to its application in the arts. I will here tell you of a fact which has astonished scientific men. I do not mean that it has astonished chemists, but many scientific men who have used glass as a material for carrying on certain very delicate operations. For instance, it was desired some time ago to try some experiments upon organic liquids. They were sealed up in glass tubes, and then exposed to a very high temperature, for the purpose of ascertaining certain results. But it was found that a number of small masses floated about in the liquid. The experimenter did not know the reason of this, but when he mentioned it to a chemist, the chemist told him that the water had dissolved the glass. One would hardly think that water dissolves glass, but it does so; and it does it slowly as well as rapidly. Here it does it rapidly, under pressure, and at a high temperature. Here is one of the experimental tubes, and if you look at it you will see that the bottom of the tube is like ground glass, whereas the other part is perfectly clear and transparent. The water here has actually dissolved the glass. Here are some other specimens still more striking, showing a quantity of gelatinous silica floating about, which has been dissolved off the glass.

These tubes were sealed up; they were put into what is called a digester, and heated to 150° centigrade. At that temperature, and even below that, glass is capable of being dissolved, and if the operation had gone on long enough no doubt the whole of the glass would have been destroyed. The important bearing of this fact will be manifest when I come to speak of the causes of the extraordinary beauty which we see in ancient stained glass. I tell you now the way in which I mean to apply this, because it is a most interesting fact, and you will have no difficulty in understanding it after I have told you that the ancient stained glass owes, to a great extent, its extraordinary beauty and its lustrous effect to the fact that certain portions of the glass have been dissolved out by the moisture of ages.

There are other substances which will decompose glass, and dissolve it up. For instance, the substance called phosphoric acid. I will now take a strong solution of silicate of potash, and put into it some carbonic acid gas. I have shown you in this crucible that silicic acid will turn out carbonic acid at a high temperature, and now I want to show you that carbonic acid will turn out silicic acid at a low temperature. When silicic acid is dissolved in caustic potash or soda, what is called silicate of soda or potash is formed. That is, the silicic acid combines with the potassic oxide, or oxide of potassium, as the base. We get the base combined with the acid, forming a salt, which is called silicate of potash. When we pass in carbonic acid, the carbonic acid will take the potash, and form carbonate of potash, and the silicic acid will be precipitated as hydrate. This, then, will be the conclusion of what I have to show you upon the chemistry of silica, and it is an interesting conclusion, too, because it shows the difference between the action of chemical bodies when they are placed under different circumstances.

Now we turn to the subject of diffusion. I need not go at any length into this subject, because, in the first course of lectures delivered here this session by Mr. Gill, he went into the subject of diffusion particularly, and therefore I need not say much about it, but it will not take long to show you this experiment. Here is some starch mixed with iodide and iodate of potassium. This will be put into a bladder, and the whole will be put into acidulated water; the acid of the water will dialyse into this thick dense substance; the acid will decompose the iodide and iodate of potassium, the iodine will be set free, and that, when set free, will give a blue colour with the starch. The blue colour will, therefore, be formed in this bladder, and will rise up the tube. This is the apparatus ordinarily used for dialysing, a simple drum, like a tambourine, with a piece of vegetable parchment put over the drum, and secured with a ring. This drum is floated on water. The water will not pass through this dialysing parchment from the basin into the drum, but if you put another liquid in it there will be, by a principle which is called endosmosis and exosmosis—a diffusion of the liquid from one vessel into another. There will be an interchange, but the direction, mainly, will be from what is termed the colloidal substance into the other and outer liquid. You have seen a great many precipitates of silica to-night; here is one like jelly, for silica is an eminently colloidal substance; colloidal means gluey, or like glue. This substance will not pass through the dialysing parchment, but the crystalline substance, which is held in solution, will pass through this dialyising medium. Now, suppose I take some silicate of potash and put it into this dialyser, and if I make my silicate of potash acid with hydrochloric acid, which I can do if I have a weak solution of silica, though, you will remember, with a strong solution it is precipitated, but if I take a weak solution, not containing more than three or four per cent. of silicic acid, then if I add hydrochloric acid, and make it acid, I have sufficient acid to unite with the sodium and to form chloride of sodium, which liquid will pass through the dialysing drum into the water; and if I keep changing the water outside the dialyser, it will go on dialysing into it until all the chloride of sodium will have diffused out; this can be ascertained by the experiment I showed you early this evening, viz., testing with nitrate of silver, and there will be nothing left in the dialyser but silica, and that in aqueous solution. Silica, then, can be got in aqueous solution by this process. Here is some aqueous silica, which has been dialysed in this dialyser. I will add some ammonia to it, and we shall get a precipitate of silica. If you look you will see a precipitate of silica floating about in the liquid. If you allow aqueous silica to stand for a length of time, or if you agitate it, or if you drop a foreign body into it suddenly, the whole mass will solidify, and you get a jelly, like this. This is pure silicic acid, which has been in aqueous solution, and which sometime yesterday or this morning gelatinised suddenly. If you allow silica in this state to dry, allowing its edges to be free, it will dry into a beautiful hard mass; and underneath one of the microscopes you will see a specimen of gelatinous silica which has been thus gradually dried, which is hard enough to scratch glass. Some time ago Mr. Roberts also found out a most interesting fact with regard to silica. If you allow it to gelatinise in atmospheric air, vegetable growths will spring up in it, and you get beautiful dendritic forms. I believe there is a specimen under one of the microscopes. This gives us a very great insight into the formation of some of those very beautiful forms in agates. But, however, I have not to dwell on this subject; my reasons for bringing before you this system of dialysing and the effects produced by it are several, and one of them is that this substance, aqueous silica, has been used in the arts, and I think it will be more extensively used than it has been. When I come to speak of the application of silica to such purposes in my later lectures I shall again refer to it, but this was the proper place to explain the principle of dialysis and how the substance, dialysed silica, is prepared.

I will break off here for a moment to show the result of the experiment, in which I put caustic lime into carbonate of potash. The two have been boiled together for some time. Before, the lime did not effervesce, but when hydrochloric acid was added to the clear liquid it did. Now, I have got a clear liquid. I will put hydrochloric acid to it, and I think you will see no effervescence. There is a very slight effervescence, but you will remember how it fizzed up before. Now I will add to this carbonate of lime some hydrochloric acid, and you see what effervescence there is now. This, then, is the way in which soda is rendered caustic.

I broke off in an interesting part of my description of silica. If you add to some of this aqueous silica some clear glycerine, you will find it does not prevent the gelatinising of the silica, but the silica will go on gelatinising, and it will unite with the glycerine. I do not know whether it will chemically unite with the glycerine or not, but, at all events, you get a perfectly homogeneous, clear, transparent substance, formed of glycerine and gelatinous silica. And this points to another means by which this peculiar form of silicic acid can be made valuable in the arts. Next Monday I shall go into the subject of glass manufacture and the materials used therein.

ANNUAL INTERNATIONAL EXHIBITIONS

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

The Japanese Plenipotentiaries Extraordinary will be received by Earl Granville, the Foreign Secretary, at the Evening Promenade on Monday next. A military band will play in the Conservatory of the Royal Horticultural Society.

His Royal Highness the Prince of Wales presided on Tuesday, at Marlborough-house, over a meeting of the Royal Commission for the Exhibition of 1851. There were present—Earl Granville, Mr. Ayrton, Sir Francis

Sandford, Sir William Tite, Mr. Baring, Mr. Gibson, Mr. Thring, and Major-General Scott (Secretary). Mr. Cole attended the meeting.

PAPER, STATIONERY, AND PRINTING.

(Continued from page 773.)

The production of type, or metal characters, is the first step in printing. From the time of the invention of printing to within a few years these metal types were invariably produced entirely by hand-labour. The type-founder held in one hand the mould, or matrix, then with a ladle he poured in a small quantity of the molten metal, gave the mould a sudden jerk upwards, to expel the air and force the metal into the fine lines of the die, and lastly opened the mould, and turned out of it an unfinished type, with a letter, figure, or other character, at one end of it. The process required considerable skill, and, under the best circumstances, was a slow one; and, for many years inventors expended a vast amount of time and skill in constructing type-founding machinery. It is not much more than ten or twelve years ago that any practical success attended their endeavours.

Two type-casting machines are now to be seen at work at the Exhibition, one of French origin, which turns out the type in the rough, much in the same manner as they were produced by the old method, but infinitely more rapidly; and an English machine, which not only casts but finishes the type, and lays them in perfect order side by side, ready to be made up into packets for delivery. This machine consists, in fact, of a small furnace and several small tools on the same bench, all connected together and worked at once. The furnace, or melting-pot, containing the molten metal, composed of tin, lead, and antimony, is heated by gas burnt with a stream of atmospheric air; the matrix is set at right angles to the side of the furnace, projecting from which is a small nozzle, and through this sufficient metal is projected, by the action of the machine at proper intervals, to form one type, the matrix into which the metal is cast being supplied with a small stream of water through an india-rubber tube in order to prevent its over-heating. The moment the type is cast it is laid on a kind of miniature tramway, and as each successive arrival pushes the previous one forward, a row of bright, fresh type, a foot or two long, is soon produced. Each of these rough types has a metallic tail, but this falls off at the slightest touch of a projecting strip of metal, or of the attendant's hand. The types having arrived at the terminus of the tramway, make their way by gravity down the face of a quadrant beneath a band, and make for the finishing machine. Being laid on a moving piece of metal, each type is now in succession carried forward between the jaws of two minute planing machines, each of which planes one side of the type, and makes those sides perfectly parallel. It is then turned at right angles, and passes by a series of cutters, which trim the foot, plane the two remaining sides, and cut the distinguishing nicks. This done, the completely finished types are laid side by side on a composing-stick, which, when full, is removed, and replaced by another. Finally, the types are removed from the composing-stick by what may be called a delicate shovel, which takes up each time just as many types as are required to make up the width of the packets in which they are tied up to be delivered to the printer. The machine seems to perform its various functions with great regularity, and is well-deserving of study with its foreign companion, which stands next to it.

The slowest, the most costly, and, it may be added, the most important, operation in the printer's art is that of setting up, or composing the type, and afterwards, when done with for a time, re-distributing it in the case.

While one set of inventors were labouring at the production of type by mechanical means, others were occupied in devising plans for composing and distributing by machinery. A very large number of machines for this purpose have been invented and shown at the various Industrial Exhibitions, but it is only recently any have been found to meet the wants of the printer. At the present moment type-composing and distributing machines of several models are in practical use, and those which have been adopted in the office of the *Times* may be seen in operation side by side with the Walter printing-press.

It would be quite impossible, without the aid of drawings, to give a complete idea of these composing and distributing machines, but their general principles may be indicated without much difficulty. To commence with the composing machine, the letters, figures, stops, and other characters are arranged separately in metal troughs or composing sticks, about fifteen inches long, and just the depth and width of the type; when filled each with its own type, these receptacles are placed upright on the top of the machine, so that the character at the bottom of the trough is in communication with the upper portion of the mechanism of the machine. The operation to be performed is this. The compositor sits down in front of the machine, and has the MS. copy to set up in type at his left hand, and his duty is to cause to descend in proper order, one by one, the letters or other characters which occur in the MS., and this he does by means of a number of keys, arranged in four rows, in the manner of a small organ key-board, each of these keys opening a small valve or trap beneath one of the characters already mentioned. From each of the numerous type-holders is a channel which leads to a central point behind the key-board. Now, if the number of channels did not exceed, say, twelve or so, the operations would be easy enough: the channels would radiate regularly upwards from the central point below, like the sticks of a fan; as each key was touched, one or other character would fall directly from its holder to the lower central point of delivery. But the number of types is many times twelve; there are, in the first place, all the letters of the alphabet (small and large), the ten figures, the stops, hyphens, dashes, &c., so that, instead of the channels being arranged simply like the sticks of a fan, they form altogether a figure much like the veins of a large compound leaf; that is to say, there are five or more main channels, and all the rest are tributaries of these, as it would be impossible to make so large a number of channels converge together to a single point. The descent of each type is therefore managed in such a way that it passes down its own channel into one of the five main channels, and thence to the central point; here it is received in a trough, or composing-stick, fixed to the lower part of the frame of the machine in a vertical position, the face of course upwards; and at the descent of each character a slight lateral movement of the machinery occurs, which causes the type to move forward in the composing-stick till the latter becomes full, when the characters are received in what printers call a "forme," that is to say, in lines just as long as the column when printed is wide. The types arrive at the forme in a horizontal position, the change being very simply effected by giving the composing stick, or trough, a quarter turn in its length, like the rifle groove of a gun barrel, so that each type falls gradually to a horizontal position as it is propelled along the trough. A second workman sits behind and to the right of the machine, facing the forme referred to, and his business is to justify the composition, that is to say, to insert spaces between the letters, and also between the lines, to stop at the end of each line, put in a hyphen when necessary, and commence a new line.

The distributing machine is, in principle, the composing machine inverted; the mass of type—or forme—to be distributed is placed at the top of the machine, and the characters, after traversing the channels of the machine, are received in the composing troughs, which are placed horizontally, and side by side, on a table beneath. The system of channels, is however, more complicated in this than in the composing machine, for, while in the latter the characters fall naturally from their tributary channels into a main one, in the former they have to be diverted mechanically from a central main channel. This is ingeniously effected in the following manner:—The secondary channels all branch off from a main passage, just as the shoots of a tree diverge from the main branch, on the two sides alternately, but in an inverted position; therefore, when a type has descended a certain distance in a main channel, it is turned into its own secondary channel by means of a small steel gate, which, when in repose, closes the side channel, but when set in action by the key of the machine which acts upon its special type, closes the main channel, and the type arriving at the gate, glides quietly and easily, foot downwards, into its own lane. The distributing machine is worked by the eye, like ordinary distributing; the line of the forme nearest the operator is lifted up, so that he may read the first character, which having done at a glance, he touches the proper key, the character drops into the channels, the line of type moves on one step, bringing the next character over the entrance to the channels, and so on, till all the types are distributed into their proper holders, or composing sticks.

The collection of printing machinery exhibits the most complete revolution possible in the trade. Of all the admirable hand or lever presses with which the whole of the printing of the world was done little more than some thirty years since, not one appears at the exhibition; they have been replaced by the platen press for small work, and the cylinder machine for large and rapid work. These platen machines form a curious and highly interesting feature of the exhibition, and offer to the mechanical student a large field of study, as the novelty of their form has called forth many most ingenious arrangements of their parts. The old printing press was entirely worked by hand, the new platen presses are worked either by treadle or steam-power. In the old presses, the forme was fixed down upon an iron table, which, by means of a winch, was run in under the platen to take the impression, and out from underneath it to be inked; except in very small work, two men, or a man and a boy, were employed, one inking the type by hand rollers, while the other fixed the sheet of clean paper on the tympan, shut down the frisket upon it to keep it in its place, then shut down the tympan on the forme, ran the table in under the platen, and then with both hands upon a powerful lever and, in the case of large work, throwing the whole weight and power of his body into the act, gave the requisite pressure.

In the new machines, the pressman, in the absence of steam, works the machine with his foot, lays the clean paper on, and takes the printed impression off; all the rest is effected automatically, while the operator can see and check the action of every part of the machine.

Every one of the many platen machines at the exhibition has its own peculiar features, but they have also a generic character which may be given in a few words. The forme of type, from which impression is to be taken, is placed vertically, and the platen necessarily in the same position, and facing the former; when set in motion the platen recedes, and turns face upwards when the paper is laid on, and kept in its place afterwards by frisket arms; behind and above the forme is the inking apparatus, and at the moment the paper is being laid on the platen, two or three small rollers, which have carefully coated themselves with ink the instant before, run down and up the face of the type in the forme, inking it completely; they have scarcely escaped up-stairs to ink themselves again, when the platen rocks over, approaches the forme, is squeezed with force against it, and the impression is given; and so the work goes on at the rate of one, two, or more thousands of printings per hour. The arrangements for giving more and less motion to the platen at different moments, to allow time for laying on the paper and inking the forme completely, and for saving time at other moments, and those for the feeding and distribution of the ink and the inking of the type, are different in nearly every machine, and exhibit much ingenuity. All the platen machines except one are English, and that exception comes from our Transatlantic cousins.

These platen machines are what are called in the trade jobbing machines; they are only intended for small work, that is to say, they only print, as a rule, sheets of paper up to demy folio, or about 19 inches by 13½ inches. On the other hand, the very best printing, such as that from fine wood blocks, has never yet been achieved by a cylinder machine, or by anything else but platen pressure. In the Exhibition will be found a platen machine of the highest class and of great power, of the kind used for very superior work—the notes of the Bank of England, &c. The platen machine referred to is a pondrous engine of peculiar construction and admirable workmanship, and deserves careful examination. The platen, which is of great weight in itself, is aided by a suspended adjunct weighing half-a-ton, if not more, and the pressure is given by two knee-joint levers, one on each side of the machine. The inking apparatus is of the most elaborate kind, and the arrangements of the feed-roller, that is to say, the go-between the ink reservoir and the distributing roller, and that which gives the latter a lateral, as well as circular motion, known as the "mouse motion," are singularly ingenious. The machine is a double feeder, so that while one attendant is carefully laying on his sheet of clean paper another sheet is taking the impression. The arrangements for inking the type, running the forme under the platen, and keeping it there at rest during the descent of the platen, include a very novel piece of mechanism, which may be described as a stud moving in two circular and two spiral grooves in a skeleton cylinder. This curious mechanism seems to work admirably.

The collection of cylinder printing machinery, although not complete—for one type in extensive use is unrepresented—is remarkably fine, and includes examples of all the great varieties, namely, machines printing one or more sheets almost at the same moment, single or double feeders as they are called—that is, those which print on one side only of the paper, and those which print on both sides of the paper before it leaves the machine, or what are called perfecting machines. These perfecting machines present a difficulty; the second side of the paper being printed an instant after the first side, there is great danger of some of the ink remaining on the blanket with which the cylinder is covered, and being transferred to the next sheet. This is what is called in the printing trade, "set-off." In printing newspapers and common work, this is avoided by using an extremely small quantity of ink; but such faint impressions would not be accepted in superior work, such as fine book printing: and, therefore, in such cases, an additional complication of machinery is created by the introduction of a clean sheet of paper, which runs between the blankets and the sheets of paper that are being printed.

In all the presses and machines above referred to, the work is printed either from the type itself or from flat stereotype—casts taken from it. In the last and newest class of machines, represented by the Marinoni and Walter machines in the Exhibition—and they are in fact, at present the sole representatives of the class at present in use in England—stereotypes of the forme are cast of the shape of the cylinder, or of the half of the cylinder. A mould is taken of the type by means of damp sheets of paper laid successively on the face of the forme, and afterwards pressed into the interstices of the type. This mould is then fitted within a circular, or semicircular, iron mould, and the metal run into it in that position. These casts are then trimmed systematically on their edges and backs by means of lathes with set cutters, and fitting accurately on to the cylinders, are held rigidly in place by means of undercut edges and screw clamps. The plates for the two sides of the paper being fixed on separate cylinders, and each printing cylinder being provided with complete inking apparatus, and having a companion cylinder to exert the necessary pressure, each sheet of paper is printed first on the one side and immediately afterwards on the other. In the Marinoni machines, which are made for six or more feeders, the arrangement of grippers, to seize the sheets of paper, and carry them between the rollers, and of tapes and other accessories, presents a most extraordinary complication, but the work is well done, and the delivery of the printed sheet is automatic.

The "Walter," or *Times* machine—which it is unnecessary to describe here, as an account of it has recently been given in the columns of this *Journal*—has made another great step in advance; it is completely automatic; a roll (or, as it is called, a "web") of dry paper is placed at one end of the machine, the end of the three or four-mile strip of paper is introduced into the machine, passes through a bath of salt water, which damps it sufficiently, and is printed first on one side and then on the other; the printed sheets are then cut off by the machine itself and laid on two tables, at the rate of about 200 per minute.

(*To be continued.*)

RAW COTTON AND COTTON PLANTS.

In this year's International Exhibition, the whole process by which cotton is cleaned or separated from the seed, and prepared for market by the different kinds of machinery known as "gins," may be witnessed. The various manipulations which the raw material undergoes after it reaches the hands of the spinner, and by which it is converted into yarn, and ultimately into cloth, will afford to thousands who have never had the opportunity of going through a Lancashire factory or cotton mill, an insight into the vast operations continually going on in the domains of King Cotton. The Great Exhibition of 1862 was held during the "cotton famine," and thousands of factory operatives were prevented by that dire calamity from becoming acquainted with its wonderful treasures. This was not owing to want of time, but to the want of means. At its commencement 60,000 industrious cotton workers were wholly out of employment and dependent on doles of charity for their very existence, whilst 200,000 more were then on short time and greatly crippled in their resources. The representatives of nearly every country attending the 1862 Exhibition met in conference to consider the cotton-growing capabilities of the world, the best means of making them available, so as to increase the supply of the much-needed commodity, and of introducing or extending the cultivation of cotton where little or none had previously been produced. That conference, and the information then imparted, had a powerful effect in stimulating the growth of cotton in every direction, and in showing how much room there was for hopeful exertions. A curious episode for a time diverted attention from cotton, and the discovery of a substitute was heralded by a loud flourish of trumpets. Everybody remembers the *Zostera marina*, which was to answer all the purposes of cotton, and to be obtained in such abundance as to forbid all possibility of scarcity. So confident was the prophecy, and so complete the illusion, that experienced cotton brokers and cotton spinners were for the moment carried away with the dissimulation; but this and other like bubbles have burst, and the dream has vanished. No fewer than 35 different countries sent cotton to the Exhibition of 1862, representing Europe, Asia, Africa, America, and Australia; but not one nor all of them could pretend to anything like competition with the Southern States, then the theatre of civil war. Whilst it was demonstrated that, as regards soil and climate, there was no difficulty in producing cotton to any extent, and in districts almost without number, it was as conclusively shown that there were formidable and nearly insurmountable obstacles to be overcome before America could be superseded as the great source of supply. Want of labour, want of roads, want of capital, want of enterprise and skill, and immobility and stereotyped characteristics of Eastern and half-civilised races, with other causes, tended to repress the sanguine expectations which at first were entertained. Nevertheless, cotton cultivation in every part of the globe received during 1862 a powerful impetus. The commissioners from different cotton-growing countries, before returning home, visited Liverpool and Manchester, and carried back with them the most ambitious projects. Supplies were received from new sources which had never before furnished any contributions of the raw material; and, under the stimulus of high prices, the most strenuous efforts were made to increase the production of cotton in every direction. Ten years have since elapsed, and we can now compute the results. America has re-entered the field of competition, and bids defiance to the world. Slave labour has disappeared, and the prognostications of its abettors have been falsified. American cotton again is king. No other can compete with it, and we are drifting back with great rapidity to the state of dependence upon this one source of supply which existed before the cotton famine. No matter what may have been the capabilities and the promises ten years ago of other countries, we are in regard to cotton very much as we were. Turkey does little or nothing more for us; the West Indies have failed to realise our expectations; Queensland and other colonies still send us mere driblets; Brazil and Egypt are limited in their production by a sparse population; and India, after all our efforts and all the appliances which we have introduced, with its model-farms and cotton commissioners, and notwithstanding the golden flood which this precious product has spread over the land, India, with regret and shame it must be confessed, is but little improved as a source of cotton supply. Samples and specimens almost without number, such as may be seen at the present Exhibition, shows what India might do; but little or nothing is done, little or no improvement in the staple of Indian cotton can be found; and though, chiefly through private enterprise in introducing improved machinery for cleaning and preparing it for market, it comes forward in better condition than formerly, it is only by constant vigilance and great exertion that we escape the adulteration and the rubbish which so long made Indian cotton a byword and a reproach. The Indian collection of cotton samples is extensive and various, obtained from the different districts where the plant is cultivated, and presenting carefully selected specimens of the chief indigenous and exotic kinds. Selections from the produce of some of the experimental or model farms afford an opportunity of comparison with the ordinary growth of the ryots in the same district which comes to Manchester in the common course of business. The whole of the Indian cases, including samples of the cottons cleaned at the recent gin trials in Manchester and specimens of dried plants, are well deserving of examination. Bales from the Khangaon press show how the large quantity of cotton which comes to that important mart is prepared for shipment. In the immediate vicinity of the Indian collection are cases of samples from Fiji and Venezeula, showing the capabilities of both for the production of a fine description of cotton. Cases of samples of cotton, chiefly from new sources, and of cotton processes, together with trees procured from America, and covered with bolls, which are exhibited by the Cotton Supply Association, will be found near each other; these, together with specimens showing the results of Major Trevor Clarke's well-known labours in hybridisation, should not be overlooked. A case containing a large collection of Italian cotton in the gallery has attracted considerable attention. It comprises samples from some eighty different localities, or communal territories, which are arranged according to species, and geographically. It is accompanied with a map of Italy, showing the means of communication with the various places from which cotton is obtained, and marking all the lines of the regular postal steamers. On each sample is further marked the means of communication, from the nearest port whence steamers sail, to the place of its growth, showing the distance by road or railway, as the case may be. Considerable interest naturally attaches to the cotton plant in actual growth in a handsome, span-roofed greenhouse, which contains nearly 100 cotton plants, in different stages of growth, of the following varieties:—Sea Island, New Orleans, Egyptian, Sea Island crossed with New Orleans (green seed), Borneo, Chinese, North-West Provinces of India, Hinginhaut, Juree, Vine cotton, Assam, Arboreum, and hybrids raised by Major Clarke, who furnished the seed from which most of the plants were grown. There is an interesting set of plants from East Indian seeds, sent to Kew by the Cotton Commissioner, from experimental farms in the Berars, the Central and North-Western Provinces. Many of the plants are showing the formation of young bolls; they will improve in size and appearance daily, and will probably make such an exhibition as has never before been seen in this or any other country. A complete botanical collection was originally intended, but though this was subsequently abandoned by the Commissioners, there is an almost perfect practical collection of the leading commercial sorts, those only having been omitted which were not likely, from their habit of growth, to show blossom or fruit. A few curious and interesting sorts will be added from time to time from Major Clarke's collection during the season. There are duplicates and spare plants of all or most kinds, which will be removed as the representative plants get bigger, and those doubtless may be had in due course by persons really interested in the subject. The cotton plant shows its capricious disposition to drop bud and boll, on the slightest provocation, as completely in an English hot-house as it does in its own appropriate country, a removal even from one house to another, or from a hot corner to a cool one, being sufficient to induce the provoking phenomenon. As the plants were grown in different places, and then transferred to the Exhibition house almost at the last moment, the peculiarity just mentioned has necessarily occasioned considerable difficulty.

EXHIBITIONS.

Vienna Universal Exhibition of 1873.—A meeting of her Majesty's Commissioners for this Exhibition was held on Wednesday, the 14th inst., at Marlborough-house. There were present—His Royal Highness the Prince of Wales, K.G., the Earl Cathcart, Sir Richard Wallace, Bart., Sir Francis Grant, P.R.A., and Mr. Philip Cunliffe Owen, Secretary.

Domestic Economy Exhibition in Paris.—The Palais de l'Industrie is once again devoted, in part, to an industrial exposition, and on this occasion it is the work of private individuals. The term "domestic economy" is used in the widest sense, for besides wearing apparel, furniture, household utensils, provisions, and potable liquors, preserves and confections of all kinds, the programme includes machinery, fine art, and toys. At present the exhibition is in a very incomplete state, but every day adds to its attractions, and it is already become popular, especially with the working classes on Sunday. The most complete, and, at present, the most attractive section, is that which is devoted to Algerian products; this includes a good natural history collection, quadrupeds, birds, fishes, insects, reptiles, minerals, corals, &c., and a fine collection of timber and ornamental woods; many brilliant samples of native woven tissues, skins, furs, and plumage, fruits, honey, vegetables, wines and spirits; implements of agriculture, pharmaceutical products, antiquities and curiosities. In the garden is a considerable collection of bricks, terra-cotta, and other building materials, specimens of construction, plain and decorative iron work, casts in plaster, and other materials, painted glass, mosaic work, tiles, &c., and apparatus, materials, and decorations for the agriculturist, the nurseryman, the gardener, and the florist. The exhibition is to remain open all the autumn.

CORRESPONDENCE.

DRILL REVIEW ON 25th JULY.

Sir,—Your reporter on this event missed a good point in the Prince of Wales's *extempore* speech in the Albert Hall. He did not address the boys as "boys," but as "My young friends." These words, spoken without premeditation, to those friendless little fellows, was sure to make an acceptable and useful impression on them; and the utterance of them is worth recording.—I am, &c.,

Felix Summerly.

MERCURIAL VAPOURS.

Sir,—Again we are startled with the destruction of health of those who are compelled to work in an atmosphere infected with noxious vapours. It is only lately the fact was promulgated that the weavers were driven into premature decline by the china clay so liberally added to woven fabrics, in order to increase the weight, add to the appearance, and conceal shortness of fibre. Similar circumstances took place some years ago in the match manufactories, when the lower jaws of the workpeople were found to be fatally attacked with "caries," in consequence of the fumes of phosphorus. The remedy in all such cases is very simple and efficacious, for it suffices to have a grated floor, and downward ventilation through the same. This mode is exactly the reverse of the plan of ventilation usually followed, as, for example, in the Houses of Parliament, where th egregious mistake was made of passing the ventilation upwards through a perforated floor, and thereby causing all the effluvia arising from shoe-leather, from the persons and clothes of those present, together with dust and sundry other noxious matters, to be forced up and into all their respiratory organs.

The introduction of fresh air is equally simple by means of a perforated zinc cornice, or even the entire ceiling in lieu of plaster, through which the fresh air would flow in gently, cool in summer and warmed in winter, in the highest part of the hall, room, or workshop. Fine-pierced zinc may be made highly ornamental, and, by stamping and embossing, to almost emulate the beauty of Brussels lace, and can be lacquered white or any fancy tint.

In the case of the above-mentioned mercurial vapours, the remedy proposed by chemical science, a truly professional one, by the bye, is not to remove the mischief, but to introduce some new element or compound that might be likely to absorb or neutralise those pestilential mercurial vapours, an absurd proposal, because we require for our health and comfort to breathe the fresh air of heaven without the artificial admixture of any chemical or other matter whatever.

I am perfectly aware that a tremendous growl will be set up against the inconvenience of having perforated floors, though already in use, but applied to a wrong purpose, as well as against the trouble of exciting downward ventilation.

But we cannot set up with impunity anything that militates against life and health; and there is no doubt that plenty of expedients, patented or otherwise, will be devised in order to remove or alleviate any such imaginary evils.—I am, &c.,

Henry W. Reveley.

Reading, August 12.

SELF-CLEANSING AND SELF-FILLING FILTER.

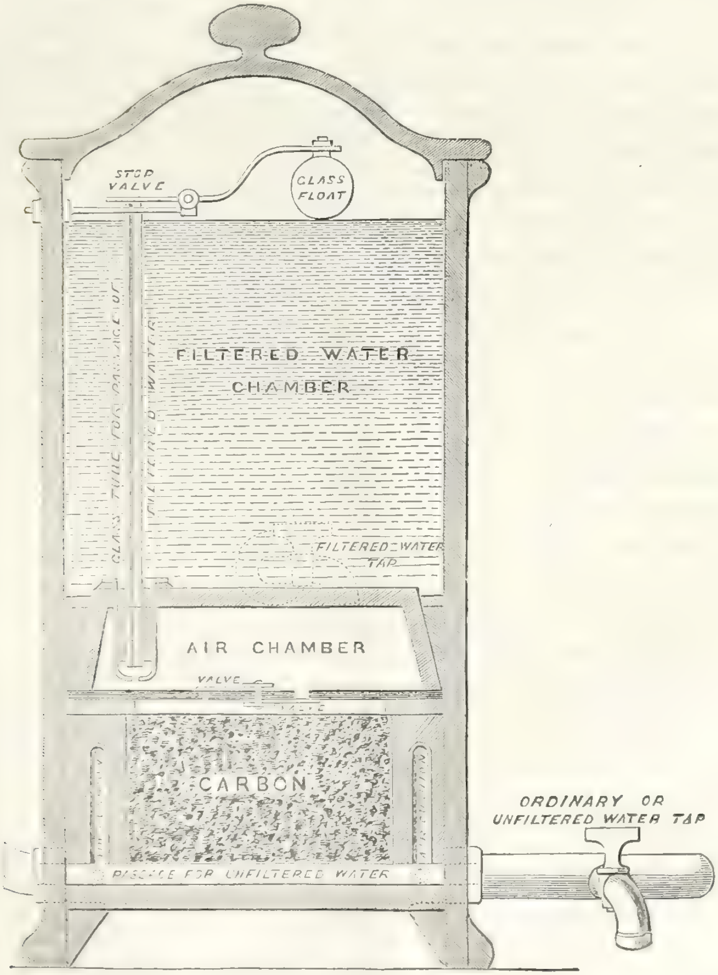
This filter is so constructed that, by being connected with the service pipe, between the cistern and the ordinary tap, all water required for household purposes is made to pass through the bottom of the filter, below the carbon, and is drawn from the ordinary tap in the usual way; this water (which is not filtered) is made the medium for cleansing and supplying the filter by the following arrangement:—The water (in the passage for unfiltered water) ascends by the pressure of the supply through the carbon into the air-chamber, by the small valve thence up through the glass tube into the filtered water-chamber (ready to be drawn off by the tap shown in dotted lines), which, when full, is stopped by the valve worked by the glass float. The water continues to enter the air-chamber until the air is compressed exactly equal to the pressure of the supply, the consequence being that whenever water is drawn from the ordinary tap, the pressure is removed from the under side of the carbon; the compressed air immediately drives back a portion of filtered water through the larger valve, down through the carbon, carrying with it all impurities attached, which are at once flushed away by the water which passes through the bottom of the filter and out at the ordinary tap. The air cushions, shown in the drawing, are inverted tubes placed over the inlet and outlet to prevent concussion, when water drawn from the ordinary tap is cut off suddenly. The advantages are, says the inventor:—

1. A continuous supply of filtered water without any attention whatever.

2. The water is filtered through a perfectly clean filtering medium, the carbon being cleansed every time water is drawn from the ordinary tap.

3. The dirt, which in all other filters remains in the carbon until it is choked up, is by the foregoing arrangement got rid of continually, thereby retaining the purifying power as long as the carbon will last.

4. The water ascends through the carbon very slowly, being regulated by the size of the aperture of the glass-tube, thus insuring perfect filtration.


STOP VALVE
GLASS FLOAT
GLASS TUBE FOR PASSAGE OF FILTERED WATER
FILTERED WATER CHAMBER
FILTERED WATER TAP
AIR CHAMBER
VALVE
VALVE
CARBON
ORDINARY OR UNFILTERED WATER TAP
PASSAGE FOR UNFILTERED WATER

5. As these filters are fixed within doors, they are not exposed to frost, as, in many instances, the cisterns are out of doors.

6. These filters are suitable when the constant service is adopted.

The inventor and maker is Mr. Moore, of 1, Arthur-street East, King William-street, London-bridge.

SLAG AS A BUILDING MATERIAL.

A paper on this subject was recently read before the American Institution of Mining Engineers ,by Mr. S. Egleston. He says:—

In the metallurgy of iron the most cumbersome, expensive, and useless product is the blast furnace slag. The variety and ingenuity of plans proposed to make use of it, or in some way utilise the heat it absorbs, or at least to get rid of it, is only equalled by the persistent want of success which these efforts have, until within a few years, attained. The amount of slag which flows from an ordinary blast furnace in twenty-four hours may be calculated at very nearly twice the production in iron by weight and five or six by bulk. The amount of heat absorbed by, and radiated from this mass of material, if it could be transformed into horse-power, would make very important changes in our present methods of manufacture, and materially diminish the cost of iron. Besides the large amount of heat lost in the slag, it is a constant source of inconvenience, accumulating near the furnace, as a hot, viscous mass, difficult to handle, requiring special tools for its removal, and necessitating the investment of a large amount of capital in land on which to pile it, which brings no return of any kind. The labour spent upon this unproductive substance is often equal to the whole of the productive labour of the furnaces. Hence the amount of skill lavished, first to make use of it, and then to get rid of it.

The first attempt, and for a long time the only one, to use it was in making roads, for which it was simply broken up by hand, and then used like any other stone. Though in itself an excellent road-making material, this form of slag is not well suited for it, and hence, as this is the only use generally known, we find enormous slag heaps, which are often over 100 feet high, served by special engines and cars, in the vicinity of many of our blast furnaces. Happy the company who, like the Hudson Iron Works, can use their slag to fill in shallow bays, and thus, by an actual production of land, turn all their slags to profitable account. In some parts of Europe, where stone is exceedingly scarce, this is the only material for road-making that can be procured in large quantities. Hence, in such countries as Silesia, every effort has been made to make the only material they have as well adapted for the purpose as possible.

The great objection to the use of slags is their brittleness. Hence very early attempts were made to devitrify them at a small cost. This necessitates a cheap fuel, which is generally an exception, and hence the most successful attempts at devitrification have been the accumulation of this slag in large masses, allowing it to cool slowly under considerable pressure. This is the case at Tarnowitch, in Silesia, and elsewhere, where the ground around the furnaces is encumbered for days together with large accumulations of slag, one foot or 18 inches in thickness, which are left to cool. This method is necessarily imperfect. Only the lower half of the slag is devitrified; but, imperfect as it is, it furnishes an excellent material for paving, and the traveller would generally be astonished to learn that the pavement over which he rides is nothing more than imperfectly devitrified blast furnace slag. As only a very small portion of the slag can be used in this way, slag heaps in Silesia would be quite as prominent a feature of the landscape as they are in the Lehigh Valley, if the furnaces were as numerous. The benefit in this case is on the side of the road-maker rather than on that of the iron manufacturer.

The necessity of having building-stone in certain countries of Europe, where it is very scarce, led to a long series of experiments, which, after a multitude of failures, resulted in the manufacture of a very useful product for certain kinds of constructions. These experiments began at a charcoal blast furnace, the slag from which was taken out of the fore-hearth with a ladle, compressed into a mould, and cooled slowly. In order to keep the slag in the hearth from becoming cool, it was covered over with charcoal. A small quantity of the powder of the charcoal became mixed with the slag, and effected a partial devitrification in the moulds. The attempt to apply this exceedingly simple process to a coke furnace failed entirely. The bricks became too porous from the evolution of gases resulting from the admixture of coal-dust. Sand and coke-dust were then substituted, but as the bricks were still fragile they are now annealed in furnaces. This process is applied in Konigshutte, in Silesia, to the manufacture of building material, of which some of the important constructions of the works are built. The slag is run from the furnace into a hemispherical basin on wheels. The bottom of this basin is covered with sand or fine coke-dust, to the depth of about three centimetres. The waggon is then drawn to the point where the bricks are to be made. The slag and sand are mixed together with a curved iron tool until most of the gases have escaped, and the mass is about the consistency of dough. It is then drawn with the same tool into a mould with a hinged cover, and punctured several times to let out the gas. The cover, which fits into the mould, is then turned down, and the slag compressed. By the time three or four moulds have been filled, the first slag brick is sufficiently solid to be removed. This is done by raising a clamp, which allows the mould to separate. The red-hot brick is now drawn into a kiln, covered over with powdered coal, and left to anneal. Each kiln contains 1,000 bricks, and is from three to four days in cooling. Four men can make 500 of these bricks in five hours. The loss in the manufacture from the breakage is about twenty per cent. The cost of annealing is about two thalers per 1,000. These bricks are rough on their surfaces, but, on account of their larger size, do not require more mortar than an ordinary brick. They do not readily absorb moisture, and for that reason are extensively used in the construction of foundations. The pillars supporting the main windpipes at Konigshutte are built of this material. In Silesia these bricks cost 25 per cent. less than ordinary brick.

A brick much inferior to this in every respect is made in the Hartz mountains out of the lead furnace slags, which are silicates of iron. These are moulded and compressed, and are used for buildings. As the bricks are very brittle, the constructions in which they are used are generally covered with a coat of mortar. The buildings of the immense mechanical preparation works of Clansthal are built of this material.

Mr. Sepulcre, a Belgian engineer, was one of the first who successfully transformed the slag into a stone which could be generally used. This he effected by causing the slag channels to terminate in an excavation, the sides of which had an inclination of about 30 deg., and with a capacity varied from half to ten cubic metres. The very steep inclination of the sides causes the section of the pits to increase very rapidly, and this allows the solid crust, which forms on the surface of the liquid slag, to rise with it without becoming attached. The slag must flow continuously into the excavation, and if, from any cause, there is an interruption, the crust must be raised, to allow of the liquid material flowing underneath. In this manner the whole mass of slag in the pit is sure to be all liquid, and will solidify from above and under pressure. After the excavation is full, it is left for five to ten days to cool, the only precaution required being to cover the top with ashes or sand to a sufficient depth to prevent the mass cooling too rapidly. The stone so produced grows hard on exposure to the air. When first made it can be easily broken into any required shape, but after exposure for a period more or less long, it becomes so much harder as to require double the number of tools to work it.

All kinds of slag are not suitable for this manufacture; those which contain too much lime fall to pieces on exposure. In general, it may be said that they should contain from 38 to 44 per cent. of silica, and that the furnace should be working well.

According to experiments made at the Conservatoire des Arts et Metiers, in Paris, this stone, when made from slag, while the furnace was running on white iron, never became fissured under a pressure of less than 242 kilogrammes the square centimetre, and was crushed at a pressure of 886 kilogrammes as a minimum. When made from gray iron, they do not crush under a pressure of less than 405 kilogrammes, but they have fissures at a pressure as low as 222 kilogrammes, or a little less than the white iron slags. This material is, therefore, stronger than the best marble.

One of the Belgian furnaces, which produces 2,500 tons of slag in thirty days, made from it 1,177 cubic metres of stone. The expense of manufacture was 820 dollars. The material sold for 1,600 dollars, making a profit of 780 dollars in thirty days; 70 per cent of the slag produced was profitably used. In order to introduce it the price was put 25 per cent. lower than ordinary stone.

In certain parts of Germany, and during the late war in our own country, basalt and certain volcanic rocks were used in the manufacture of glass. But little is wanting in certain blast furnace slags to make them of the same composition as basalt, and this fact suggested their use in the manufacture of glass. The experiments which were made with slag were so successful that in some parts of Belgium some of the glass makers have contracted with the blast furnaces to furnish them a certain amount of slag every week. One furnace, producing thirty tons of cast iron in 24 hours, that I visited during the last summer, furnished one day's run of slag per week to the glass makers. To prepare it for this use the slag is run out on cast-iron plates and cooled with water.

Attempts have been made in some parts of Europe to use the heat evolved by the slags for domestic purposes. The most simple and the most practical one is the employment of the heat of the slag by the men for cooking, or heating their food already cooked. Attempts have been made to use it for heating the houses near the furnace, by allowing it to run into iron moulds and placing them in a drum; but the expense attendant upon it, and the trouble of constantly changing the slags, probably cost more than the saving of fuel, and undoubtedly kept the unfortunate persons who were subject to this expensive economy in an uncomfortable state both of mind and body.

Mr. Minary, director of the Franche Comté Iron Company, conceived the idea of using the slags by granulating them as they flow from the furnace. To do this the trough through which the slags run is made to terminate in a stream of water which has sufficient velocity to carry the grains of slag into a pit prepared for it, from which it is charged into waggons, without further expense, by an endless chain with buckets. The engine for this purpose is run by the gases of the furnace, and requires scarcely a horse-power. In these works, which consist of five blast furnaces, each producing 20 tons in twenty-four hours, the introduction of this improvement resulted in a saving of the wages of twenty men occupied in charging the slags, and of five blacksmiths who prepared their tools. Much larger waggons were brought to the furnace, which, as the granulated slag can be discharged at any height by the endless chain, were for the most part railroad cars. No one is now employed to look after the slags, as the whole of the work can be done by the founder and his assistant. The saving thus effected amounts to 5,000 or 6,000 francs a year, whilst the cost of granulation does not exceed ·07 dollars the ton of slag. This rendered the slag portable by the ordinary methods of transportation, did away with all the special tools formerly used, and reduced the labour of getting rid of the slag to almost nothing.

The granulated slag was first used as gravel in the works, and to make the bed of the casting-house. It was found that from such a casting bed the pigs came out clean and bright, preferred by the puddlers even to that cast in iron moulds. This method of using the slag is now of almost universal application in the Siegen district, in Prussia, where most of the furnaces run on spiegel. The grains of iron which the slag contains were formerly separated by stamping. They are now separated by granulation, and are carried in a receptacle for the purpose, while the light porous slag is carried off by the water, thus avoiding the expense of crushing and washing, to which all the furnaces were subjected before the method of granulation was introduced. It is also extensively used in some parts of France and Belgium.

THE BRITISH ASSOCIATION.

The annual meeting of the British Association for the Advancement of Science commenced on Wednesday, the 14th inst., at Brighton. The first general meeting was held in the dome of the Pavilion, at 8 p.m., when the retiring President, Sir William Thompson, resigned the chair to his successor, Dr. William B. Carpenter, LL.D., F.R.S., F.L.S., F.G.S., who delivered the inaugural address.

Dr. Carpenter began by a reference to his recollections of the first meeting of the Association at Bristol, 36 years ago, and of the great men who took part in it, of whom only a few are now remaining. He next referred to the Deep-Sea Sounding Expedition about to be despatched by the Admiralty, under the command of Captain Nares, and under the scientific charge of Professor Wyville Thomson, and to the results of the Eclipse Expedition of last year. He then proceeded as follows:—

Man as the Interpreter of Nature.

It has been customary with successive occupants of this chair to open the proceedings of the meeting over which they respectively presided with a discourse on some aspect of Nature in her relation to man. But I am not aware that any one of them has taken up the other side of the inquiry—that which concerns man as the "Interpreter of Nature;" and I have therefore thought it not inappropriate to lead you to the consideration of the mental processes by which are formed those fundamental conceptions of matter and force, of cause and effect, of law and order, which furnish the basis of all scientific reasoning and constitute the *Philosophia primá* of Bacon. There is a great deal of what I cannot but regard as fallacious and misleading philosophy—"oppositions of science," falsely so-called—abroad in the world at the present time. And I hope to satisfy you that those who set up their own conceptions of the orderly sequence which they discern in the phenomena of Nature as fixed and determinate laws, by which those phenomena not only are, but always have been, and always must be, invariably governed, are really guilty of the intellectual arrogance they condemn in the systems of the ancients, and place themselves in antagonism to those real philosophers by whose grasp and insight that order has been so far disclosed. For what love of the truth as it is in Nature was ever more conspicuous than that which Kepler displayed in his abandonment of each of the conceptions of the planetary system which his imagination had successively devised so soon as it proved to be inconsistent with the facts disclosed by observation? In that almost admiring description of the way in which his enemy Mars, "whom he had left at home a despised captive," had "burst all the chains of the equations, and broke forth from the prisons of the tables," who does not recognise the justice of Schiller's definition of the real philosopher—as one who always loves truth better than his system? And when at last he had gained the full assurance of a success so complete that (as he says) he thought he must be dreaming, or that he had been reasoning in a circle, who does not feel the almost sublimity of the self-abnegation with which, after attaining what was in his own estimation such a glorious reward of his life of toil, he abstains from claiming the applause of his contemporaries, but leaves his fame to after ages, in these noble words:—"The book is written; to be read either now, or by posterity, I care not which. It may well wait a century for a reader, as God has waited 6,000 years for an observer." And when a yet greater than Kepler was bringing to its final issue that grandest of all scientific conceptions, long pondered over by his almost superhuman intellect, which linked together the heavens and the earth in the *nexus* of a universal attraction, establishing the truth for whose utterance Galileo had been condemned, and giving to Kepler's laws a significance of which their author had never dreamed—what was the meaning of that agitation which prevented the philosopher from completing his computation, and compelled him to hand it over to his friend? That it was not the thought of his own greatness, but the glimpses of the grand universal order thus revealed to his mental vision, which shook the soul of Newton to its foundations, we have the proof in that comparison in which he likened himself to a child picking up shells on the shore of the vast ocean of truth—a comparison which will be evidence to all time at once of his true philosophy and of his profound humility. Though it is with the intellectual representation of Nature which we call science that we are primarily concerned, it will not be without its use to cast a glance in the first instance at the other two principal characters under which man acts as her interpreter—those, namely, of the artist and of the poet. The artist serves as the interpreter of Nature, not when he works as the mere copyist, delineating that which he sees with his bodily eyes, and which we could see as well for ourselves, but when he endeavours to awaken within us the perception of those beauties and harmonies which his own trained sense has recognised, and thus impart to us the pleasure he has himself derived from their contemplation. As no two artists agree in the original constitution and acquired habits of their minds, all look at Nature with different (mental) eyes; so that to each Nature is what he individually sees in her. The poet, again, serves as the interpreter of Nature, not so much when, by skilful word-painting (whether in prose or verse) he calls up before our mental vision the picture of some actual or ideal scene, however beautiful, as when, by rendering into appropriate forms those deeper impressions made by the Nature around him on the moral and emotional part of his own nature, he transfers these impressions to the corresponding part of ours. For it is the attribute of the true poet to penetrate the secret of those mysterious influences which we all unknowingly experience; and having discovered this to himself, to bring others, by the power he thus wields, into the like sympathetic relation with Nature, evoking with skilful touch the varied response of the soul's finest chords, heightening its joys, assuaging its griefs, and elevating its aspirations. While, then, the artist aims to picture what he sees in Nature, it is the object of the poet to represent what he feels in Nature; and to each true poet Nature is what he individually finds in her. The philosopher's interpretation of Nature seems less individual than that of the artist or the poet, because it is based on facts which anyone may verify, and is elaborated by reasoning processes, of which all admit the validity. He looks at the universe as a vast book lying open before him, of which he has, in the first place, to learn the characters, then to master the language, and, finally, to apprehend the ideas which that language conveys. In that book there are many chapters, treating of different subjects; and as life is too short for any one man to grasp the whole, the scientific interpretation of this book comes to be the work of many intellects, differing not merely in the range, but also in the character of their powers. But while there are "diversities of gifts," there is "the same spirit." While each takes his special direction, the general method of study is the same for all. And it is a testimony alike to the truth of that method and to the unity of Nature that there is an ever-increasing tendency towards agreement among those who use it aright. Temporary differences of interpretation being removed, sometimes by a more complete mastery of her language, sometimes by a better apprehension of her ideas, lines of pursuit which had seemed entirely distinct or even widely divergent are found to lead at last to one common goal. And it is this agreement which gives rise to the general belief—in many, to the confident assurance—that the scientific interpretation of Nature represents her not merely as she seems, but as she really is. When, however, we carefully examine the foundation of that assurance, we find reason to distrust its security; for it can be shown to be no less true of the scientific conception of Nature than it is of the artistic or the poetic, that it is a representation framed by the mind itself out of the materials supplied by the impressions which external objects make upon the senses, so that to each man of science Nature is what he individually believes her to be. And that belief will rest on very different bases, and will have very unequal values, in different departments of science. Thus in what are commonly known as the "exact" sciences, of which astronomy may be taken as the type, the data afforded by precise methods of observation can be made the basis of reasoning, in every step of which the mathematician feels the fullest assurance of certainty; and the final deduction is justified either by its conformity to known or ascertainable facts, as when Kepler determined the elliptic orbit of Mars; or by the fulfilment of the predictions it has sanctioned, as in the occurrence of an eclipse or an occultation at the precise moment specified many years previously; or, still more emphatically, by the actual discovery of phenomena till then unrecognised, as when the perturbations of the planets, shown by Newton to be the necessary results of their mutual attraction, were proved by observation to have a real existence; or as when the unknown disturber of Uranus was found in the place assigned to him by the computations of Adams and Le Verrier. We are accustomed, and I think most rightly, to speak of these achievements as triumphs of the human intellect. But the very phrase implies tha the work is done by mental agency, and the coincidence of its results with the facts of observation is far from proving the intellectual process to have been correct. For we learn from the confessions of Kepler that he was led to the discovery of the elliptic orbit of Mars by a series of happy accidents, which turned his erroneous guesses into the right direction; and to that of the passage of the radius vector over equal areas in equal times by the motion of a whirling force emanating from the sun, which we now regard as an entirely wrong conception of the cause of orbital revolution. It should always be remembered, moreover, that the Ptolemaic system of astronomy, with all its cumbrous ideal mechanism, did intellectually represent all that the astronomer, prior to the invention of the telescope, could see from his standpoint, the earth, with an accuracy which was proved by the fulfilment of his anticipations. And in that last and most memorable prediction, which has given an imperishable fame to our two illustrious contemporaries, the inadequacy of the basis afforded by actual observation of the perturbations of Uranus, required that it should be supplemented by an assumption of the probable distance of the disturbing planet beyond, which has been shown by subsequent observation to have been only an approximation to the truth. Even in this most exact of sciences, therefore, we cannot proceed a step without translating the actual phenomena of Nature into intellectual representations of those phenomena; and it is because the Newtonian conception is not only the most simple, but is also, up to the extent of our present knowledge, universal in its conformity to the facts of observation, that we accept it as the only scheme of the universe yet promulgated which satisfies our intellectual requirements. When, under the reign of the Ptolemaic system, any new inequality was discovered in the motion of a planet, a new wheel had to be added to the ideal mechanism,—as Ptolemy said, "to save appearances." If it should prove, a century hence, that the motion of Neptune himself is disturbed by some other attraction than that exerted by the interior planets, we should confidently expect that not an ideal but a real cause for that disturbance will be found in the existence of another planet beyond. But I trust that I have now made it evident to you that this confident expectation is not justified by any absolute necessity of Nature, but arises entirely out of our belief in her uniformity; and into the grounds of this and other primary beliefs, which serve as the foundation of all scientific reasoning, we shall presently inquire. There is another class of cases, in which an equal certainty is generally claimed for conclusions that seem to flow immediately from observed facts, though really evolved by intellectual processes; the apparent simplicity and directness of those processes either causing them to be overlooked or veiling the assumptions on which they are based. Thus, Mr. Lockyer speaks as confidently of the sun's chromosphere of incandescent hydrogen, and of the local outbursts which cause it to send forth projections tens of thousands of miles high, as if he had been able to capture a flask of this gas, and had generated water by causing it to unite with oxygen. Yet this confidence is entirely based on the assumption that a certain line which is seen in the spectrum of a hydrogen flame means hydrogen also when seen in the spectrum of the sun's chromosphere; and high as is the probability of that assumption, it cannot be regarded as a demonstrated certainty, since it is by no means inconceivable that the same line might be produced by some other substance at present unknown. And so when Dr. Huggins deduces from the different relative positions of certain lines in the spectra of different stars that these stars are moving from or towards us in space, his train of reasoning is based on the assumption that these lines have the same meaning—that is, that they represent the same elements—in every luminary. That assumption, like the preceding, may be regarded as possessing a sufficiently high probability to justify the reasoning based upon it; more especially since, by the other researches of that excellent observer, the same chemical elements have been detected as vapours in those filmy cloudlets which seem to be stars in an early stage of consolidation. But when Frankland and Lockyer, seeing in the spectrum of the yellow solar prominences a certain bright line not identifiable with that of any known terrestrial flame, attribute this to a hypothetical new substance which they propose to call helium, it is obvious that their assumption rests on a far less secure foundation, until it shall have received that verification which, in the case of Mr. Crookes' researches on thallium, was afforded by the actual discovery of the new metal, the presence of which had been indicated to him by a line in the spectrum not attributable to any substance then known.

Common Sense as the Basis of Scientific Inquiry.

In a large number of other cases, moreover, our scientific interpretations are clearly matters of judgment; and this is eminently a personal act, the value of its results depending in each case upon the qualifications of the individual for arriving at a correct decision. The surest of those judgments are those dictated by what we term "common sense," as to matters on which there seems no room for difference of opinion, because every sane person comes to the same conclusion, although he may be able to give no other reason for it than that it appears to him "self-evident." Thus, while philosophers have raised a thick cloud of dust in the discussion of the basis of our belief in the existence of a world external to ourselves—of the Non Ego, as distinct from the Ego—and while every logician claims to have found some flaw in the proof advanced by every other, the common sense of mankind has arrived at a decision that is practically worth all the arguments of all the philosophers who have fought again and again over this battle-ground. And I think it can be shown that the trustworthiness of this common-sense decision arises from its dependence, not on any one set of experiences, but upon our unconscious co-ordination of the whole aggregate of our experiences; not on the conclusiveness of any one train of reasoning, but on the convergence of all our lines of thought towards this one centre. Now, this "common sense," disciplined and enlarged by appropriate culture, becomes one of our most valuable instruments of scientific inquiry; affording in many instances the best, and sometimes the only basis for a rational conclusion. Let us take as a typical case, in which no special knowledge is required, what we are accustomed to call the "flint implements" of the Abbeville and Amiens gravel-beds. No logical proof can be adduced that the peculiar shapes of these flints were given to them by human hands; but does any unprejudiced person now doubt it? The evidence of design, to which, after an examination of one or two such specimens, we should only be justified in attaching a probable value, derives an irresistible cogency from accumulation. On the other hand, the improbability that these flints acquired their peculiar shape by accident becomes to our minds greater and greater as more and more such specimens are found; until at last this hypothesis, although it cannot be directly disproved, is felt to be almost inconceivable, except by minds previously "possessed" by the "dominant idea" of the modern origin of man. And thus what was in the first instance a matter of discussion has now become one of those "self-evident" propositions which claim the unhesitating assent of all whose opinion on the subject is entitled to the least weight. We proceed upwards, however, from such questions as the common sense of mankind generally is competent to decide, to those in which special knowledge is required to give value to the judgment; and thus the interpretation of Nature by the use of that faculty comes to be more and more individual; things being perfectly "self-evident" to men of special culture which ordinary men, or men whose training has lain in a different direction, do not apprehend as such. Of all departments of science, geology seems to me to be the one that most depends on this specially-trained 'common sense;' which brings as it were into one focus the light afforded by a great variety of studies—physical and chemical, geographical and biological—and throws it on the pages of that great stone book on which the past history of our globe is recorded. And while astronomy is of all sciences that which may be considered as most nearly representing Nature as she really is, geology is that which most completely represents her as seen through the medium of the interpreting mind; the meaning of the phenomena that constitutes its data being in almost every instance open to question, and the judgments passed upon the same facts being often different according to the qualifications of the several judges. No one who has even a general acquaintance with the history of this department of science can fail to see that the geology of each epoch has been the reflection of the minds by which its study was then directed; and that its true progress dates from the time when that "common-sense" method of interpretation came to be generally adopted which consists in seeking the explanation of past changes in the forces at present in operation, instead of invoking the aid of extraordinary and mysterious agencies, as the older geologists were wont to do whenever they wanted—like the Ptolemaic astronomers —"to save appearances." The whole tendency of the ever-widening range of modern geological inquiry has been to show how little reliance can be placed upon the so-called "laws" of stratigraphical and palæontological succession, and how much allowance has to be made for local conditions. So that while the astronomer is constantly enabled to point to the fulfilment of his predictions as an evidence of the correctness of his method, the geologist is almost entirely destitute of any such means of verification. For the value of any prediction that he may hazard—as in regard to the existence or non-existence of coal in any given area—depends not only upon the truth of the general doctrines of geology in regard to the succession of stratified deposits, but still more upon the detailed knowledge which he may have acquired of the distribution of those deposits in the particular locality. Hence, no reasonably-judging man would discredit either the general doctrines or the methods of geology because the prediction proves untrue in such a case as that now about to be brought in this neighbourhood to the trial of experience. We have thus considered man's function as the scientific interpreter of nature in two departments of natural knowledge, one of which affords an example of the strictest and the other of the freest method which man can employ in constructing his intellectual representation of the universe. And as it would be found that in the study of all other departments the same methods are used either separately or in combination, we may pass at once to the other side of our inquiry—namely, the origin of those primary beliefs which constitute the ground work of all scientific reasoning. The whole fabric of geometry rests upon certain axioms which every one accepts as true, but of which it is necessary that the truth should be assumed, because they are incapable of demonstration. So, too, the deliverances of our common-sense derive their trustworthiness from what we consider the "self-evidence" of the propositions affirmed. This inquiry brings us face to face with one of the great philosophical problems of our day, which has been discussed by logicians and metaphysicians of the very highest ability as leaders of opposing schools, with the one result of showing how much can be said on each side. By the intuitionalists it is asserted that the tendency to form primary beliefs is inborn in man, an original part of his mental organisation; so that they grow up spontaneously in his mind as its faculties are gradually unfolded and developed, requiring no other experience for their genesis than that which suffices to call these faculties into exercise. But by the advocates of the doctrine which regards experience as the basis of all our knowledge, it is maintained that the primary beliefs of each individual are nothing less than generalisations which he forms of such experiences as he has either himself acquired or has consciously learnt from others, and they deny that there is any original or intuitive tendency to the formation of such beliefs beyond that which consists in the power of retaining and generalising experiences. I have not introduced this subject with any idea of placing before you even a summary of the ingenious arguments by which these opposing doctrines have been respectively supported; nor should I have touched on the question at all, if I did not believe that a means of reconcilement between them can be found in the idea that the intellectual intuitions of any one generation are the embodied experiences of the previous race. For, as it appears to me, there has been a progressive improvement in the thinking power of man, every product of the culture which has preceded serving to prepare the soil for yet more abundant harvests in the future. Now, as there can be no doubt of the hereditary transmission in man of acquired constitutional peculiarities, which manifest themselves alike in tendencies to bodily and to mental disease, so it seems equally certain that acquired mental habitudes often impress themselves on his organisation with sufficient force and permanence to occasion their transmission to the offspring as tendencies to similar modes of thought. And thus, while all admit that knowledge cannot thus descend from one generation to another, an increased aptitude for the acquirement, either of knowledge generally or of some particular kind of it, may be thus inherited. These tendencies and aptitudes will acquire additional strength, expansion, and permanence in each new generation, from their habitual exercise upon the materials supplied by a continually enlarged experience; and thus the acquired habitudes produced by the intellectual culture of ages will become "a second nature" to every one who inherits them. We have an illustration of this progress in the fact of continual occurrence that conceptions which prove inadmissible to the minds of one generation, in consequence either of their want of intellectual power to apprehend them, or of the preoccupation by other habits of thought, subsequently find a universal acceptance, and even come to be approved as "self-evident." Thus, the first law of motion, divined by the genius of Newton, though opposed by many philosophers of his time as contrary to all experience, is now accepted by common consent, not merely as a legitimate inference from experiment, but as the expression of a necessary and universal truth; and the same axiomatic value is extended to the still more general doctrine that energy of any kind, whether manifested in the "molar" motion of masses, or consisting in the "molecular" motion of atoms, must continue under some form or other without abatement or decay; what all admit in regard to the indestructibility of matter being accepted as no less true of force—namely, that as *ex nihilo nil fit*, so *nil fit ad nihilum*. But, it may be urged, the very conception of these and similar great truths is in itself a typical example of intuition. The men who divined and enunciated them stand out above their fellows, as possessed of a genius which could not only combine but create, of an insight which could clearly discern what reason could but dimly shadow forth. Granting this freely, I think it may be shown that the institutions of individual genius are but specially exalted forms of endowments which are the general property of the race at the time, and which have come to be so in virtue of its whole previous culture. Who, for example, could refuse to the marvellous aptitude for perceiving the relations of numbers which displayed itself in the untutored boyhood of George Bidder and Zerah Colburn the title of an intuitive gift? But who, on the other hand, can believe that a Bidder or a Colburn could suddenly arise in a race of savages who cannot count beyond five? Or, again, in the history of the very earliest years of Mozart, who can fail to recognize the dawn of that glorious genius, whose brilliant but brief career left its imperishable impress on the art it enriched? But who would be bold enough to affirm that an infant Mozart could be born among a tribe whose only musical instrument is a tom-tom, whose only song is a monotonous chant? Again, by tracing the gradual genesis of some of those ideas which we now accept as "self-evident"—such, for example, as that of "uniformity of nature"—we are able to recognise them as the expressions of certain intellectual tendencies which have progressively augmented in force in successive generations, and now manifest themselves as mental instincts that penetrate and direct our ordinary course of thought. Such instincts constitute a precious heritage, which has been transmitted to us with ever-increasing value through the long succession of previous generations, and which it is for us to transmit to those who shall come after us, with all that further increase which our higher and wider range of knowledge can impart. And now, having studied the working action of the human intellect in the scientific interpretation of nature, we shall examine the general character of its products; and the first of these with which we shall deal is our conception of matter and of its relation of force.

Matter in Relation to Force.

The psychologist of the present day views matter entirely through the light of his own consciousness; his idea of matter in the abstract being that it is a "something" which has a permanent power of exciting sensations, his idea of any "property" of matter being the mental representation of some kind of sensory impression he has received from it; and his idea of any particular kind of matter being the representation of the whole aggregate of the sense-perceptions which its presence has called up in his mind. Thus, when I press my hand against this table, I recognise its unyieldingness through the conjoint medium of my sense of touch, my muscular sense, and my mental sense of effort, to which it will be convenient to give the general designation of the tactile sense; and I attribute to that table a hardness which resists the effort I make to press my hand into its substance, while I also recognise the fact that the force I have employed is not sufficient to move its mass. But I press my hand against a lump of dough, and finding that its substance yields to my pressure, I call it soft. Or, again, I press my hand against this desk, and I find that although I do not thereby change its form, I change its place; and so I get the tactile idea of motion. Again, by the impressions received through the same sensorial apparatus, when I lift this book in my hand, I am led to attach to it the notion of weight or ponderosity; and by lifting different solids of about the same size, I am enabled, by the different degrees of exertion I find myself obliged to make in order to sustain them, to distinguish some of them as light, and others as heavy. Through the medium of another set of sense-perceptions, which some regard as belonging to a different category, we distinguish between bodies that feel "hot" and those that feel "cold;" and in this manner we arrive at the notion of differences of temperature. And it is through the medium of our tactile sense, without any aid from vision, that we first gain the idea of solid form, or the three dimensions of space. Again, by the extension of our tactile experiences, we acquire the notion of liquids, as forms of matter yielding readily to pressure, but possessing a sensible weight which may equal that of solids; and of air, whose resisting power is much slighter, and whose weight is so small that it can only be made sensible by artificial means. Thus, then, we arrive at the notions of resistance and of weight as properties common to all forms of matter; and now that we have got rid of that idea of light and heat, electricity and magnetism, as "imponderable fluids," which used to vex our souls in our scientific childhood, and of which the popular term "electric fluid" is a "survival," we accept these properties as affording the practical distinction between the "material" and the "immaterial." Turning, now, to that other great portal of sensation, the sight, through which we receive most of the messages sent from the universe around, we recognise the same truth. Thus, it is agreed alike by physicists and physiologists, that colour does not exist as such in the object itself; which has merely the power of reflecting or transmitting a certain number of millions of undulations in a second; and these only produce that affection of our consciousness which we call colour when they fall upon the retina of the living percipient. And if there be that defect either in the retina or in the apparatus behind it which we call "colour blindness," or Daltonism. some particular hues cannot be distinguished, or there may even be no power of distinguishing any colour whatever. If we were all like Dalton, we should see no difference, except in form, between ripe cherries hanging on a tree and the green leaves around them; if we were all affected with the severest form of colour-blindness, the fair face of nature would be seen by us as in the chiaroscuro of an engraving of one of Turner's landscapes, not as in the glowing hues of the wondrous picture itself. And in regard to our visual conceptions, it may be stated with perfect certainty, as the result of very numerous observations made upon persons who have acquired sight for the first time, that these do not serve for the recognition even of those objects with which the individual had become most familiar through the touch, until the two sets of sense perceptions have been co-ordinated by experience. Thus, in a recently recorded case, in which sight was imparted by operation to a young woman who had been blind from birth, but who had nevertheless learnt to work well with her needle, when the pair of scissors she had been accustomed to use was placed before her, though she described their shape, colour, and glistening metallic character, she was utterly unable to recognise them as scissors until she put her finger on them, when she at once named them, laughing at her own stupidity (as she called it) in not having made them out before. When once this co-ordination has been effected, however, the composite perception of form which we derive from the visual sense alone is so complete that we seldom require to fall back upon the touch for any further information respecting that quality of the object. So, again, while it is from the co-ordination of the two dissimilar pictures formed by any solid or projecting object upon our two retinæ that (as Sir Charles Wheatstone's admirable investigations have shown) we ordinarily derive through the sight alone a correct notion of its solid form, there is adequate evidence that this notion also is a mental judgment based on the experience we have acquired in early infancy by the consentaneous exercise of the visual and tactile senses. Take, again, the case of those wonderful instruments by which our visual range is extended almost into the infinity of space or into the infinity of minuteness. It is the mental, not the bodily, eye that takes cognisance of what the telescope and the microscope reveal to us. For we should have no well-grounded confidence in their revelations as to the unknown if we had not first acquired experience in distinguishing the true from the false by applying them to known objects; and every interpretation of what we see through their instrumentality is a mental judgment as to the probable form, size, and movement of bodies removed by either their distance or their minuteness from being cognosced by our sense of touch. The case is still stronger in regard to that last addition to our scientific *armamentum*, which promises to be not inferior in value either to the telescope or the microscope; for it may be truly said of the spectroscope that it has not merely extended the range of our vision, but has almost given us a new sense by enabling us to recognise distinctive properties in the chemical elements which were previously quite unknown. And who shall now say that we know all that is to be known as to any form of matter, or that the science of the fourth quarter of this century may not furnish us with as great an enlargement of our knowledge of its properties, and of our power of recognising them, as that of its third has done? But it may be said, is not this view of the material universe open to the imputation that it is "evolved out of the depths of our own consciousness"—a projection of our own intellect into what surrounds us—an ideal rather than a real world? If all we know of matter be an "intellectual conception," how are we to distinguish this from such as we form in our dreams, for these, as our Laureate no less happily than philosophically expresses it, are "true while they last." Here our "common sense" comes to the rescue. We "awake and behold it was a dream." Every healthy mind is conscious of the difference between his waking and his dreaming experiences, or, if he is now and then puzzled to answer the question "Did this really happen, or did I dream it?" the perplexity arises from the consciousness that it might have happened. And every healthy mind, finding its own experiences of its waking state not only self-consistent, but consistent with the experiences of others, accepts them as the basis of his beliefs, in preference to even the most vivid recollections of his dreams. The lunatic pauper who regards himself as a king, the asylum in which he is confined as a palace of regal splendour, and his keepers as obsequious attendants, is so "possessed" by the conception framed by his disordered intellect that he does project it out of himself into his surroundings; his refusal to admit the corrective teaching of common sense being the very essence of his malady. And there are not a few persons abroad in the world who equally resist the teachings of educated common sense whenever they run counter to their own preconceptions, and who may be regarded as—in so far—affected with what I once heard Mr. Carlyle pithily characterise as a "diluted insanity." It has been asserted over and over again of late years, by a class of men who claim to be the only true interpreters of Nature, that we know nothing but matter and the laws of matter, and that force is a mere fiction of the imagination. May it not be affirmed, on the other hand, that while our notion of matter is a conception of the intellect, force is that of which we have the most direct—perhaps even the only direct—cognisance? As I have already shown you, the knowledge of resistance and of weight which we gain through our tactile sense is derived from our own perception of exertion; and in vision, as in hearing, it is the force with which the undulations strike the sensitive surface that affects our consciousness with sights or sounds. True it is that in our visual and auditory sensations we do not, as in our tactile, directly cognosce the force which produces them; but the physicist has no difficulty in making sensible to us indirectly the undulations by which sound is propagated, and in proving to our intellect that the force concerned in the transmission of light is really enormous. It seems strange that those who make the loudest appeal to experience as the basis of all knowledge, should thus disregard the most constant, the most fundamental, the most direct of all experiences; as to which the common sense of mankind affords a guiding light much clearer than any that can be seen through the dust of philosophical discussion. For, as Sir John Herschel most truly remarked, the universal consciousness of mankind is as much in accord in regard to the existence of a real and intimate connection between cause and effect as it is in regard to the existence of an external world; and that consciousness arises to every one out of his own sense of personal exertion in the origination of changes by his individual agency. Now, while fully accepting the logical definition of cause as the "antecedent or concurrence of antecedents on which the effect is invariably and unconditionally consequent," we can always single out one dynamical antecedent—the power which does the work—from the aggregate of material conditions under which that power may be distributed and applied. No doubt the term "cause" is very loosely employed in popular phraseology; often (as Mr. Mill has shown) to designate the occurrence that immediately preceded the effect—as when it is said that the spark which falls into a barrel of gunpowder is the cause of its explosion, or that the slipping of a man's foot off the rung of a ladder is the cause of his fall. But even a very slightly trained intelligence can distinguish the power which acts in each case from the conditions under which it acts. The force which produces the explosion is locked up, as it were, in the powder; and ignition merely liberates it by bringing about new chemical combinations. The fall of the man from the ladder is due to the gravity which was equally pulling him down while he rested on it; and the loss of support, either by the slipping of his foot or by the breaking of the rung, is merely that change in the material conditions which gives the power a new action. Many of you have doubtless viewed with admiring interest that truly wonderful work of human design, the Walter printing machine. You first examine it at rest; presently comes a man who simply pulls a handle towards him, and the whole inert mechanism becomes instinct with life—the blank paper continually rolling off the cylinder at one end, being delivered at the other, without any intermediate human agency, as large sheets of print, at the rate of 15,000 in an hour. Now, what is the cause of this most marvellous effect? Surely it lies essentially in the power or force which the pulling of the handle brings to bear on the machine from some extraneous source of power, which we in this instance know to be a steam-engine on the other side of the wall. This force it is which, distributed through the various parts of the mechanism, really performs the action of which each is the instrument; they only supply the vehicle for its transmission and application. The man comes again, pushes the handle in the opposite direction, detaches the machine from the steam-engine, and the whole comes to a stand; and so it remains, like an inanimate corpse, until re-called to activity by the renewal of its moving power. But, say the reasoners who deny that force is anything else than a fiction of the imagination, the revolving shaft of the steam-engine is "matter in motion;" and when the connection is established between that shaft and the one that drives the machine, the motion is communicated from the former to the latter, and thence distributed to the several parts of the mechanism. This account of the operation is just what an observer might give who had looked on with entire ignorance of everything but what his eyes could see; the moment he puts his hand upon any part of the machinery and tries to stop its motion he takes as direct cognizance, through his sense of the effort required to resist it, of the force which produces that motion as he does through his eye of the motion itself. Now, since it is universally admitted that our notion of the external world would be not only incomplete, but erroneous, if our visual perceptions were not supplemented by our tactile, so, as it seems to me, our interpretation of the phenomena of the universe must be very inadequate if we do not mentally coordinate the idea of force with that motion, and recognize it as the "efficient cause" of those phenomena —the "material conditions" constituting (to use the old scholastic term) only "their formal cause." And I lay the greater stress on this point, because the mechanical philosophy of the present day tends more and more to express itself in terms of motion rather than in terms of force—to become kinetics, instead of dynamics.

Value of Kepler's Laws.

Thus, from whatever side we look at this question—whether the common sense of mankind, the logical analysis of the relation between cause and effect, or the study of the working of our own intellects in the interpretation of nature—we seem led to the same conclusion —that the notion of force is one of those elementary forms of thought with which we can no more dispense than we can with the notion of space or of succession. And I shall now, in the last place, endeavour to show you that it is the substitution of the dynamical for the mere phenomenal idea which gives their highest value to our conceptions of that order of Nature, which is worshipped as itself a god by the class of interpreters whose doctrine I call in question. The most illustrative, as well as the most illustrious example of the difference between the mere generalisation of phenomena and the dynamical conception that applies to them, is furnished by the contrast between the so-called laws of planetary motion discovered by the persevering ingenuity of Kepler, and the interpretation of that motion given us by the profound insight of Newton. Kepler's three laws were nothing more than comprehensive statements of certain groups of phenomena determined by observation. The first, that of the revolution of the planets in elliptical orbits, was based on the study of the observed places of Mars alone; it might or might not be true of the other planets; for, so far as Kepler knew, there was no reason why the orbits of some of them might not be the eccentric circles which he had first supposed that of Mars to be. So Kepler's second law of the passage of the radius vector over equal areas in equal times, so long as it was simply a generalisation of facts in the case of that one planet, carried with it no reason for its applicability to other cases, except that which it might derive from his erroneous conception of a whirling force. And his third law was in like manner simply an expression of a certain harmonic relation which he had discovered between the times and the distances of the planets, having no more rational value than any other of his numerous hypotheses. Now, the Newtonian "laws" are often spoken of as if they were merely higher generalisations in which Kepler's are included; to me they seem to possess an altogether different character. For, starting with the conception of two forces, one of them tending to produce continuous uniform motion in a straight line, the other tending to produce a uniformly accelerated motion towards a fixed point, Newton's wonderful mastery of geometrical reasoning enabled him to show that, if these dynamical assumptions be granted, Kepler's phenomenal "laws" being necessary consequence of them, must be universally true. And while that demonstration would have been alone sufficient to give him an imperishable renown, it was his still greater glory to divine that the fall of the moon towards the earth—that is, the deflection of her path from a tangential line to an ellipse—is a phenomenon of the same order as the fall of a stone to the ground; and thus to show the applicability to the entire universe of those simple dynamical conceptions which constitute the basis of the geometry of the Principia. Thus, then, while no "law" which is simply a generalisation of phenomena can be considered as having any coercive action, we may assign that value to laws which express the universal conditions of the action of a force the existence of which we learn from the testimony of our own consciousness. The assurance we feel that the attraction of gravitation must act under all circumstances according to its one simple law is of a very different order from that which we have in regard (for example) to the laws of chemical attraction, which are as yet only generalisations of phenomena. And yet, even in that strong assurance, we are required by our examination of the basis on which it rests to admit a reserve of the possibility of something different—a reserve which we may well believe that Newton himself must have entertained. A most valuable lesson as to the allowance we ought to make for the unknown "possibilities of Nature" is taught us by an exceptional phenomenon so familiar that it does not attract the notice it has a right to claim. Next to the law of the universal attraction of masses of matter there is none that has a wider range than that of the expansion of bodies by heat. Excluding water and one or two other substances, the fact of such expansion might be said to be invariable, and, as regards bodies whose gaseous condition is known, the law of expansion can be stated in a form no less simple and definite than the law of gravitation. Supposing those exceptions then to be unknown, the law would be universal in its range. But it comes to be discovered that water, while conforming to it in its expansion from 39½ deg. upwards to its boiling point, as also, when it passes into steam, to the special law of expansion of vapours, is exceptional in its expansion also from 39½ deg. downwards to its freezing point; and of this failure in the universality of the law no rationale can be given. Still more strange is it that by dissolving a little salt in water we should remove this exceptional peculiarity, for sea-water continues to contract from 39½ degrees downwards to its freezing-point 12 degrees or 14 degrees lower, just as it does with reduction of temperature at higher ranges. Thus, from our study of the mode in which we arrive at those conceptions of the orderly sequence observable in the phenomena of Nature which we call "laws," we are led to the conclusion that they are human conceptions subject to human fallibility, and that they may or may not express the ideas of the Great Author of Nature. To set up these laws as self-acting, and as either excluding or rendering unnecessary the power which alone can give them effect, appears to me as arrogant as it is unphilosophical. To speak of any law as "regulating" or "governing" phenomena is only permissible on the assumption that the law is the expression of the *modus operandi* of a governing power. I was once in a great city which for two days was in the hands of a lawless mob. Magisterial authority was suspended by timidity and doubt; the force of its command was paralysed by want of resolute direction. The "laws" were on the statute-book, but there was no power to enforce them. And so the powers of evil did their terrible work, and fire and rapine continued to destroy life and property without check, until new power came in, when the reign of law was restored. And thus we are led to the culminating point of man's intellectual interpretation of Nature—his recognition of the unity of the power of which her phenomena are the diversified manifestations. Towards this point all scientific inquiry now tends. The convertibility of the physical forces, the correlation of these with the vital, and the intimacy of that *nexus* between mental and bodily activity which, explain it as we may, cannot be denied, all lead upward towards one and the same conclusion; and the pyramid of which the philosophical conclusion is the apex has its foundation in the primitive instincts of humanity. By our own remote progenitors, as by the untutored savage of the present day, every change in which human agency was not apparent was referred to a particular animating intelligence. And thus they attributed not only the movements of the heavenly bodies, but all the phenomena of Nature, each to its own deity. These deities were invested with more than human power; but they were also supposed capable of human passions, and subject to human capriciousness. As the uniformities of nature came to be more distinctly recognised, some of these deities were invested with a dominant control, while others were supposed to be their subordinate ministers. A serene majesty was attributed to the greater gods who sit above the clouds; while their inferiors might "come down to earth in the likeness of men." With the growth of the scientific study of nature the conception of its harmony and unity gained ever-increasing strength. And so among the most enlightened of the Greek and Roman philosophers, we find a distinct recognition of the idea of the unity of the directing mind from which the order of nature proceeds; for they obviously believed that, as our modern poet has expressed it—

> "All are but parts of one stupendous whole,
> Whose body Nature is, and God the soul."

The science of modern times, however, has taken a more special direction. Fixing its attention exclusively on the order of Nature, it has separated itself wholly from theology, whose function it is to seek after its cause. In this, science is fully justified, alike by the entire independence of its objects and by the historical fact that it has been continually hampered and impeded in its search for the truth as it is in Nature by the restraints which theologians have attempted to impose upon its inquiries. But when science, passing beyond its own limits, assumes to take the place of theology and sets up its own conception of the order of Nature as a sufficient account of its cause, it is invading a province of thought to which it has no claim, and not unreasonably provokes the hostility of those who ought to be its best friends. For while the deep-seated instincts of humanity and the profoundest researches of philosophy alike point to mind as the one and only source of power, it is the prerogative of science to demonstrate the unity of the power which is operating through the limitless extent and variety of the universe, and to trace its continuity through the vast series of ages that have been occupied in its evolution."

Statue of Leonardo di Vinci.—A colossal statue of Leonardo di Vinci, by the well-known sculptor Magni, has just been placed in the Piazza della Scala at Milan.

GENERAL NOTES.

Italian Irrigation.—The new canal, recently opened from the Canal Cavour, for the irrigation of the Lomellina, has been named the "Canal Quintino Sella," as a tribute of respect to the present Minister of Finance, who has from the first been a zealous advocate in Parliament for promoting this undertaking.

The St. Gothard Railway.—The Italian papers state that the St. Gothard Railway Company have broken off all treaty with the Public Works Company of Turin, of which Signor Grattoni is the president, stating as a reason the exorbitant demand of the latter for the execution of the St. Gothard Tunnel. A Geneva correspondent says that this great work has been given to M. Favre, a railway contractor of Geneva, representing a company of Swiss and French capitalists, who have guaranteed to complete the work in eight years, making a deposit of 8,000,000 of francs as caution money. The precise conditions of the contract are not yet known, but a premium of 5,000 francs will be paid to the contractor for every day that his tunnel is finished before the time agreed on, as, on the other hand, he will be fined the same amount for every day that he is behindhand. M. Favre has been engaged in many railway contracts in France, and carried out part of the Paris, Lyons, and Mediterranean Railway. The cuttings at the entrance to the tunnel are being pushed on at each end, and on the north side, at Göschenen, are in a forward state, and it is expected will be completed to the mouth of the tunnel in about a fortnight. At Airolo the works are progressing favourably.

Instruction in Science.—The Lords of the Committee of Council on Education having decided to transfer the instruction in physics, chemistry, and natural history from the Royal School of Mines, in Jermyn-street, and the College of Chemistry, in Oxford-street, to the new buildings in Exhibition-road, South Kensington, the following courses of lectures and practical laboratory instruction will be given at South Kensington at the dates specified:—Chemistry by Professor Frankland, D.C.L., F.R.S. A course of forty lectures on inorganic chemistry, commencing 21st October, 1872. A course of 30 lectures on organic chemistry, commencing 13th January, 1873. Laboratory instruction, consisting of an elementary and an advanced course, commencing on 1st October. Fees:—Lectures on inorganic chemistry £4. Lectures on organic chemistry £3, together £6. Laboratory instruction £12 for 3 months, £9 for 2 months, and £5 for one month. Biology, by Professor Huxley, LL.D., F.R.S., a course of eighty lectures on biology (or natural history, including palæontology) with laboratory instruction, commencing the 7th of October, 1872. Fee for the full course £10—for the lecturers only £4, for the laboratory instruction £6. Physics, by Professor Frederick Guthrie. The course will consist of lectures, with laboratory work on the subject of the lectures, divided as follows:—Twelve lectures on molecular physics, sound, etc., commencing 24th February, 1873; fifteen lectures on heat, commencing on 24th March; fifteen lectures on light, commencing on 12th April; twenty lectures on electricity and magnetism, commencing on 19th May. Each course will be complete in itself, and may be taken separately. Fee £5 per course, including laboratory work, or £15 for all the courses. For the lectures alone £1 per course. N.B.—Students entering for the Associateship of the Royal School of Mines are not obliged to attend the practical work in physics and biology. Besides these students and teachers in training, only such a limited number of occasional public students will be admitted as can be accommodated.

Traffic over the Alpine Passes.—The following is the number of travellers by the post-carriages over some of the Swiss mountain-passes and the income they yielded in 1871:—

	Travellers.		Revenue. Francs.
St. Gothard	42,008	....	427,000
Simplon	30,590	....	254,000
Splügen	24,888	....	214,000
St. Bernhard	15,082	....	75,000
Brünig	14,908	....	71,000
Maloja	12,450	....	58,000
Schyn and Julin	11,089	....	94,000
Fluëla	11,781	....	57,000
Oberalp	7,778	....	37,000

The Deepest Well in the World.—Twenty miles from Berlin is situated the village of Sperenberg, noted for the deepest well that has ever been sunk. Owing to the presence of gypsum in the locality, it occurred to the government authorities, in charge of the mines, to attempt to obtain a supply of rock salt. With this end in view, the sinking of a shaft or well, 16 feet in diameter, was commenced some five years ago, and at a depth of 280 feet the salt was reached. The boring was continued to a further depth of 960 feet, the diameter of this bore being reduced to about 13 inches. The operations were subsequently prosecuted by the aid of steam until a depth of 4,194 feet was attained. At this point the boring was discontinued, the borer or bit being still in the salt deposit, which thus exhibits the enormous thickness of 3,907 feet. The boring would have been continued in order to discover what description of deposit lay under the salt, but for the mechanical difficulties connected with the further prosecution of the operations. During the progress of this interesting work, repeated and careful observations were made of the temperature at various depths. The results confirm very closely those which have been already arrived at under similar circumstances.

Memorials of Peter the Great.—The two-hundredth birthday of Peter the Great is being celebrated in Russia, not only by grand fêtes and an universal exhibition at Moscow, but by curious artistic and literary collections and publications; thus the keeper of the Imperial Library of St. Petersburg has published a work entitled *Pierre le Grand selon les Littératures étrangères*, which contains no less than 1,500 pieces, many of which are original, collected by the present keeper of the library and his predecessor. Amongst the unpublished *morceaux* is a monograph of documents for a history of Peter the Great, communicated to Voltaire by Catherine II. The collection of portraits which has been made of Peter the Great in one of the *salles* of the St. Petersburg library includes more than 350 works; of these some are in portfolios for want of space, but there are 200 exhibited. These consist of oil paintings, drawings, lithographs, down to the commonest prints. One of these works is curious of itself, and has a strange history. It is a copy, made on zinc, at Teheran, of the portrait by Dupont, after Delaroche, to illustrate a Persian translation of Voltaire's *Pierre le Grand*. Amongst the curiosities is a philosophical and theological thesis, engraved by Sczyrski, printed on satin, and presented in 1691 by the Academy of Kiew to the two young Czars, Pierre and Ivan Alexievitch, who then reigned conjointly. The satin is more than two metres long by a metre wide, and the young czars are represented seated side by side on a throne, and surrounded by the personages of their court, and allegorical figures. Another of the curiosities is the signboard of the public-house at Wapping which the Czar used to frequent, and which was re-named in his honour. This curious memorial was taken to Russia in 1804, purchased by the Academy of Sciences, and afterwards transferred to the imperial library. It is painted on both sides, and is hung on a revolving hinge.

Journal of the Society of Arts.

No. 1,031. Vol. XX.

FRIDAY, AUGUST 23, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

MEMORIAL WINDOW IN ST. PAUL'S.

In connection with the Thanksgiving in St. Paul's for the recovery of H.R.H. the Prince of Wales, the President of this Society, it has been suggested that the Society should provide a Memorial, in the form of a Painted Window, to be set up in the Cathedral, thus helping at the same time to complete the decoration of the interior of that edifice.

The Council, therefore, propose to the Members that a fund for this purpose should be raised among them by subscription, each member of the Society being at liberty to subscribe Five Shillings for himself, and the like sum for each member of his family. It is estimated that the window will cost not less than £700.

Members willing to aid the Council in this work are requested to fill in the Form which has been sent to them, with the amount of Subscription, and return it to the Secretary. Post-office Orders should be made payable at the Charing-cross office, to Mr. Samuel Thos. Davenport. The first published subscription list amounted to £351 3s. A further list will shortly be published.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

THIRD COURSE OF CANTOR LECTURES.

SILICATES, SILICIDES, GLASS, AND GLASS PAINTING.

By Professor Barff.

Lecture III.—Delivered Monday, April 22nd, 1872.

Ladies and Gentlemen,—We concluded our last lecture with an explanation of dialysis, and I showed you how solutions of alkaline silicates, when they are made slight by acid, say with hydrochloric acid, will lose their alkali, which will pass through vegetable parchment or any similar substance which acts as a dialysing medium, and how we get in our dialyser a liquid which will gelatinise and which contains simply pure silicic acid dissolved in water. I could not last time show you some very beautiful specimens which I have now, through the kindness of Mr. Roberts, the chemist of the Mint, placed on the table. These are specimens made, I believe, in the time of the late Professor Graham, and they were some of the first produced. Here is some solution of a dialysed silicate which has been in existence for some years, and has not gelatinised; it contains only a small quantity of silica, 1 or 1½ per cent., I believe. Here is some which has gelatinised in extremely beautiful forms. Here again is some that has solidified with glycerine. If you remember, I mentioned to you that glycerine and silicic hydrate would mix together in a most unexpected manner, and gelatinise together, and here is a specimen of it. I do not know the date, but it is several years old. I shall revert to this again in my last lecture. Here again are some very interesting specimens. Some of this alkaline silicate was dried over sulphuric acid, and here is the result. It is a specimen of real interest. The vessel in which the silica was contained was placed over sulphuric acid, but the temperature was reduced by a freezing mixture of ice and salt, and you will notice this is made up of a number of very minute beautiful crystalline-looking substances. Unfortunately they are not crystals; if they were, it would be a matter of great interest to us, for we have never yet been able to crystallise silica.

I will now pass on to the subject of our lecture this evening. If I take a solution of an alkaline silicate, say silicate of soda or potash, and if I add to it some alcohol, you will see a precipitate is immediately formed. Here is the precipitate, and I will turn it out into a dish. You will see that a solid lump is formed. Last Monday evening we added hydrochloric acid to some of this silicate of potash, and a precipitate was formed. But the precipitate in that instance was very different from this precipitate. That was a precipitate of silicic acid in a hydrated form. This is a precipitate of silicate of potash. Here is some that was made some days ago, and put into this dish. It is now attached to it so firmly, that if you were to try and scrape it off the bottom, I believe you would bring away some of the glaze of the dish. It has got very hard in the course of this short time, and it will get very much harder. This silicate is soluble in water, and if it were boiled in water you would get it dissolved, and the solution would be different in composition from the one from which I have precipitated it. In order to get silicate freely soluble in water, you must have an excess of alkali. Now, in almost all the soluble silicates which are made by fusion (and here are some specimens of soluble silicates, silicate of soda and silicate of potash, which are glass, and made by fusion), there is excess of alkali, and they will readily dissolve in boiling water, and when dissolved form alkaline solutions. If this, precipitated by alcohol, be dissolved in water, the solution will not be so alkaline. I show you this experiment for two reasons; first, it introduces the subject of glass; and, secondly, I shall have to revert to it again in my last lecture on the application of silicates.

Glass is a silicate. There is some glass which is soluble. All that is necessary to make glass is silicic acid taken in any form you please, and some alkali. Put these together, fuse them, and you make a glass. If the alkali is in excess you have a soluble glass. The silicate in this dish is said to have a definite chemical composition—it is a true silicate. Again, there are other silicates which have been prepared, the compositions of which answer to certain chemical formula, and they are therefore said to have definite compositions. But of ordinary glass, we cannot say as we can of these, that it has a defined chemical composition. Here is a lump of glass which is made by the admixture of sand and some alkali. There are other things in it which I shall have to mention by-and-bye. But if you put a little more alkali, or a little less, you still have glass—not of as good quality, but you have glass—and it seems, owing to the varieties of sand that glass-makers use, they employ more or less alkali, and also certain other ingredients to correct the effects of the impurities in the sand. These ingredients enter, some of them, into the form of silicate with the silicic acid. Therefore, inasmuch as no two glass-makers probably make their mixture exactly the same, we are quite sure that the two glasses cannot have the same definite chemical composition. That silicates of definite composition may exist in them is probably true, but we cannot consider them to be definite silicates.

Silica itself, a piece of flint, for instance, or some of that silica which we precipitated the other day from fluoride of silicon, is very infusible; indeed you cannot melt it, except with the heat of an oxy-hydrogen blowpipe, and then it does melt into a clear bead, but, united with an alkali, it fuses very readily. It is not necessary that it should be mixed with soda or potash, for if you were to take some of that red lead and heat it with sand, the two would melt and form a glass. I have a specimen here in which there is no alkali at all, that is to say, no soda or potash. There is lead and silicic acid. If I were to take some of that red lead and put it into an ordinary fire-clay crucible, and heat it, the red lead would eat through the crucible, and in time a glass would be formed, by the silica in the crucible uniting with the lead oxide, so that it is not absolutely necessary that you should have an alkali like soda or potash present in order to form glass; lead oxide with silica will do it.

Glass is said to have been discovered by Phœnician merchants, who were cooking their food upon the seashore, and there happened to be some of a salt of what was then termed natrium, which we call sodium, in the neighbourhood—some salt of soda. The heat of the fire caused the salt to unite with the soda, and so a glass was formed. It is an interesting story, but it is not true, because we know that very beautiful glass vessels were made long before this; and we also know that in the Egyptian mummies, which have been in existence several thousand years, are frequently found very beautiful specimens of glass beads and ornaments.

In this country, glass was introduced as early as the year 674, by the Venerable Bede. He introduced glass into this country for the adornment of church windows, but it was not extensively used for very many years after this. The first large glass works for the manufacture of window-glass were established at Ravenhead, near St. Helen's, in Lancashire, about the year 1776. Flint glass works were established earlier than this in London, at the Savoy House, and in Crutched Friars in the year 1559, and it appears that, in the year 1655, Sir Robert Maunsell gained a monopoly for the manufacture of flint glass. The second Duke of Buckingham is also said to have encouraged the manufacture by bringing over Venetian artists to make glass for window purposes; but, however, it is only of late years that glass has been used largely for glazing purposes—I mean within the last century and a half, because there were reasons which prevented it. First of all, the expense of manufacture; then monopoly; and later on, the system of duties which prevented the use of the better kinds of glass for the purpose of glazing house windows. When the duties were repealed, then the manufacture of glass became much more general, and it could be obtained at a much cheaper rate, and was made in very much larger quantities. I think I am right in saying that now more than 17,000 feet of plate-glass are made here in a day, but I only speak from recollection.* I will not go further into the history of glass manufacture, because it would take up more time than I can spare, and the information may be obtained by reading any book on glass manufacture.

We now pass on to the materials used in glass-making. I have already noticed one kind of glass—soluble glass. In its manufacture soda is used, and silica in the form of sand, or potash and sand. There are on the table specimens of various kinds of glass, which have been most kindly lent me by the Thames Plate Glass Company, by Messrs. Powell, of Whitefriars, and by Messrs. Chance, of Birmingham. We now come to the most important part of our subject, the consideration of the materials of which glass is made, and the way those materials act together in the formation of glass. I will take this part of the subject first, and then pass on to the mechanical operations afterwards. We will begin with plate-glass. These are the materials used in its manufacture. These are samples sent by the Thames Plate Glass Company. First, there is the sand. This comes from Leighton Buzzard, and there is also some sand from Welford, and here is some from Lynn. There are three kinds of sand, and these sands are of slightly different compositions, so that when they are used the mixtures have to be varied a little, so as to counteract the effect of such impurities as may exist in the sand. Here is some Buxton lime, and here is some sulphate of soda. These are the principal materials that are used in plate-glass manufacture. Other substances, to which I will call your attention presently, are also used, but these are the principal constituents of plate-glass. You see we have lime in this silicate, whereas in soluble glass we have only got soda or potash together with the silica; but here we have another base in this silicate, which is called plate-glass, so that this is a silicate of at least two bases, whereas soluble glass is a silicate of one, and, if of two, of soda and potash. Plate-glass properly made is insoluble.

Here we have another set of samples, consisting of materials used in the manufacture of flint-glass. Here is a specimen of the alkali, which is not the same as that used in the manufacture of plate-glass. This is a potash salt, carbonate of potash, known by the name of pearl-ash. Here is a specimen of the sand employed, which you will notice is whiter than the other sand I just now showed you. I believe this specimen is Fontainebleau sand. There is a sand in the Isle of Wight, at Alum-bay, which I believe answers the purpose perfectly well. Here are specimens of another base which is used in the manufacture of flint-glass. In plate-glass we have a second base, which is lime; in flint-glass we have another base, which is oxide of lead; and this is a specimen of the oxide of lead used by Messrs. Powell.

Now we pass on to crown and sheet glass. I have little to say about these materials, except that we have specimens here of the sand used, sent by Messrs. Chance. This is the washed sand, and that is the coarse sand. They have also sent specimens of alkali, sulphate of soda, and of lime, which is also used as a second base, just as it is in the manufacture of plate-glass. The first process that these substances undergo before they are made into glass, after purification, is fritting. The sand is carefully washed, and the alkali, in some cases, I believe, is purified, so that the materials may be as pure as possible before they are mixed. When they are mixed, the next operation is to "frit" them, as it is termed. Fritting is a very important operation. However carefully you may mix together the sand and the alkali, and the lime, you would not get them so perfectly incorporated but that there might be a subsidence in the melting as soon as the heat first began to act upon them in the glass pot. If you frit together these materials, you in a great measure prevent any such subsidence, and, therefore, any such imperfect admixture. The fritting process is carried on in a furnace or oven in which there is a fire along the side, the flames of which are continually playing in the oven over the materials, causing an intense heat. The materials, in the first place, are dried by this process; after that, if any lime exists there as carbonate, it is decomposed. The decomposition of the carbonate of lime in the glass pot would be attended with unpleasant consequences, inasmuch as any carbonic acid gas evolved there would increase the number of bubbles that would rise up through the glass when in a molten state in the pot. It is, therefore, in the fritting process that any carbonate that may be in the lime is decomposed. Then the heating process is carried on to what one may call an incipient infusion; that is to say, there is a slight adherence together or combination of the particles of sand, the alkali, and the bases employed. After this, the sand, alkali, and the other materials subjected to the fritting process are put into the glass pot, and then they are melted. Now, certain other substances are added to these materials, not that these substances are used as contributing to the structure of the glass, but they are employed in order to render the glass pure in colour, and to correct or destroy any impurities which may exist in them.

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* The weekly production of polished plate-glass in England is about 140,000 superficial feet, or 7¼ millions of feet annually, and the estimated value, inclusive of thick rough plate used for gratings and rough cast plate for skylights, is about £1,000,000 per annum. Considerable manufactories also exist in France, Belgium, and the Rhenish Provinces, the most extensive of which are the celebrated works at St. Gobain, in France, and St. Marie d'Oignies, in Belgium. The manufacture has not been introduced into America, except upon the most limited scale, and the United States form the principal export market for other articles. These statistics are furnished by Mr. Robinson, of the Thames Plate Glass Company.

I think it will be best to commence with the chemistry, as I may call it, of the glass pot, and a most complicated affair it is; but I will try and unravel it as well as I can. We have in the glass-pot, sand, lime or lead, and soda or potash salts, fusing together. In addition to these, certain substances are put into the pot—manganese, this black substance; arsenic, that white substance; and, in some cases, carbon or coal. Now carbon is a reducing agent, and arsenious acid is also, under certain circumstances, a reducing agent, but under others it is an oxidising agent. Manganese is also an oxidising agent, and sometimes nitre or saltpetre is used, and that is an oxidising agent. Suppose you put a mixture of sand, lime, and soda, or potash salts, together with some coal, anthracite or non-bituminous coal is the description of coal used, the action of the coal will be to reduce the oxides that are present. But if you reduce the oxides that are present, in many instances you injure the colour of the glass. Therefore, oxidising agents have to be used in order to oxidise these up again to such a point of oxidation that they produce as little injury to the glass as possible. Formerly carbonate of soda was used in the manufacture of plate, crown, and flint glass, but of late years sulphate of soda has been employed. If you put sulphate of soda with silicic acid and heat them, you will form a glass, but it will take a very high temperature to get a perfect incorporation of the silicic acid with the soda, and a perfect expulsion of the sulphuric acid from the mixture. To facilitate this, charcoal or anthracite coal is used. But the effect of the anthracite coal on a sulphate is to decompose it, and thus assist the silicic acid in replacing the sulphuric acid of the sulphate of soda.

In my first lecture I spoke to you of those elements, and the compounds of those elements with one another, which occur in glass-making. I also took up some considerable portion of your time in explaining to you the nature of salts, such as carbonate of soda, and sulphate of soda, and sulphate of potash. I told you that it was essential for everyone to understand the chemical principles regulating these combinations, in order that they might know scientifically how glass is produced, and what takes place in its manufacture; because I conceive that you all wish to know the scientific principles involved in the manufacture of glass. For in order to make enlightened improvements in any species of manufacture, we must know the scientific principles upon which those manufacturing processes are founded and carried on.

I spoke to you about oxygen; and I burnt some phosphorus in oxygen and some carbon, and no doubt many of you said, "We have seen these experiments over and over again;" but I do not know that there is one of us who does not require to have his knowledge brushed up at some time or other. You might ask me a great many questions in chemistry which I really could not answer. I should have to go back, and think over things I had seen long ago, and have probably forgotten, before I could answer. It was from my desire that all the processes should be thoroughly known and understood, that I introduced such experiments as these, in order that I might be able in my later lectures to make the proper application of them. And had I had time, I should not have contented myself with burning those two substances in oxygen, but should have shown you how those two substances were capable of different degrees of oxidation. For it is upon the different degrees of oxidation that exist in the materials used in the manufacture of glass, that the purity of our glass depends, as well as the various colours with which we are enabled to enrich the glass which we make. Therefore it is that I want you to thoroughly understand and appreciate the principles upon which these changes and interchanges are founded. Phosphorus forms two oxides, phosphoric acid, which we formed when we burnt it the other night; and phosphorous acid, when the supply of oxygen is limited. Carbon also forms two oxides, carbonic when the oxygen is in excess, and carbonic oxide when oxygen is in small quantity, or when the carbon is in excess. Oxides of iron exist in most specimens of sand. And it is to the presence of iron oxide that the green colour of this glass is owing; and it is because that same iron oxide is not present in this other specimen that it is so white. There are two oxides of iron which we have to deal with. The first is called protoxide, or ferrous; and the second is called peroxide, or ferric. The protoxide you never see, except in laboratory experiments; but the peroxide you constantly see, in the form of iron rust. One of these oxides gives to glass a green colour, the other gives a yellow colour; but it requires a large quantity of the peroxide to impart that yellow colour; therefore a small quantity of peroxide in the glass mixture will not materially affect its tint, but a small quantity of protoxide will colour glass green; so that a very little of it destroys the whiteness of the glass. The glass-maker, then, as he cannot get the iron out of the sand—for the expense of this operation would be too great—has to convert this oxide, the green oxide, or that which produces the green colour, into the oxide which produces the yellow colour; and though a small quantity will discolour the glass green, it takes a very large quantity of the yellow to discolour the glass yellow. This conversion is accomplished by the action of certain re-agents, as we call them. Black oxide of manganese is put into the pot for the purpose of converting the lower oxides of iron into the higher oxides. It changes the ferrous to the ferric, and if the manganese be not in excess, then you have a glass that is almost white. If, however, the manganese be in excess, then you have a purple tinge in the glass

I had intended to give you a little more of the history of glass making, but I dare say you will be very glad I did not, because what I am speaking of now is more interesting. But in that history I meant to refer you to many of the windows you see about London. You notice there are frequently small panes of purple glass in windows, and then there are white panes above; so that, when the white blind is drawn down, you see first a white pane, and then a purple one. In former times they could not make plate glass in large sheets. The plate-glass made about forty years ago was in much smaller sheets than it is made now—much of it has become purple, and this is because the black oxide of manganese, used to correct the iron, in some instances was used in excess; but whether that be the case or not, if black oxide of manganese exists in glass at all as such, it is found that the action of light upon it is such as to bring out the purple colour eventually, although it did not exist at all in the glass immediately after its manufacture. Three, four, or five years will produce this effect. Professor Faraday was consulted about this, but he could give no opinion as to how it took place; and many chemists have thought about it, but cannot explain it. A remark fell accidentally from a gentleman in Messrs. Powell's glass warehouse the other day—where I was treated with the greatest possible kindness, everything about the works being shown to me—which has given me a clue, by which I hope we may discover the cause. It was the gentleman who is engaged, I believe, in the mixing department. I will not explain to you my thoughts upon it now, but at some future time, if I have ever again the pleasure of addressing you, I will explain it, or I will do so in the pages of the Society's *Journal*, if it lead to anything worth communicating. I am informed by the manager of the Thames Plate Glass Company that no manganese is used in their manufacture, but that instead of it they use arsenious acid. You see it here in lumps, like lumps of broken porcelain; it is the common poisonous white arsenic; it is in what is called the vitreous form of arsenious acid. How does this act? Arsenious acid is a reducing agent under many circumstances. If I were to take a solution of bichromate of potash, and treat it with arsenious acid, I should reduce it and make arsenic acid of it. I should oxidise the acid at the expense of the chromate. How, then, is it that it can be an oxidising agent? I have experimented upon it to-day, and I find that if I mix together some arsenious acid with the proto-salt of iron, and if I heat them together, metallic arsenic is given off, which burns with a grey flame when it comes in contact with atmospheric air, and I get the higher oxide of iron formed. I mentioned the other day that the volatility of a compound determined the decomposition. Here we get metallic arsenic, which is volatile, given off; the ferrous oxide or protoxide takes away its oxygen, and a per-salt of iron is formed. That is the way I account for its action. This arsenious acid acts, then, as an oxidising agent in this case, bringing the iron to the maximum of oxidisation. Thus the occurrences which take place in the glass pot are really of scientific interest. Here is the result; it may be simply of empiricism, or it may have been from the suggestion of a scientific man. A substance is used instead of the black oxide of manganese. The black oxide of manganese has disadvantages where it has to be used to oxidise a large quantity of iron, which I have already explained to you, and it has another, viz., it destroys the pots. Here is a substance which has not got this disadvantage, but which still has a disadvantage, for if it does not become properly mixed, and if it is not properly decomposed, or if too much is used, it will render the glass cloudy and milky, so that great care has to be taken in its use. Here is a piece of white enamel glass, which owes its whiteness to the presence of arsenic used in excess.

I would fain linger longer on this part of my subject, but I fear my time will not allow it. But I have one or two little experiments, illustrative of reduction and oxidation, to show you, which I do not think will take long. This is one—Here is a solution of permanganate of potash, which has a very deep purple colour. I will put to it some sulphurous acid, and you will notice that the purple colour will disappear in a moment, and the liquid becomes perfectly white. This is a case of reduction. The sulphurous acid takes away the oxygen from this permanganate, and so the permanganate loses its purple colour, because the manganese is reduced to a lower point of oxidation. I may mention in passing that this permanganate is a substance used for testing for the presence of organic matter in water. A weak solution is used; the water supposed to contain organic matter is thrown into it, and if the colour disappears rapidly you know that the water contains a good deal of organic matter, for organic matter acts as a reducing agent. This substance is sulphate of manganese, a salt of the lowest oxide. I will put a crystal or two into this dish, and a little soda and nitrate of potash, and Mr. Lewis will fuse them, and we shall then get manganate of potash, which is green; he will then dissolve it in water. The liquid will be made acid, and it will be almost immediately oxidised into the purple salt. You have here an instance of what we mean by oxidation and reduction. I do not mean to say that this oxidation and reduction is exactly the same as takes place in the glass-pot, because no permanganate is used, but this black oxide of manganese, when used in the glass pot, is reduced, or loses some of its oxygen, and oxidises the iron at its own expense, and becomes a lower oxide of manganese, which has no power whatever to stain glass. If the glass becomes purple with the excess of this oxide, it can be stirred up with a piece of wood, and the carbon of the wood will again reduce this black oxide of manganese, carbonic acid gas being formed, and you can thus destroy the colour which it imparts to the glass. I think I am justified in showing you this experiment, as a mode of explaining to you the principles of reduction and oxidation.

Here is some of this protosalt of iron which gives the green colour to glass. I will add to it a little of an oxidising agent, nitric acid, which has a similar action to nitrate of potash. A change has taken place in the liquid in a moment. I will now boil it, and we shall get a yellow liquid, which now contains the persalt of iron; it is a salt of the peroxide of iron, the oxide which gives the yellow colour to glass. I will take a little of this and dilute it with water, and add to it a wonderfully delicate re-agent for finding out the presence of persalts of iron, sulpho-cyanide of ammonium. We shall get a blood-red colour formed, so deep that, as you see, it bears great dilution. The protosalt of iron I took in the first instance will not give this blood-red colour with this re-agent, so that you see oxidation has taken place. It is the same thing as takes place in the glass-pot, only a different oxidising agent is used.

I have also shown you how ferric oxide can be reduced readily by one of the re-agents which are used in glass-making to the protosalt. This proves the necessity of using these agents in certain proportions, in order to obtain a perfect and satisfactory result.

I shall now pass on to the method of making the glass. It is necessary that there should be a furnace in which to fuse the mixture, and that there should be glass pots of sufficient strength and refractoriness to enable them to stand the high temperature to which they are exposed. The material of which glass pots are made is what is called fire-clay, or Stourbridge clay. Here is a specimen of it in the rough state. Great care is requisite in the manufacture of a glass-pot. In the first place, the clay is moistened, and all stones are carefully removed. It is then got into a pasty state, and the way the pot is put together is exceedingly interesting. If there should happen to be any air bubbles in the finished pot, it is quite clear that, when the pot got heated, the air in the bubbles would expand, and the pot would crack, or some portion of it would be forced out on the outside or inside, according as the air bubble was nearer to either of these surfaces. The clay is kneaded, pressed, and the pieces are pushed together with the greatest possible care, and the pot is built up, little by little, into its proper shape. The making a glass-pot is really a work of some art, and is of considerable interest to witness. When the pot is made, it is dried by simple evaporation of its moisture into the air, or if the air be very moist, it is artificially heated by hot-water pipes, so that a slight rise of temperature is obtained. The drying process is allowed to go on very gradually indeed; it is never hurried. After the pot has become dry, it has then to be exposed to the trial heat. There is an arch built, which really is only a modification in shape of the fritting furnace I spoke to you about just now. It is made large enough to receive one or two pots, or more if required, and is called the pot arch. A fire is lighted on one side only, and the flames play under the arch, over the pot and round about it, until at last the pot becomes red hot, or almost white hot. It is subjected to this heat for a certain length of time, and in this hot state is removed from the pot arch, and put into its place in the furnace, in which the glass is made. Glass pots are never allowed to get cold, from the time they are first heated until the time they come to an end, which may be from five to ten or twelve weeks. I believe it is considered very good if a glass pot lasts ten or twelve weeks. They frequently break through untoward circumstances, but from the time it is put into the furnace to the time it breaks, and is taken away, the pot is always kept hot. There are various forms of glass pots used. Here is a piece of one before it has been put into the pot arch after it has been dried. If you look at it and scrape it, you will see how extremely compact it is. I forgot to mention that some old pot, ground fine, is used with the Stourbridge clay; but that is a matter of little interest now. Here is a piece of pot which has come out of the furnace after it has done its work. You see from the colour and general appearance that it has been a good pot. If you see a pot with flaws in it, with yellow or brown lines, or anything showing that it is streaky in any way, that will tell you that that pot most likely came to an unlucky end because it was not properly made. This piece is glazed with the vitrified substance which has been made in it. A plate glass pot is circular and straight up and down, and with an indentation round the middle on the outside, by means of which the pot can be lifted out of the furnace. A crown glass pot is smaller at the bottom than it is at the top, and there is no rim round it, but it is rather larger than a plate glass pot. A flint glass pot is covered so that nothing from the fire can enter it. It has an orifice opening out to the workmen, which comes to the outside of the furnace. I will tell you why they are made in this shape presently. They are built up with as much care as the others, or perhaps with more, for there is more work in them, and they are more expensive. The ground plan of a glass furnace is generally circular, the fire-place being in the centre, and there are iron gratings below, with a space or channel through which the air passes, which is called a cave, which provides a draught to keep up the fire. The glass pots are arranged round the furnace, in the case of flint pots, with the mouths outwards. There is a dome roof, arched above, and the flues which convey the products of combustion come near to the mouths of the pots, so that the draught forces the flame to play over the top of the pot in order that the greatest amount of heat may be obtained. The whole of this is enclosed in a building of brick-work, of a conical form, which is called a cone. There has been of late years a new method adopted at the Thames Plate Glass Company for melting glass. Mr. Siemens' regenerator is used, so that coal is not burnt in the glass furnace, but carbonic oxide, the gas formed by the burning of coal in a limited supply of oxygen. Here is a sample of the coal which is employed; it is called cannel coal. A large quantity of carbon is contained in this sort of coal, and the carbonic oxide, after it is formed, mixed with air, is heated in a furnace up to a temperature of about 800°, and passes into the glass-furnace and burns, so that an extraordinary amount of heat is produced. I am told that the heat is so great, that, if it were desired, those in charge of the furnace could melt the pots. The manager says, it does its work very well, that the heat is most steadily maintained, and the result is most satisfactory. This regenerator causes an enormous saving of coal; the saving is as 37 to 50, as I was informed by the chairman of the company. It has other advantages also, because none of the coal gets into the open glass pots.

I must now leave the subject of the furnace without stopping to speak of the accidents to which it is liable, the repairs, and so forth. These glass pots, as I have told you, are open at the top, and the flames play over the top, and therefore there is a greater amount of heat acting on the glass from a given quantity of coal; but where it is desired to have the glass as pure and as beautiful as can be obtained, as in the case of flint-glass, the products of the combustion of the coal are not allowed to come in contact with the glass, nor is any coal or other matter that may be in the furnace allowed to drop into it; therefore a covered pot is used. The effect of using a covered pot is, that longer time is required to make the glass. In an open pot you can "found" the mixture, as it is called, in, I think, 18 hours; but in a covered pot I believe you cannot found the mixture under from 36 to 40 hours.

We are now led back again to consider the different kinds of glass. Glass with lime in it, instead of lead oxide, takes a longer time to fuse than that which has oxide of lead in it. Oxide of lead has the power of causing the fusion of vitreous substances to take place much more rapidly, and at a lower temperature; so oxide of lead is used in making glass in covered pots. Its effect is twofold. First of all it renders the metal softer, and more easy to melt; and, in the next place, it makes the glass much more brilliant, and gives it the power, which this specimen has, of brilliantly refracting light, so that to have a considerable quantity of lead in glass is an advantage, but to have too much is a disadvantage, because it renders the glass soft and much more easily injured by scratching. In Bohemia, where they make white glass in open pots, and use wood as fuel, there is no necessity to use so large a quantity of lead, or any lead at all, as in the glass we make in this country where coal is employed.

We pass on now to the way the glass is fashioned. To begin with plate-glass. I had not seen a plate-glass works for more than fifteen years until I was kindly invited by a gentleman, whom I see present, to visit the Thames Plate-glass Company's works. When I went over the Ravenhead Works, which were then the largest works in England, some 15 years ago, they used to refine their plate-glass; it was founded in one pot and refined in another. It was ladled out with proper vessels into a "cuvette," as it was termed—a small pot; the cuvette was then removed from the furnace, and the glass from it was poured upon the plate-table. It appears this operation has been given up for some time. The present pot is so made that it can be taken out of the furnace, and when the glass is in a proper state for pouring an iron apparatus catches the pot round the indented part in the middle, and a crane lifts it out of the furnace and swings it round over a movable table, which travels upon rails. The glass is turned out upon this table, and, when turned out, it looks like a mass of red-hot dough; glass when in a state to be worked is not liquid, but is in a pasty state, and when the pot is turned over it tumbles out like a mass of dough. There are narrow bands of iron, or guages, of a certain thickness, a quarter of an inch or five-eighths, or whatever thickness the glass is required to be of, placed on the edges of the table, and a roller then passes over the soft glass, which it spreads out upon the table, and presses it to the width to which it is allowed to extend itself by the guages. When that has been done, as soon as the glass is set, but before it is absolutely hard, it is loosened, and the table it placed opposite to an annealing furnace, in which the plate is pushed. Five, six, seven, or eight plates, I believe, are put one upon another in the furnace. The process of annealing I will speak of presently. Here is a specimen of plate-glass from this first process. One side, that which touched the table, is quite rough, and has marks upon it. The other has a beautifully smooth surface. After the plate is so made, and the glass is annealed, it is bedded down on a perfectly level surface with plaster of Paris; and a large plate of iron, so arranged by machinery as to have an elbow movement, is put upon it. Boys stand by the side, and throw water and sand, of rather a coarse quality, upon it, and the piece of iron grinds the surface of the plate by means of the sand. After a time the plate is reversed, and the other side is ground in the same manner. After that, it undergoes a process of smoothing, which is conducted in a similar way; and it is then polished by an instrument which I have not time to explain, though its action is most interesting; it has been improved of late years, though the principle on which it acts is the same as it was years ago. With regard to sheet and crown glass, the method of procedure is this. First, with regard to crown glass, a portion is gathered on the blow-pipe, and on the table are specimens showing the different shapes which it assumes at different stages of the process. It is first blown globular in form, and then becomes flattened on the side opposite the blow-pipe, and when it is flattened, a workman comes with an iron rod, on which he has gathered some soft glass, and fastens it on to the flattened side. It is then opened where the blow-pipe was attached, and the workman goes before what is called a flashing furnace, a large open space so intensely heated that screens have to be worn in standing before it. The man then trundles the rod with the glass attached, in much the same manner as a servant trundles a mop, in front of this furnace; the glass gets so hot that it becomes perfectly soft, gradually opens and enlarges, until all of a sudden you see a very beautiful sight, the edges fly open, and in one instant the sheet of glass is formed.

Now with regard to the making of sheet-glass. The glass is first of all gathered, when soft, on a blow pipe, and blown into a cylindrical form. Then the cylinder is elongated more and more, and the ends are taken off, so that you have a perfect glass cylinder such as you see on the table. Then it is cut down with a diamond on the inside, and is placed in a furnace heated to a very high temperature. The glass gets soft, a man with a tool turns its edges out, the glass falls down, and with a wooden tool, moistened with water, it is gently rubbed over on the surface, and thus you get a sheet of glass such as is now used for glazing ordinary windows. There are several models on the table representing these operations, but they are small; the quantity of glass which a man has to work with on the end of his blow-pipe is often very great, so that it requires an extremely strong man, and one who understands his work well to blow a large sheet of glass. The blow-pipe itself is about six feet long to start with, and then there is the cylinder of glass of considerable length also at the end of it, so that the man has to stand on a bench with a sort of pit below him, in which he swings it backwards and forwards, in order to get the soft glass to assume the oblong form.

Now, a few words about annealing, and I will leave the subject of flint glass-making until our next lecture. When the glass is manufactured, if nothing further were done to it, and if allowed to get cool, it would be exceedingly brittle, and would not stand changes of temperature. A cheap tumbler or wine glass is one of the most expensive things you can buy, for if you put hot water into it, it will crack in a moment, and that is because it has not been properly annealed. The annealing process consists in allowing the glass to cool slowly. Two different kinds of annealing processes are adopted. In the Plate Glass Company's works, they place the plates in an annealing oven, where they enter at the highest temperature they ever will be exposed to, and they are then allowed four or five days to cool down; the longer the cooling takes, if not too long, the better. In flint glass works, and in crown and sheet glass, I hear that now they anneal by what is called a *lire*, that is, a long oven, at one end of which there is a furnace playing just as in the pot arch. The goods travel down upon a sort of railway, from one end to the other, so that they go from the hottest portion to the coolest, and the time allowed for the process is such as to allow the particles of glass to assume their proper position with respect to one another, and to attain proper cohesion. I have here alittle experiment with which I will conclude the lecture. It shows the effect produced when glass has not been properly annealed. Here are some Prince Rupert's drops. If I break off the end of one of them, the whole will fly to pieces, with a slight explosion. Why is this? The particles of glass are held together here, not by cohesion amongst themselves, but they seemed to be bound together by the film of glass outside. Break that film of glass outside, and the particles fly from one another. It is the same kind of thing which takes place when you put hot water into a badly-made glass. The proper annealing of glass, therefore, is most important. I shall be obliged to allude to annealing again when I treat about the durability of the glass used for stained-glass windows.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

PAPER, STATIONERY, AND PRINTING.

(Continued from page 789.)

The notice of the typographical printing machines and presses given in the last number of the *Journal* is not complete without the mention of Mr. Bailey's press, a combination of the lever hand-press with the self-inking platen machine and the cutting and embossing press. This machine is specially designed for the use of shopkeepers who have a small amount of printing to do from time to time, and for that of scientific and other societies, companies, offices, and amateurs. The general form of this press resembles that of the well-known copying machine, the lever being placed at the upper part, and at such a height that the operator can, when necessary, throw the whole weight of his body upon it, and thus avoid the exercise of any muscular power worth consideration. The platen swings in the frame, and being counterpoised, is brought face upwards, to receive the paper to be printed, by a slight touch of the hand; the inking table is behind, and the same movement which brings the platen to receive the paper, causes the inking rollers to run over and ink the type beneath. When the platen is allowed to fall back to the position for taking the impression, it is immediately locked, so that it can only descend in a perfectly vertical direction, and thus secures a parallel pull and a clean impression. The machine altogether is very ingeniously planned. Every portion of it is under the eye of the operator; the force required to work it is trifling, and it possesses a special feature in connection with the inking apparatus, namely, that the rollers cannot be left at rest on the inking table, but are suspended above it by the return of the platen to its place; this prevents the otherwise rapid destruction of the composition of which the rollers are made. With the addition of dies, punches, &c., the machine is readily converted into an embossing, cutting, or perforating press; and without any change, except the removal of the chase in which the type is placed for printing, it becomes at once a powerful copying or standing press. The principal machine at the Exhibition is mounted on an elegant cabinet, fitted with all requisites for the use of an institution or an amateur; but in its plain form it can be placed on an ordinary shop counter or strong table. With this machine is also a smaller and more simple modification of it, but not self-inking, which will print a page as large as that of this *Journal*, and, if necessary, in the middle of a large sheet of paper. This handy little press is intended for printing handbills, circulars, grocers' and other bags, paper, &c.; and it is also applicable for copying, pressing, embossing, piercing, cutting, and perforating. These presses contain many little novelties in arrangement, and they have the great advantage of acting entirely without metal springs.

The same progress which has caused the almost total disappearance of the hand letter-press has had the like effect in the case of the old lithographic printing-press. With the exception of one, on which the printing of music is shown, there is but one press of the ancient model in the Exhibition. The cylinder has taken the place of the scraper; and steam, or the treadle, leave both the operator's hands free to feed the machine and take off the printed impressions. The student desiring to become acquainted with this class of machines cannot do better than commence by examining the smallest and simplest in the Exhibition. In this machine, which is exhibited by Messrs. Figgins (Waddie's patent), all the parts are seen at a glance, and being reduced to their simplest expression, are easily comprehended, being only intended for small work; the cylinder of the larger lithographic machines is in this a mere pressing-roller of small diameter, and one man can drive the machine with one foot while he lays on and takes off the paper.

Other machines, of various dimensions and powers, are exhibited by Messrs. Furnival and Company, Dearden and Newsum, Hughes and Kimber, Simon and Son, J. M. Johnson and Sons, and possibly others. It is not within the scope of these observations to describe each machine, or draw any comparison between them, but to point out to those interested in such matters commercially, and to students in engineering, the points that deserve special attention. In the first place, it will be seen that, in machines driven by steam or the foot, it is necessary to employ stones with somewhat broader margins than usual, and slightly champfered off towards the edges, so that the inking-rollers may not catch against them; and, secondly, that special arrangements have to be made to secure perfect parallelism between the face of the stone and that of the cylinder; this latter condition is obtained by placing the lithographic stone in an iron bed, fitted with a series of adjusting-screws, and it is said that a few minutes generally suffice for the operation. The sponging of the stone is effected in various ways; in some cases the damping roller is formed on a wire frame, filled with sponge and covered with soft leather, and a small stream of water is provided in case it should be required; in other cases the roller is merely moistened from time to time, or a damp sponge is drawn along the margin of the stone, to maintain the original condition. The inking for fine work requires to be very complete, and therefore the distribution and feed of the ink is carried out with much care, the speed of the machine being so arranged as to give plenty of time for the inking. In one if not more instances, a special arrangement is made by which the stone is inked twice for each impression, in order to produce solid and brilliant colouring; the cylinder is held fast by means of self-acting bolts during the process of inking, and in the case of double inking an additional lever is thrown into action, which prevents the movement of the cylinder during twice the ordinary period, or, in other words, while the rollers run twice over the inking table and the lithographic stone. In lithographic work in more than one colour, and especially in what is called chromo-lithography, for the production of which each sheet has to pass a dozen or more times through the press, exact registration is essential; the deviation of the paper from its proper position to the extent of a hair's breadth is sufficient to obliterate the finer lines of a design, and spoil the work, possibly at the very last moment. The inventors and makers of lithographic printing machines have, therefore, given great attention to the registering apparatus; the old "points" are completely discarded, and a more accurate adjustment secured, while, at the same time, the printing goes forward with immensely greater speed. This important arrangement is effected by means of self-acting clips, or "grippers," as they are called in the trade, attached to the cylinders. These consist of brass rules the length of the cylinder, provided with several studs, or tenons, which fall into corresponding sockets or mortices in the cylinder. The paper is placed in its proper position on the feed-table, which is inclined at a slight angle towards the cylinder; its lower edge is seized at precisely the right moment by the grippers, which close automatically against a metallic or leathern lip. This, however, is not all; the feed-table is provided with stops which regulate the position of the paper in a lateral direction, and the feed-boy's duty is to place the sheet of paper carefully against these stops; if this be done, the register is maintained perfect, except from some accidental disturbance, such as shrinking or cockling of the paper, but in some machines an automatic feed-stop is adopted, which at once makes the act of feeding a less nice task, and the accuracy of register more secure; at the back of the feed-table is a bolt, which forms a part of the stop in the front; a cam is placed on the ends of the cylinder, and acts upon this bolt; the feed-boy lays the paper on as usual against the stop, which, at the last moment before the paper is seized by the grippers, is gently pressed forward through a short distance, and, should the paper not quite touch the stop, the error is thereby corrected. This nice adjustment ought to be effective, unless, indeed, the paper were so thin as to bend upwards instead of moving, but as such is rarely the case in high-class work, and as the feed-table is made of polished mahogany, and has consequently a slippery surface, failure must be rare. Most of these machines are kept in motion, and visitors may judge for themselves how nearly chromo-lithographic printing by machinery has reached perfection.

It may not be amiss to mention that the catalogue promises an example of a still more novel kind of lithographic press, namely, a "rotary self-acting lithographic printing machine, to print from curved stones," but its place is void at the Exhibition; the appearance of this "Marinoni" or "Walter" of lithographic machines is yet to take place.

The processes of copper and steel-plate printing may be seen in action in the room No. 26, but the machines employed call for no especial remark; this kind of printing depends almost entirely on the skill of the workman in inking and cleaning off his plate. The machine employed is a simple roller press.

Amongst the most interesting machines invented of late years to carry out auxiliary processes in connection with the printing trade are those for folding printed sheets. In Room No. 5, one of Davies's machines may be seen at work, folding small illustrated works with great dispatch and regularity; and another and larger machine of the same class folds the *Mail* as it issues from the "Walter" press. In the former case, the sheet is folded three times, and the publications, when folded, are neatly piled one upon the other by means of a small wooden "flyer," like those which deliver the printed sheets from the "Wharfedale," "Marinoni," and other printing machines; in the latter case, the great printed sheet is folded four times, and the machine is so arranged that two men feed it alternately as fast as possible, a second sheet being introduced before the other has quitted the machine. This machine is worked by steam, and its impulse is so great that the folded papers are thrown out by it horizontally into a wooden tray, so that they are placed in heaps with the titles all in the same direction. These machines consist of a gripper apparatus like those of the printing machines already described, of a series of tapes or narrow bands, which carry the sheets through the machine, and of knives or folding blades, which, with the aid of a pair of rollers, do the actual folding. The process is this:—A sheet is presented to the jaws of the grippers, which carry it into its exact position on the folding table; the folding-blade descends precisely in the middle of the margin, or rather the unprinted portion down the middle of the sheet which forms two margins when the fold is made, carries the doubled sheet through a slit, and delivers it to the charge of a pair of rollers, between which it passes, and then proceeds onwards between tapes to another table, where a second blade, at right angles to the former, again folds the sheet across the middle, and delivers it in like manner to a second pair of rollers and another series of guide tapes; the operation is again repeated by the third and fourth set of blades and rollers, and the operation is complete. In these machines the grand *desideratum* is perfect register at starting. If the first folding-blade fall precisely on the central line of the unprinted portion in the middle of the sheet, all the successive folds will be accurate; if, on the contrary, there be an error at starting, that error will be magnified, and the sheet spoiled. The machines work with such accuracy that the margins of the folded sheets are beautifully regular, and, conseqently, as little as possible has to be cut off the edges, and the margins of the book are left as wide and handsome as possible—a great thing in the eyes of the lover of books. This exact registration is obtained before starting by means of a very neat mechanical adjustment at the junction of the gripper crank with the main driving apparatus of the machine. There is another folding machine by Messrs. Simon, in Room No. 26, but it is not in action, and the principle is the same as in the others.

Ruling stands in the same relation to account books that printing does to other books. Two ruling machines may be seen at work at the Exhibition. The process is a very simple one. A number of brass ruling-pens, one for each line to be drawn upon the paper, are arranged in a frame or bar; the paper is placed beneath tapes or cords, on an endless traversing bed, and passes under the pens. If all the lines had to be made from one end of the paper to the other, the process would be rapid and continuous; as it is, the workman has to keep a very sharp eye on the paper, while he turns the handle of the machine with one hand and lifts or drops the pen frame with the other. Messrs. Letts show a novel application of the ruling machine in the production of ruled borders in various colours for cards, show boards, &c., and in what are called "Patent rainbow show-cards." In place of the ordinary ruling pen, pieces of thin brass, from half an inch to an inch or more wide, with turned up-sides, are placed in the frame, and each being supplied with a different colour, when sheets of paper are passed through the machine they are then coloured in stripes with one or more intervening blanks, or white stripes, if desired, and the sets of pens being multiplied, two, three, or more sets of stripes may be ruled at once on the same sheet. It is surprising how evenly the colours are laid on by this simple process. These tinted papers are then printed on by means of a block, which renders all the ground black, and shows the letters, ornaments, &c., of the various colours of the card, one line green, another red, a third white, a fourth violet coloured, and so on, in short, as many different colours as there are stripes ruled on the card or paper, produced by a single printing.

Another comparatively new auxiliary machine, and which is little known out of the printing and stationery trades, is that by means of which lines of small holes are pierced, as in the sheets of postage-stamps, in order to facilitate the separation of cheques or other documents from their counterfoils, without the use of knife or scissors. The piercer consists of a single row of small steel punches, passing through a brass guide with a corresponding number of holes, and into an iron plate pierced in the same manner as the guide. The machine is wide enough to take a large sheet of paper, so that the punches number several hundreds. Motion is given to the punching-frame by means of a treadle.

In bookbinding, not only folding, but, with the exception of sewing the sheets together, and the finishing of the highest class of work, almost all the various operations are now performed by machinery. One of the heaviest and most troublesome manual operations in the trade used to be the rounding of the backs, which was effected by means of heavy hammers, and could only be well done by very experienced men; the back of the book, before being covered, was dressed with glue, and before this was quite set, the convex form was entirely produced by means of the hammer alone. At present the rounding is effected by simple though powerful machines, the largest of which will give a huge ledger or grand folio volume a perfectly rounded back in a few seconds. The book is nipped in the machine back upwards, and thus held, is passed beneath a fixed bar, backwards and forwards, till the result is obtained. The front and side edges of books are cut by means of the paper-cutting machines already mentioned, instead of the old plough; the hydraulic press is made to do the work of compression instead of the old hammer; and, lastly, the whole of the lettering and ornamentation, of all but the highest class of work, is now done by arming and embossing presses. Three of these arming presses are in the Exhibition, one of them being a large, powerful machine. The cyphers, crest, armorial bearings, &c.—from which the press takes its name—as well as any letterings or ornaments to appear on the covers or back of the book, are engraved on a gun-metal block, or, in the case of the back, the title and ornaments are sometimes cut separately, and fixed down on a strip of paper by means of glue; the cover is then laid on the block and submitted to heavy pressure. If the cover of the book be of leather, the plain ornamentation, or "blind tooling," as it is called, is produced by pressure only, aided by heat, which is obtained from gas burning within the press; but in the case of cloth binding, this blind tooling is produced by inking the block before each impression. In the case of gold work, leaf-gold is laid over the block, and made to adhere firmly by means of heat and pressure. Press work never produces the beautiful effect of hand tooling, but the appearance is brilliant, and the cost infinitesimal as compared with that of the latter.

There is one other process connected with bookbinding, and that a very old one, exhibited by Messrs. Letts, namely, the production of marbled paper, and the marbling of the edges of books. Few persons not in the trade have seen this curious process; the colours to be applied to the sheets or edges, are laid in streaks, on the surface of water, in a small cistern, the waves, curls, and other figures, are then produced by the application of small rakes or combs, much in the same manner that the imitations of the grain of wood are produced by the decorative painter, and sometimes spots are intrduced in addition, by merely sprinkling the various colours on to the rest from a brush; when the colours are thus laid upon the water, the sheet of paper or book-edge is applied, and the colours, having no affinity for the water, immediately adhere to the paper. When dry, the marbling is glazed by friction. The colour has to be laid on the water for each separate sheet of paper, so that the operation is a slow one; in the case of book-edges, however, the whole of the surface being covered with the marble colours, a number of edges may be marbled in mass or successively. Perhaps some day even marbling, as well as sewing the sheets together, together with the other operations in bookbinding, may be done by machinery; but it is difficult to conceive an effective marbling machine.

Connected with printing will be found a large collection of ingenious little machines in the Room No. 26—hand-embossing presses, eyelet presses for labels and other stationery work, presses for dating railway tickets and other documents, and for numbering the pages of books. Most of these machines are self-working, and in many of them the changes of date and number are made automatically. Altogether they present an assemblage of highly-ingenious contrivances applied to useful purposes, saving of time, and the assurance of accuracy.

In the room near the entrance of the Indian court will be found a manufacturing stationer's shop in miniature, where Messrs. Parkins and Gotto show the use of the lithographic printing machine, the hydraulic and other presses, cutting and stamping machines, die-sinking and embossing. Opposite to this pencil-making is exhibited with the aid of simple machinery; and, in an adjoining room, the manufacture of sealing-wax.

In the same room already referred to, that in which is the entrance to the Indian court, are the processes of anastatic printing, and those of the production of prints by the Woodbury and Heliotype methods. The first of these resembles lithographic printing in *fac-simile*, only it is executed with metal plates instead of stones; and the two latter processes of reproducing photographs have lately been fully described in the pages of the *Journal*, and in other publications.

Graphotype engraving is seen in operation in room No. 5. This peculiar process consists in drawing with a chemical ink on finely-pulverised chalk, which has been submitted to great pressure beneath a hydraulic press, and afterwards coated with a kind of size; when the drawing is finished, all the surface of the chalk which is untouched by the ink is picked and brushed out to the required depth, the whole being then immersed in a solution which hardens the chalk, and from it stereotype or electrotype blocks are then cast in the usual way, and printed from in the same manner as woodcuts or type.

In the rooms adjoining the Indian court, is a considerable collection of examples of printing in colours, and amongst them may be specially mentioned some beautiful representations of plants, printed in seven colours by the ordinary letter-press. Belgium, Austria, and Prussia also send some remarkable examples of colour printing. There is besides a large collection of engravings produced from wood blocks, and by other means, amongst which may be mentioned representations of trees, taken from enlarged copies of photographs, for horticultural works.

The rest of this portion of the galleries contains a magnificent collection of specimens of printing of all kinds. Type-founders' specimen books and sheets; lithographic printing; postage stamps, with, in one case, impressions from a plate from which one million of sheets had previously been printed; and, lastly, books of all classes, including many illustrated works of great beauty from Austria, Russia, Germany, Italy, Sweden, Denmark, Jerusalem, Bucharest, the United States, Columbia, Salvador, as well as from the presses of Great Britain, Victoria, Shanghai, Rangoon, &c., making, altogether, a splendid display of typographical skill. Of a different kind, but quite as interesting from another point of view, is the collection of newspapers, magazines, and other periodical publications, collected from almost every part of the civilised world, which is to be seen in the corridors behind the dining-rooms. While the former collection exhibits the perfection of the printers' art, the latter shows its extraordinary extension and dissemination.

Whether we look at this division of the Exhibition, with regard to the amount of scientific ability and ingenuity called into play in its behalf, with respect to its enormous growth and to the number of hands engaged in it, or with a view to the great commercial, scientific, and moral effects of the produce of the printing press, we must arrive at the conclusion that few, if any, industries could offer more interest in an educational point of view—the highest aim of this or any other Exhibition.

EXHIBITIONS.

THE VIENNA EXHIBITION.

The following correspondence has appeared in the *Times*:—

To the Editor of the "Times."

Sir,—Some observations were made at a recent Council meeting of the Royal Agricultural Society of England, by a very practical member of that practical body. I asked him to put his observations on paper, and they appear to be of national interest, and therefore I venture to ask you to print them.

I am, Sir, yours faithfully,
Cathcart.

12, Hanover-square, Aug. 14.

Orwell-house, Ipswich, Aug. 12.

My Lord,—In compliance with your request, I have much pleasure in forwarding a few remarks on the Vienna Exhibition.

I was in Vienna very recently, and can bear ample testimony to the magnitude of the preparations for the Exhibition, and the advanced state of the building. I may say frankly that I was altogether unprepared for what I saw there, and also for the great business activity which seems to pervade all Germany now. Building is going on rapidly in all the cities, and there is a demand for all kinds of manufactured goods, which will make the occasion of the Exhibition valuable to manufacturers.

This seems to be generally understood, and many foreign countries are making great efforts to seize the advantages of the Exhibition. For it must be remembered that this Exhibition differs from all that have preceded it, in the peculiar circumstances arising from the locality of the city in which it is held, Vienna being the centre of a network of railways, and the last commercial town of Europe whence the products of the West are sent to the East.

It will be visited by many Russians, Poles, Wallachians, and others, who would never reach an exhibition at London or at Paris. I am disposed to think that the advantages of participating in the exhibition are not very widely realised in England, and this appears to me subject for regret. If it were possible by special address from the Royal Commission to call the attention of the leading houses in each branch of manufacture to the exhibition, probably a larger representation of English skill would be made than would otherwise be the case.

I regret to say that I found a strong feeling at the bureau of the exhibition in Vienna that Austria, having twice taken an active part in London exhibitions—1851 and 1862—at great cost, it was unworthy of England not to do the same in a national manner at Vienna next year; and this feeling is expressed in the enclosed circular, in which Switzerland is contrasted with England. This circular, being given to me by Baron Schwarzenborn, accurately expresses his views as manager.

It is most desirable, if possible, to remove this feeling, as it will operate prejudicially to England in the jury awards and reports, and give further ground to the cry that England is being outstripped by the Continent. This cry will, to a certain degree, be justified if England takes only a secondary place in the list of awards, no matter what the cause may be.

As regards agriculture, it appeared to me that the plans of the exhibition are arranged for a very complete and interesting display, and although it would be too much, perhaps, to anticipate that any live-stock would be exhibited from England, I hope the Royal Agricultural Society of England's committee may see their way to the exhibition of a collection of seeds, and such produce as can be preserved readily, and to arrangements for securing a good and comprehensive report of the agricultural section of the exhibition. British agricultural machinery will probably be well represented, as the principal manufacturers are alive to the importance of the exhibition to their business, and the most important matter for them will be that England should be well represented on the jury.

I have no doubt, from a conversation with Mr. Owen, that he will do all that the limited funds of the Commission permit most effectively; and I think, if our Legation at Vienna would back him up well, it would be of great value to him. Major Goodenough, Military Attaché to the Legation, takes a great interest in the exhibition, and in his special department would, I am sure, do all that he could. I must ask your lordship to kindly excuse the length of these notes.

It appears to me most important that England should stand well at the Vienna Exhibition, and show the excellence of her products in as many classes as possible. If her most eminent manufacturers contribute to the exhibition, there is no doubt that England will stand well, and that a considerable accession of business and consequent employment for the people will be the result.

I have the honour to be, faithfully yours,

R. C. Ransome.

The Earl Cathcart.

Switzerland and the Vienna Universal Exhibition of 1873.

Switzerland, one of the smallest states of Europe in extent, though one of the most important on account of its industrial civilisation, is about to take a part in the Vienna Exhibition of 1873, which some of her richer and more powerful neighbours might emulate with advantage. The following translation of a letter from Bern, published in one of the leading papers of Vienna, the *Neue Freie Pressè*, will show what the National Commission proposes to do. It will be noticed that a sum of 400,000f.—that is £16,000—has been voted towards defraying the expenses likely to be incurred. Surely, if Switzerland can do this, England ought to be able to supply more than the £6,000, which has been granted by Mr. Lowe to the English Royal Commission?

The letter alluded to above is as follows:—

Bern, July 19, 1872.

Both Councils—namely, the National Council and the State Council—have taken into consideration the propositions of the Federal Council concerning the participation of Switzerland in the Vienna Exhibition. They have agreed unanimously to all the principal resolutions, which are, therefore, now inserted with legal authority. I, therefore, communicate these resolutions to you *in extenso*. They are as follows:—

1. The Confederation takes upon itself the cost of the Swiss section of the Vienna Exhibition of 1873 in the matter of—

(*a*) The general architectural arrangements and fittings of the space occupied.

(*b*) The ground-rent for all objects of exhibition, as well as the setting up and care of the same in the exhibition building.

(*c*) The carriage to and from, and the railway insurance between, the Swiss boundary station and the exhibition building for all objects of art and agriculture, as well as for such industrial objects as do not exceed the weight of 50 kilogrammes for each single exhibitor, and can be conveyed by the ordinary means of transport.

(*d*) The housing, feeding, and taking care of all cattle exhibited, so far as these expenses are not defrayed by the general direction of the exhibition.

(*e*) The insurance of objects of exhibition against fire in the exhibition building, and the insurance of the cattle, so far as the latter is possible.

(*f*) The Commissioners and the prize jurymen.

2. The Confederation pays in advance, but will have itself reimbursed by exhibitors, either directly or by the agency of the Cantons, the cost of—

(*a*) The foundations, erection, and gearing of machinery and similar apparatus, the exhibition stands, show-cases and tables, and, in short, the interior arrangements of the Swiss Exhibition, according to the regulations issued by the Commissioners.

(*b*) The carriage to and from the exhibition and the railway insurance of those industrial and commercial objects whose weight is more than 50 kilogrammes, and which can be forwarded by ordinary means of transport; also those objects of industry and commerce which must be forwarded by express train.

(*c*) In short, everything the cost of which, according to the present arrangements, is not defrayed by the Confederation itself.

3. The Commissioners take charge of—

(*a*) The reception of all objects of exhibition, as well as their return to the Swiss delivery station.

(*b*) The carriage and railway insurance of the same to and from the exhibition building.

(*c*) The erection of show cases, the interior arrangement of the exhibition, the reception of exhibition objects, the unpacking and arranging of the same, the removal and storing of the packing cases, the inspection and preservation of the objects, and the repacking of those objects which will not have been sold.

4. The Commission is to be nominated by the Federal Council.

5. The Confederation is responsible to the exhibitors for the conveyance of objects to the same extent as the Commissioners; the conveyance and insurance companies are responsible to the Confederation. It is the duty of the exhibitors to deliver their objects, carefully packed, at the indicated railway stations.

6. Swiss connoisseurs will decide at certain fixed places on the admissibility to the exhibition of objects of art. The admissibility of all other objects will be decided on by the Cantonal Commissioners, but their decisions must be confirmed by the Swiss Home Department, and the Cantonal Commissioners must inform the latter in due time of the place and date of examination of exhibition objects, in order that the said department may be represented at the examination.

7. Objects sent to and returned from the exhibition are free from Custom-house charges on their passing the Swiss frontier.

8. In order to facilitate their visiting the exhibition, the Confederacy grants a sum of at most 50,000f., or £2,000, to such workmen or artisans who receive at least an equal sum in their own cantons, be it from the Government, the commune, corporations, or private individuals.

9. The Federal Council grants a sum of at most 400,000f., or £16,000, towards defraying the above-mentioned expenses.

To the Editor of the Times.

Sir,—The letter of Mr. Ransome relative to the Vienna Exhibition will, it is hoped, do much to arouse a feeling in this country which will operate favourably as regards England's place on that occasion. The Council of the Society of Arts have observed with regret the apathy which results from the knowledge that England, nationally, is only prepared at present to take a small part in that important meeting. The Council has reason to believe that this exhibition is of very great importance, as determining the question of supply to a vast Eastern market, and that a very serious national loss will result if steps are not taken to do something more effectual than is at present contemplated.

The "strong feeling" spoken of, that "England is taking an unworthy part," is not to be wondered at; and the Council purpose calling together a conference of gentlemen interested in these questions as soon as there is some lull in the energetic holiday-seeking of the present period.

I am, Sir, your obedient servant,
F. Eardley-Wilmot, Major-General (Chairman of Council).

August 19.

Waste Materials at the Vienna Exhibition.—Among the supplemental exhibitions which will be formed in connection with the Vienna Universal Exhibition of 1873 is to be one showing what steps have been taken since 1851—the date of the first London exhibition—in the utilisation of substances previously regarded as waste. On the one hand will be shown the waste products in all the industrial processes included in the forthcoming exhibition; on the other hand, the useful products which have been obtained from such wastes since 1851. This is intended to serve as an incentive to further researches in the same important direction.

THE SPORADES.

An interesting and instructive description of the physical features of the Islands of the Ottoman Archipelago, and the condition of the inhabitants, who are chiefly occupied in the sponge fisheries, is furnished by Mr. Biliotti, the British Vice-Consul at Rhodes, in his report upon the trade of the Sporades for the year 1869. It appears that in all former years the whole of the sponges, amounting annually to about £120,000, formed part of the exports of Rhodes, but a diversion has taken place in the traffic in consequence of the steam vessels calling direct at the Sporades. The decreased value in prices, equal to 25 per cent., is to be attributed also to the quantities fished with diving apparatus, which have encumbered the markets with more merchandise than is required for the annual consumption. The number of diving apparatuses employed during the year by the islanders was about 60, only a few having attained £700 or £800 each, whilst others had hardly covered their expenses. According to all probability this number in a few years will be increased to 300 and 400, owing to the convenient conditions offered to the divers by M. Denayrouze, of the French firm of Rouquerol and Denayrouze. By means of the superior inducements thus held out, an important branch of commerce, representing in value no less than £40,000, and requiring annually new gear for at least £10,000, will be lost to British industry.

The island of Calymnos possesses the greater number of sponge fishing-boats (nearly 300); but they are not to be compared, for construction, size, and gear, to those of Symi. However, within the last few years the Calymniotes have built on the island, and purchased at Symi, annually 10 or 12 boats, mostly of six or seven tons, for the purpose of proceeding in them to the coast of Africa, where they could not go in their old boats of three or four tons. To go and fish on the coast of Barbary they were obliged formerly to charter large vessels, on board which they embarked their boats; but this entailed on them a heavy expense, which they now save. Boats of larger size than those hitherto used in general at Calymnos are also required for diving apparatuses, the number of which—20—stands in a low proportion with that of the boats fishing for sponge, especially when it is considered that the produce of the former is, on an average, three or four times that of the latter. But the divers here have not the means of purchasing themselves diving apparatuses, and these are furnished to them by native undertakers, who receive for share one-third of the fishery. Although they find great convenience in this investment, still, the undertakers themselves cannot dispose of much ready money, most of their capital consisting in shares in sponge-fishing boats and in credits on the divers. The only article exported from Calymnos is sponges, and the sponge fishery is the sole industry of the inhabitants, who, although they are all seamen, have but an insignificant mercantile marine. The island, which is very mountainous, possesses only three narrow valleys with arable land. In these, and on a few slopes of the mountains which are susceptible of agriculture, the inhabitants grow on an average 10,000 bushels of barley a-year. Fig trees are the only ones found in some numbers at Calymnos. There are many wild olives, the fruit of which the inhabitants gather and preserve for eating. The cultivated olive trees are so few that they are not worth mentioning. Honey is also produced, but in insignificant quantities. The Calymniotes possess about 8,000 sheep and goats, which give cheese, butter, and wool in proportion to their numbers. There is a pottery on the island, where are manufactured the earthenware jars required for local use. Soap was almost unknown a few years ago, and the inhabitants were and are still in the habit of washing their linen with a special earth found in the island. The Calymniotes in general have more instruction than the other islanders, and are very fine speakers. Without being more barren than some of the Sporades, Castel-Rosso is the only island where there is no agricultural produce of any kind, and where even fruit trees—such as fig trees—are not grown. But its mercantile marine is of great importance. Few persons can afford to build a large vessel without assistance in money, but they never borrow from foreigners. Two or three people associate, and furnish the main funds, and small sums are contributed by different parties to enable the owners to finish the vessel. The equipment is more or less complete in consequence of the money which is available, and it is of rare occurrence to see a Castel-Rosso vessel, newly built, possess her entire rigging. Shareholders usually take employment on board, a circumstance which accounts for the unusually large number of seamen on board Castel-Rosso vessels. Their principal, or rather their exclusive occupation consists in firewood, timber, and plank trade, between the coasts of Caramania and the Archipelago, Syria, and especially Egypt.

The Castel-Rossiotes boast of being the best divers in the Archipelago. They go, they pretend, as deep as forty fathoms, and despise diving apparatus, of which not a single one has hitherto been employed by them, as they can descend in them only to a little more than twenty fathoms. Hitherto, the places where they fished for sponges were the coasts of Syria and Caramania; but last year four of their boats proceeded for the first time to the coast of Barbary, and the profits they have realised are so much above their former earnings, that they all intend next season to proceed there. The quality of the Caramanian sponges is not much liked, in consequence of the roots being red, owing, no doubt, to their growing on ferruginous rocks. Although many Castel-Rossiotes work in foreign countries, it is unknown that they should marry out of the island. Husbands are found for all the girls, and the population is greatly increasing. The women still wear their old costume, which is very much like the Turkish dress. It consists of a white shirt, falling over long and wide trousers, the lower part of which, being seen, is also in silk, but usually of a red colour; the first part of the shirt is fastened with large silver buckles; of a silk gown, opened in front, so as to allow all the shirt to be seen, fastened at the waist with a silk sash; and of a cloth spencer, worn above all. On the head a number of kerchiefs, concealing the hair, and making a rather heavy head-dress, over which falls loose a large kerchief. They use sandals instead of shoes. The young women wear red caps, with their hair falling over their shoulders in tresses, in which gold coins are intermingled.

The Cassiotes are the most active, enterprising, and daring of all the inhabitants of the Sporades. During the Greek insurrection they were quite a match for the Ottoman navy. Cassos, which had then much suffered, possesses now a thriving population of at least 7,000 souls, owing their welfare to shipping, to which they have at all times addicted themselves. All the Cassiotes are seamen, and the best in the Ottoman Archipelago, which may be attributed to their being compelled, in consequence of the want of harbours on their island, to be at sea all the year round, instead of disarming their vessels in the winter season as do the other islanders. Few foreign vessels call at Cassos. The only article of exportation is gypsum stone, which is found on the neighbouring island of Armathia. About 20,000 cwt. are sent yearly to Constantinople, Smyrna, Odessa, and Athens. The houses of the Cassiotes are better furnished, and they live in a more comfortable style, than the inhabitants of the other islands of the Sporades. There are grown upon the island about 2,000 bushels of wheat, and 4,000 bushels of barley. They possess 6,000 sheep and goats, attended by nearly 100 shepherds, who make 4,000lbs. of butter, and 8,000lbs. of cheese. There are at Cassos a few fig, olive, and almond trees, as well as a few acres of vineyards. Every house possesses two or three water tanks, as the only spring in the island is at some distance from the town, and gives but an insignificant quantity of water. There are no communal schools, as is the case on the other islands, but there are three private schools, in which pupils who can pay are only admitted. However, the Cassiotes, in consequence of their constant voyages and intercourse with foreigners, have more general knowledge than the other inhabitants of the Sporades. Cos, although situated in the middle of the Sporades, does not form part of the group of islands bearing that name, so at least the inhabitants of the Ottoman Archipelago consider, as it does not enjoy the immunities granted to the other islands. The Coses have not that daring and enterprising spirit which distinguishes most of the other populations, and no progress can be marked in the welfare of the island. There are only belonging to Cos five boats, of together about 145 tons, and manned with 40 seamen, who are all Turks. The harbour of this island, at which a government dredging machine has been at work for several years, is only fit for small craft. The peasants addict themselves more especially to the cultivation of vineyards, and the grapes are of very good quality. Fig trees do not grow well. There are perhaps upwards of 100,000 wild olive trees, which are not grafted. Cotton might be grown in some quantity, but peasants neglect every other branch of agriculture for the cultivation of vineyards. There are about 40,000 sheep and goats on the island, and 1,000 yokes. Formerly, large quantities of lemons and oranges were produced, but in 1850 a severe frost destroyed all the trees, which have never recovered since. New trees have been planted, but they have not yet given much produce. The Turks living in the town of Cos were formerly large landed proprietors, and they lived on the income derived from the produce of their gardens, but the frost which destroyed the orange plantations caused the ruin of many of them. They are now in general in worse condition than the Greeks, and their number is yearly decreasing. The island of Fourni belongs to a family of Patmos, on whom it was bestowed by the Porte, under circumstances which have reduced the inhabitants to poverty. They produce a little wheat, barley, olive oil, cheese, honey, and a few figs, but in quantities hardly sufficient for their own consumption. The only article of exportation is charcoal, of a value of about £100 a-year. A few of the young men have begun to take employment as rowers on board Calymnos sponge fishing boats. The islets of Lipso, Orki, Gaïdaro, Levitha, Marathi, Hiliomidi, Fragonissi, and 15 other small islets, some of them mere rocks, all surrounding Patmos, were hitherto in the hands of the monks of the convent of the latter island, who derived therefrom revenues of some importance; but the Porte, considering that they were illegally detained by the monks, has taken possession of them, and divided the lands amongst the people living on them, with the exception of one-third of the arable lands of Lipso, which has been given to 42 families of Patmos. The last-mentioned have taken their share of the land with the intention, it would seem, of returning it to the monks. On the island of Lipso, which is the most important of the group, there being 1,200 acres, there are 29 families. The other large isles are inhabited by one or two only.

(*To be continued.*)

GENERAL NOTES.

The Geographical Society of France.—This society has in its hands a small balance—about £500—which is the remainder of a sum originally intended to aid African travellers in discovering the road to Timbuctoo. It has resolved to devote the money in question to the encouragement of explorers in distant countries generally, and has thrown out an appeal to the public for subscriptions for the same object.

Public Monuments in France.—The subscription for a monument to the late able director of the Sèvres Museum, and, in fact, founder of the famous ceramic museum there, M. Riocreux, is closed—the amount collected being sufficient for the intended purpose; but several persons have since applied to have their names added to the list of subscribers, and amongst these are an English lady and gentleman.—A subscription is opened at Dijon for a statue to the late Marshal Vaillant, who has left to the old Burgundian capital, of which he was a native, the small house which belonged to his family, a full-length portrait of himself by Horace Vernet, and two magnificent Sèvres china vases. The Marshal was a great collector, but his galleries of pictures and *objets d'art* were destroyed or ravaged, together with his château in the neighbourhood of Paris and all its contents, during the siege of Paris.—Another subscription is on foot for a monument in memory of the composer Auber, who, it will be remembered, died a year since. The committee in this case includes all the professors of the Conservatoire, many directors of theatres, and a number of musical connoisseurs and friends of the famous composer.

Consumption of Tea.—A Custom-house return has been issued, which shows an enormous increase in the consumption of tea in the United Kingdom. In 1811 it averaged 1lb. 4oz. per head, and the average price was 6s. 8d. per pound; in 1821 the price was about 1s. less, and in 1831 there had been a further fall of 1s. 2d.; but the consumption per head was substantially the same as in 1811. In 1841 the price was 2d. lower than in 1831, and had fallen to 4s. 2¾d., and the consumption per head in the year had advanced to 1lb. 6oz. In 1851 the average price had fallen to 3s. 4¾d., and the consumption had increased to 1lb. 15ozs. In 1861 the price had fallen to 2s. 10d., and the consumption had risen to 2lb. 11oz. per head. In 1871 the average price had fallen to 1s. 10½d., and the year's consumption had risen to 3lb. 15oz. per head, the total quantity entered for consumption exceeding 123,000,000lb. The average rate of duty on tea, paid by the consumer, was 1s. 2½d. per lb. in 1801, 3s. 4d. in 1811, 2s. 9½d. in 1821, 2s. 2¾d. in 1831, 2s. 2¼d. in 1841, the same in 1851, 1s. 5d. in 1861, and 6d. in 1871.

Journal of the Society of Arts.

No. 1,032. Vol. XX.

FRIDAY, AUGUST 30, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

THE LIBRARY.

The following books have been presented to the Library :—

Journal of the Society of Telegraph Engineers. No. 1, Vol. I.

Report of International Congress on the Prevention and Repression of Crime, including Penal and Reformatory Treatment, United States.

Quarterly Weather Report of the Meteorological Office, January to March, 1871. Presented by the Meteorological Committee.

Second Report of the Commissioners appointed to revise the Laws for the Assessment and Collection of Taxes in New York, 1872. Presented by the Cobden Club.

Abstracts of Specification of Patents applied for from 1854 to 1856—Metals. Part I. Presented by the Registrar-General of Victoria.

Annual Report of the Commissioners of Agriculture and Arts for the Province of Ontario, on Agriculture and Arts, for the year 1871. Presented by the Legislative Assembly.

The National Union for Improving the Education of Women. A Letter to the Editor of the *Times*. By Mrs. William Grey. Presented by the Authoress.

Report of the Veterinary Department for the year 1871 ; with an Appendix. Presented by the Department.

Classification de 250 Matières Tannantes, par M. Bernardin. Presented by the Author.

No. 3. "The Work of the National Union for Improving the Education of Women," by Emily A. E. Shirreff. Presented by the Authoress.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

THIRD COURSE OF CANTOR LECTURES.

SILICATES, SILICIDES, GLASS, AND GLASS PAINTING.

By Professor Barff.

Lecture IV.—Delivered Monday, April 29th, 1872.

Ladies and Gentlemen,—I had somewhat to divert my subject from the channel in which I had intended it should flow, on account of the press of matter, and from feeling that I could not do justice to every part of it in these lectures, for I should have felt it to be unsatisfactory had I passed on and left anything indistinct and imperfectly explained. I had therefore arranged to omit the subject of enamels and mosaics, and leave them to some future opportunity ; but I have been asked to-day to add another lecture to the course. This will make a difference in my method of treating the subject this evening, and I shall omit what I intend to say with regard to the process of burning in photographic images on enamel, and shall defer it to this day fortnight. In the sixth lecture I will give you those points which I have been obliged to omit in the preceding lecture, also some other matter connected with the composition of enamels, the treatment of mosaics, and the production of solid wall decoration. I shall consider this subject as distinct and separate from artistic painting with soluble silicates. I was told to-day that one gentleman had been anxious to know the process of polishing plate-glass, which I had referred to before, but which time will not permit me to go into to-night ; but I will describe it in the supplementary lecture, and will also give an account of the materials used.

You may remember, probably, that in my last lecture I took some Prince Rupert's drops and broke them ; I was informed that some of the fragments struck the door at the opposite side of the room, showing the force with which they flew asunder, as soon as the external bond which held them together was broken. Here are now two of these Prince Rupert's drops that were left ; they have been heated and allowed to cool slowly. I will now take these and break them ; you see there is no tendency in the particles to fly about at all. This shows you that the reason why those others disintegrated so rapidly was, that the glass was not properly annealed. When glass is cooling, or rather, when it is cooled suddenly, the particles take a long time to arrange themselves, as they are ultimately to settle down so as to form a compact mass. I told you that all glass was annealed, sometimes in *lires* and sometimes in ovens. I will not go further into this now, but I want to make one remark, which is this, that if glass is heated at all to softness and cooled suddenly, then some time must be allowed for the particles to re-arrange themselves properly, and it is because of this not being attended to by the manufacturers of cheap thermometers that we get them registering wrongly. When a thermometer is made, the glass is submitted to a high temperature, so that it may become soft. If then it be sealed up and marked immediately afterwards, it is sure to register wrongly in the course of time. Its zero will be a degree, or even more than a degree, above what it ought to be, because the particles of the glass do not properly arrange themselves for some time, and therefore the pressure of the air outside, continually exerted upon the vessel whose particles are re-arranging themselves, causes the bulb in which the mercury is placed to become contracted, so that, if the zero and boiling point are marked immediately after the sealing of the thermometer, they are sure to be somewhat changed, and so the thermometer will register incorrectly. Therefore good thermometers are always left for some months before they are marked and sold. I mention this because it is a matter of some importance, and as a warning to those who desire to have a good instrument, to obtain which it is always better to go to a good maker. I have now to speak briefly of the manufacture of flint glass. Here is a model of a closed flint glass-pot, and because it is covered over at the top a greater length of time is required to fuse the materials put within. I did not mention last time that the materials are never put cold into the pot, and that it is always at a white heat when a certain quantity of mixed material, after it has been fritted, is thrown in, and then, when this has run down into a molten state, more is added until the pot is filled. The pots, which are very large, when full, are left for a long time exposed to the action of heat, that the glass may become refined, and freed from air bubbles, which would give it a milky or streaky appearance when made. This founding takes about 48 hours in closed pots; therefore, when closed pots are used, a considerable quantity of red lead is employed, because that is a flux which causes fusion to take place at a lower temperature than it would require without such a flux. When the glass is ready for working, the mouth of the pot, looking, as I explained to you before, towards the outside of the circular furnace, the workman dips in his blow-pipe, and gathers on the end of it a small quantity of glass, which is in a pasty state. Now, considerable care is required to have the glass in a proper condition. If it is too hot it will be liquid, so that it would pour, and could not be worked. Therefore, during the time (12 hours, or more) which is required to work off a pot, as it is called, the man who has the management of the furnace has to be particularly careful that the glass is always kept in a proper and workable condition. When the glass is gathered on the end of the blow-pipe, the workman blows it into a globe; and here, also, he has to be very careful, for if by inadvertence he were to withdraw the blow-pipe from his mouth and leave the end open, the glass being in a soft state, and the air inside being extremely rarified, there would be a collapse, from the pressure of the air outside, and the hot air would be driven back. Practically, there is no difficulty about it, for the man who has to blow the glass knows exactly when he should allow the end of the tube to become free, and when not. In that way a globe is obtained, and, as I mentioned to you last time, a cylinder is first a globe, and then made cylindrical by swinging the blow-pipe, with glass on it, in the vertical position backwards and forwards. Small articles, such as are made in flint glass works, are treated in a similar way when it is wanted to elongate the vessel. In the case of a tumbler, or a wine-glass with a foot to it, the whole is not made at one operation. The globe, when blown, is allowed to cool, and then it is heated again at the front of the glass pot, for there is heat there sufficient to soften the glass in that way, and with proper tools, which I need not describe, but which are something like sugar tongs, a bowl of glass is shaped out, the size being determined with callipers. The operation is a very nice one, and I am told that no one can become a glass-blower who does not take to it in early life. The boys that gather are the future glass-blowers, and an adult person attempting to take to it can never accomplish it. I believe experiments have been tried by those who have been desirous of acquiring the art, but they have failed. After the bowl is made, the foot is detached from the blow-pipe, and the foot after being fashioned is attached to the bowl. These are operations which it is impossible for me to describe by word of mouth; and any words I might use would not convey a proper idea of the operation. All the vessels, after they are made in this way, are carried to an annealing furnace and annealed. With this short notice I think I must leave the subject of flint glass-making, for I have something more pressing to treat of, and which, I think, should claim precedence, and which, I believe, will be more useful, because I shall be able to give you practical hints which will enable some of you, who have a turn for art, to form beautiful decorative glass for the adornment of your houses, or places of public worship; and so by means of cultivating this very beautiful art, you may make it useful also.

I will now speak of the process by which coloured glass is made. Coloured glass is made in the same way as ordinary glass, except that certain substances are added to colour it. It is often said that the mystery of stained glass painting is lost—that the art which was once known to our forefathers in the middle ages has been lost. But this is altogether a mistake, there is nothing which they did which we cannot do. It is true that, after the decay of mediæval art, up to about 30 years ago, the stained glass that was made was anything but like that which it was intended to imitate, viz., the glass which adorns the ancient cathedrals of this and other lands. You will understand this if you look at some windows in the Temple Church, which are extremely good for the time at which they were made. They were a decided advance in the right direction upon what had preceded them. I shall have to allude to them again as well as to other windows, in the next lecture, when I speak of the styles of glass-painting. I cannot help referring to them now for this reason. A gentleman, named Whinston, a barrister, was much interested in this subject of glass-painting, and studied it very carefully. He saw that there was something wrong in the treatment that was being adopted, and he desired to ascertain how it was that the old windows, which had been made so many years, were so different from these modern imitations of them. He, in conjunction with Messrs. Powell, of Whitefriars, to whom we owe entirely this revival of the ancient mode of making glass, set to work and analysed the old glass, to see with what metallic oxides they were coloured, &c. They also examined carefully the method in which they imagined the old glass was made. Mr. Whinston examined old treatises on the subject. He read carefully a book by a writer of the middle ages, and a translation is given in the appendix to a work which he published. It is interesting to see how very similar the older methods were to those employed at the present time; yet there were differences. I will not go through a description of the various stages of their work; however, we owe them both a heavy debt of gratitude. Others may have taken up the same subject, and doubtless have, but they were the first in the field, and the enterprise and intelligence which Messrs. Powell displayed in this matter are beyond all praise. They have furnished us here to-night with specimens of their coloured glass, and by means of these I hope to be able to illustrate to you the method of manufacturing glass suitable for church windows and decorative purposes of all kinds, and contrast it with that which is used for domestic purposes, and show you how it was that gradually stained glass painting began to decline from about the end of the 16th century. If you look at this cylinder, which is a beautiful specimen of glass, sent by Messrs. Chance, of Birmingham, you will see that it is most perfect in its manufacture, and all their glass in domestic uses is of this character, most carefully and beautifully made. But it is because the glass which those who revived glass-painting employed was so perfect in its manufacture, and so fine in substance, that much of the effect of the ancient glass painting was wanting in their works. Various means were employed by architects and others to remedy these defects by covering the glass in places with opaque enamel, so as to give it an antique appearance, and also to get the lustrous effects which they saw glistening forth in the windows of the old artists. The effect of this was to cause darkness, and to destroy utterly that brilliancy which they hoped to attain.

Now, here is a cylinder of glass which is made for church windows. I dare say that even at this distance you can see that it is very imperfect on its surface, and irregular in its substance. The cylinder is not particularly true in its form, it is not even in its thickness, and the glass has not been refined with the same care as that which I showed you just now. It is full of air-bubbles and streaks; and if you look at a person through it, his features will be distorted in all kinds of directions. In fact, you cannot see at all distinctly through it. Now this very defect in the manufacture of glass for stained windows is its beauty. If you allow the light to pass through a sheet of glass, like this fine specimen, it passes through it uninterruptedly, but if you allow it to pass through this coarser glass, it is refracted, and this gives it its beauty and brilliancy. There, again, is another sheet of glass which will illustrate it better; it is full of striæ and air bubbles. It is interesting to watch the course which the change in the manufacture of glass has taken in the last thirty years. All sorts of what one may call tricks have been resorted to to produce the effect of old and partly disintegrated glass. It was found, on examining the old glass, that it was full of little spots, or minute holes. I think I told you the reason of this in a former lecture, that it is because the glass is not perfectly homogeneous; some silicate, more alkaline than the rest which compose it, has dissolved out, which, you will remember, it does readily when water acts upon it slowly, and there is no doubt whatever that to this disintegration of a great portion of the old glass its pearly lustre and extreme beauty are owing. These irregularities in thickness all refract light, and cause it to stream through the glass as through a number of prisms, and thus we get a more lustrous and beautiful effect than we do when light is allowed to pass through a perfectly homogeneous medium.

Here is a specimen of patent-rolled plate-glass, which I allude to because I think it right to give all the credit to those who, by scientific means, have done anything to improve or advance this beautiful manufacture. This was invented by Mr. Hartley, of Sunderland, a glassmaker of great intelligence, who found out a very simple thing, that he could ladle out from a pot of glass a desired quantity, and throw it upon a table, and roll it. These marks which you see are from engraved lines in the iron table upon which it is rolled. This glass is very lustrous, and is often used in the manufacture of stained-glass windows. Mr. Hartley has also done much in the improvement of coloured glass. I will now describe how glass is coloured. Here is a piece of blue glass. It is what is termed pot metal, that is to say, the blue colour passes all through the substance of the glass. It is made blue in the pot. Here, again, is a piece of ruby glass, and in it you will see striæ and irregularities in its colour which make it so valuable to the artist. This glass is not coloured throughout its substance, but is simply coated on the surface. There are certain other glasses which can be coated, for instance, blue glass can be coated, because oxide of cobalt when used in quantity imparts a very deep blue colour to the glass, so that you can have a thin film of it covering white glass, and producing a deep blue colour. Again, greens and purples also can be coated, and they are all of them, I believe, to be obtained coated either in this country or from abroad. But ruby is always a coated glass. If you look at this specimen, you will see that it is perfectly opaque. It does not look like glass, but like a piece of red sealing-wax; it is coloured with the sub-oxide of copper. When the workman is making a disc or cylinder of ruby glass, he gathers upon the end of his blow-pipe, first, a piece of ruby glass, which is like this opaque glass, and then on the outside he gathers a quantity of white glass. He knows how to take the two glasses in proper proportions, so as to have a proper thickness of white and of ruby. He then blows and gets a globe, or cylinder, which is composed of white glass covered with a very thin film of ruby glass; and it is only when this ruby glass is seen spread out thin that you are able to see its ruby colour.

Here again is the material used in making another kind of ruby glass, which is very beautiful. This is ruby made with oxide of gold. Here, you see, is a mass of red glass, not particularly brilliant in colour, which is made in the glass-pot, and great care is required in its manufacture, for if is heated too much the oxide of gold is destroyed, and is reduced to a regulized state, and metallic gold does not colour glass. A piece of this glass is attached to a blow-pipe, just in the same way as the other, and is coated in the same way with plain glass. I hope to have a small piece of this gold ruby here next week, that you may see its beautiful colour. I will proceed now to the subject of stained glass, or glass painting, and leave to my next lecture the colouring of glass in the mass, because next week we shall be able to make some coloured glass in small quantities; and, having the electric light, I shall be better able to show you how the white glass is coloured then than I can do now. I could not commence the description of the method of staining or painting glass without first mentioning the way in which glass is coloured, because you will see, when we come to treat of the manufacture of stained glass windows, that there is, properly speaking, no staining whatever except in one instance; it is simply painting. It is called stained glass, but this is an incorrect name for it. This piece of glass is not stained; it is coated with coloured glass.

I have here a piece of yellow glass. It is stained with oxide of silver, and this is really the only stained glass which is used in windows. Other glasses are either coloured throughout their substance, or are coated. I shall this evening illustrate the method of staining yellow glass. This little furnace, which you see here, will be used for the purpose. I shall, I hope, be able to show you also a method by which a ruby stain can be obtained. Silver stain varies from a light straw colour to a deep orange; but a ruby stain is, as its name implies, a true red. Here is a piece of glass which was coloured with a ruby stain in this muffle, but as the heat was allowed to become too great, there has been a little metal reduced here, which spoils the colour in parts. It is very instructive to examine this, because it shows the importance of attending to temperature in all these operations. In making a stained window, the first thing to be done is to make the design. Here are some sketches of various designs for windows; these, as well as everything pertaining to stained glass manufacture, have been lent us by Messrs. Lavers, Barraud, and Westlake, of Endell-street, artists who hold a very high position as glass painters; it is, therefore, quite unnecessary for me to make any comments on the merit of their works. The first thing to be done is to make the design. After that the working drawings, or large cartoons, are drawn by the artist. You see here a series of them, which have been used in the manufacture of a stained glass window, and here is the window which was executed from them.

The various black lines which you see are lead lines. When a cartoon is finished, tracings are taken from it, and thus you see how easy it would be for anyone who has a talent for drawing to make first a small sketch, and afterwards to make the large cartoon. As to the taste required and the style to be adopted, I will not say anything to-night, as I am now simply speaking of manipulation. There is nothing easier than for a person who can draw to enlarge the drawing afterwards. A tracing is made of the whole and of different parts of the windows, and it is from these tracings that the glass used in the window is cut. One tracing will serve both for cutting the pieces of glass required to make up the window and also for performing the operation of leading, of which you see a sample here. Here are the pieces of glass which were laid upon this tracing. It is very easy, when they are cut, for the workmen to lay them down in their places and join them together by means of these pieces of lead, in the way which I will presently show you. I now come to the most interesting and important of all the operations after the cartoon is drawn, that is, the painting of the glass. Certain substances are used for the purpose of painting on glass. Here you see certain dark lines, indicating the shape of the design. If it were a rosette or a face, it would be outlined in just the same manner. Mr. Yeoman, an artist from Messrs. Lavers, has been kind enough to come here this evening, and he will illustrate the work before you. He will take a piece of glass, which he has got ready for the purpose, and will show you how the manipulation is performed. He will put upon it a colour, the composition of which I will describe, and afterwards I will put it into this muffle, and fire it before you. The material with which Mr. Yeoman is going to paint is opaque. It is quite clear that if much of that material were used, the transparency of the glass, the property for which we most prize it, would be destroyed. Therefore, an artist who knows his work is as sparing as he can be in the use of this material, provided he can produce the effect which is desired. The material is made of various oxides of iron which are infusible, which do not enter into chemical combination to any appreciable extent with the fluxes employed, but which are simply held in suspension by them, and which are fixed on the glass when the fluxes are fused. There are different ways of making fluxes, and in my supplemental lecture I shall have an opportunity of showing you new methods of making them, by which they can be easily produced and rendered very fusible; and where the flux is required to be coloured so as to be transparent, it can be so composed as to insure this effect at the temperature which is at our command. The bases of most fluxes are borax and oxide of lead. Borax is a substance which renders the glass fusible, and so also is red oxide of lead. Many prefer to use the lead and the borax in chemical combination, and for this purpose they precipitate a solution of common borax by a solution of lead nitrate, and they then get a lead borate, which makes an exceedingly good flux; but there is always a drawback to the use of borax as a flux for painting stained glass windows. I do not know whether you have ever noticed it, but if you look, you may notice on the outside of many modern church windows a white mildewed appearance upon the dark brown colour with which the glass is painted. If the glass by any accident gets placed the wrong side outwards—and that sometimes does happen when it is painted on the wrong side—the painted portion is exposed to the action of the weather; this and the moisture in the air causes the borax to dissolve slowly, so that the flux which fixes the colour upon the glass is to a great extent destroyed. I have seen many works of really distinguished artists in which some of the lines and shading of the faces have disappeared altogether, owing, no doubt, to the fluxes being made soft with too much borax. Many glass painters—at least it used to be so years ago—are pleased to see their fluxes come out of the oven bright. Now I, on the contrary, would rather not see them come out bright; I would rather see them come out dull, for that is a proof they are not too fusible, and is an earnest that they will last a much greater length of time. Different substances are used in these paints. For instance, that which Mr. Yeoman is using is made of dark-coloured oxide of iron. Here is some in this bottle. He is mixing it with some sticky material—gum can be used, or sugar and water; spirits of tar is sometimes used, and various materials are employed for causing these fluxes temporarily to adhere to the glass until they are burnt in. I cannot here tell you the relative advantages of these materials, nor why one is used in preference to another in a particular kind of work. If any of you take to glass-painting as an amusement, you will soon find out the substance best suited to your wants as a vehicle. Here is the piece of glass which Mr. Yeoman has painted. You see the imperfect state in which it is; the background is stopped out, the glass is covered with a sort of film, but there are bright spots in it. Mr. Yeoman will work away with a stiff brush, and brush out the high lights and then he will shade it; and when it is finished I will show it to you, and then we will put it into the muffle. If we desired to stain that leaf, and make a portion of it yellow, the way to do it would be by applying to it the silver stain which I have already alluded to. There are different kinds of silver stain. The silver stain used formerly was made by melting together some antimony and silver, throwing them into water, and then grinding down the mixture to a fine powder. This was mixed with some Venetian red (not that the Venetian red had any other effect than that of keeping the particles distributed, and preventing them from settling in the vessel in which the stain was mixed). Some adhesive material was then added or not, as was desired, before its application to the glass; but gum is objectionable, because it hinders the oxidation of the silver until after some length of time, for the presence of carbon in the gum reduces the oxide as it is formed, or prevents oxidation. The better way is to float on such a stain with water simply, and to allow to dry. The oxide of silver it is that stains the glass, not the metallic silver. It has been said, I think, that Sir Humphery Davy, at one time, had the idea that certain particles of metal were held in a sort of solution in the glass, and caused it to be coloured, but I think that idea is altogether given up, and that we are all of us agreed that it is to the presence of metallic oxides, forming distinct silicates, that stained glass owes its particular colour. The silver here put on in a metallic state must be oxidised, and then, when it becomes oxidised, it strikes a colour in the glass. This piece of glass here is stained with another stain used in Messrs. Lavers' establishment. That orange stain was fired in their kiln, and here is some of the stain which I have put on a piece of glass, which we will fire when the muffle gets sufficiently hot. Here are two different specimens of stains which have not been fired, one of which is opaque and another is transparent; after firing both will stain the glass yellow. The glass with this transparent stain is coloured a dirty yellow. There are certain mechanical advantages in using this stain, for instance, the glass painter is enabled to see the effect produced by the yellow in the places where he wishes to have a yellow colour eventually. The composition of this stain is a secret which I am not in possession of; it belongs to Mr. Yeoman. Here are other transparent stains, which I have known of and used for years. I can cover a piece of glass with this colourless liquid, dry it, place it in the furnace, and bring it out stained yellow. I think it best to take the silver in the form of a solution of a silver salt, and I prefer to use the nitrate of silver, or common lunar caustic, dissolved in water. If I put that solution on the glass, and allow the water to evaporate, I have then a thin deposit of nitrate of silver. The action of heat upon that is to decompose the nitric acid, which is in combination with the oxide of silver in the nitrate, and as soon as that decomposition takes place, which it does very rapidly at a much lower temperature than I have here, then the oxide of silver does its work, and stains the glass. In making stained glass, one ought to be particularly careful not to allow the temperature to rise too high, because, if you do, you get an effect produced which you will see illustrated in this piece of glass. If you examine it, you will find that it has become opaque in parts. When this happens, it is always a defect. It is said that the glass is sulphured when this happens, but that is not really the case. There is no sulphide formed. If you go on heating this glass to a higher temperature than is required, you will reduce the oxide, and have metallic silver deposited. Everybody who has managed a kiln knows that this too often happens. Here is another illustration of the same kind of thing. In this case copper oxide was used to stain the glass ruby, but the reduction has gone too far, and copper has been left on the surface of the glass in the reguline state. Here is the leaf which Mr. Yeoman has painted and shaded. If I were to rub it, the colour would come off easily; but presently, when it has been fired in the muffle, and heated to a dull red heat for a short time, the fluxes will be melted, and the colour which was combined with the fluxes will be indelibly fixed upon the glass. You notice that this part is white, or nearly white. Mr. Yeoman will now put on a portion of it some silver stain, so that when it comes out of the muffle it will be yellow where the stain has been applied. If I have not time this evening to show you the process of staining ruby, I will show it you in my supplementary lecture, because I shall have the muffle here again to illustrate the way in which these very beautiful photographs are transferred to and fixed on enamel, by a process which Mr. Solomons, of Red Lion-square, has invented. I shall then show you that process, and describe it in all its stages.

After the glass has been painted and fired, there remains the process of putting it together. I should mention, however, that in executing a large figure, like those you see on the drawings before you, a glass easel is employed. It is made of a large sheet of thick glass placed upon a frame, and then the glass for the figure, after it has been cut to the proper shape, is caused to adhere to the plate of glass, so that the artist is able to see through it and study properly his effects. He can paint the figure as a whole, and shade it until the effect produced is in accordance with the original design.

And now we come to leading, a very important part in the manufacture of a stained-glass window, for it is that which, when well done, ensures its durability. Here are some pieces of lead in the first stage of the process, and you notice how pliable they are. A conscientious glass-painter always takes care to get the best lead he can, free from tin or solder, because any admixture of such metals impairs its pliability. Here is an iron mould, the construction of which I need not stay to explain; a series of these strips are cast together, the mould is then opened, and they are turned out, being in the shape of this one, and called carms. They are then passed through what is called a vice, which makes certain marks on the core of the lead, and, at the same time, draws it out to about four times the length it was when first cast. Here are some so drawn out; they are of great substance, strong and thick at the back, but narrow in front, in order that they may interfere as little as possible with the light. There are some narrower than any I have here, and they are used for the finest parts of the work. In some cases even eyes have been leaded into the face; the lead used for this purpose is called string lead. If you notice there are little marks along the lead, which are formed by the vice, the cheeks of which are movable, so that in the same vice you may form pieces of various degrees of strength and thickness by changing the cheeks. You will not have much difficulty in understanding how easy it is to work with such a pliable material as this, to encircle the pieces of glass and to tie them together. The workman puts a piece of glass down on his cartoon, encircles it with lead thus; he then cuts off the ends, and fastens into it another piece of glass, thus fixing it down with nails until the soldering time comes, when, of course the joints are all soldered together. The soldering is accomplished by using a "soldering-bit," which is very different from that which plumbers use in mending a water-pipe which has burst. It is of copper, pointed in form, and around it is a ring, with gas-jets, which, being lighted, keeps it hot, and then with a little piece of solder, the lead being first scraped clean, the joints are easily made, for the bit melts the solder. The operation is facilitated by putting on the joint a drop of a liquid made for the purpose, consisting of a solution of zinc in muriatic or hydrochloric acid.

The stained glass window is now all put together, and the only thing that remains to be done is to cement it. The window is laid down upon a flat table, and a mixture is carefully rubbed in, so as to fill up all the interstices. Various mixtures are used for this purpose. Years ago whitening and oil, sometimes whitening mixed up with the dregs of old paint pots, and sometimes plaster of Paris was used. I think, however good these may be, that it would be better to use a soluble silicate, for that would adhere to the glass, and render the stopping more durable and more effective in keeping out wet. However, that still remains to be tried; it is only a hint which I throw out for the benefit of any one who may be disposed to try it.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

Jewellery.—A superb and valuable necklace and bracelet, completed by Messrs. Gass, of Regent-street, for his Highness the Khédive of Egypt, enriched with 125 fine brilliants, and containing nine ancient gold coins, of great rarity, of Arsinoe, Queen of Egypt, wife of Ptolemy II., who reigned about three centuries before the Christian era, has been recently added on loan to the jewellery galleries of the Exhibition. On the reverse of each coin there is a double cornucopiæ.

Royal Albert Hall.—The second series of people's concerts was brought to a close on Tuesday last. These concerts have been a success, and no one who has seen the attentive and appreciative audiences that have gathered week after week but must feel that the desire of the promoters to increase the love of good music in the people is being realised, and that they have succeeded in a far more difficult matter, that of affording the public the opportunity of hearing and enjoying it at a very small cost. For threepence, the price of a pint of beer, to make an every-day comparison, anyone can indulge for a couple of hours in an intelligent and ennobling recreation. A new series commences on Monday next, and will be continued every Monday until further notice, the price of admission being further reduced to sixpence for three persons.

EXHIBITIONS.

MOSCOW POLYTECHNIC EXHIBITION.

The International Polytechnic Exhibition of Moscow is different from most preceding exhibitions, inasmuch as it does not include fine arts, and is more particularly devoted to those specialities which relate to daily life and its practical wants. It is intended to represent a consecutive series of economic appliances, the results of the influence of science on practice. Not only models worthy of imitation in the respective spheres of domestic economy, trade, and industrial art, but also illustrations of all the ways and means by which the best results may be obtained therein, are included. The Russian Government, through the Imperial Commission, have stated that the great object of the exhibition is the education of the Russian people, by full explanatory information and practical illustrations. Thus it forms a kind of temporary museum, which excludes all useless repetitions of the same objects, the aim of its promoters being to represent, as intelligibly and clearly as possible, a picture of the present state of the various departments of practical art and science, to make its contents easy of access and interesting, not only to those specially concerned, but also to the mass of the public, and to aid in bringing about further serviceable results.

All competition among the exhibitors has been excluded. The Commission in its programme expressed its desire that all exhibitors—Russian ones especially—"should take part in the exhibition, not with the object of comparing their products with those of others, but for the purpose of acquainting the public with those ways and means which certain manufactures possess for the attainment of the best possible results."

The day fixed for the opening of the exhibition, the 30th May according to the old style of reckoning, still in use in Russia, or the 11th June, according to the new style, adopted by every other European nation, was the two hundredth anniversary of the birth of the Emperor Peter the Great. The exhibition was made to partake, therefore, to a certain extent, of a festival in his honour, and the first section of it is devoted more particularly to his memory. The city of Moscow is the great commercial capital of Russia, and its foundation dates from the 14th century. It is connected with St. Petersburg by a line of rail, opened in 1851, and other railways connect it with the Baltic and neighbouring countries. Over most of these lines of rail special facilities and reduced rates and fares were accorded, both for the carriage of goods and passengers.

The exhibition is divided into the following sections:—Historical, Marine, Military, Sebastopol, Geologo-Mineralogical and Mining, Zoological, Botanical and Horticultural, Agricultural, Arboricultural, Architectural, Technical, Technological, Applied Physics, Manual Labour, Printing, Railway, Manufacturing, Astronomical, Educational, Medical, and Domestic Economy.

Generally, it may be said that, on the whole, it is a success. Being the first of its kind in Russia, there has been great delay, which possibly could not be helped, and great confusion, which only experience can avoid. The exhibition is not a very interesting one to foreigners, because of the rules which have been referred to. France, which appointed an imperial commission, sent nothing.

British Exhibits.

The British exhibits were got together, as will be remembered, under the auspices of the Society of Arts. To a committee—consisting of Lord Henry G. Lennox, M.P., Chairman of Council of the Society of Arts; the Right Hon. the Lord Mayor; G. C. T. Bartley, Esq.; Frank Buckland, Esq., M.D., Inspector of Fisheries; Andrew Cassels, Esq.; Edwin Chadwick, Esq., C.B.; Hyde Clarke, Esq.; Henry Cole, Esq., C.B.; Gabriel Kamensky, Esq.; Edwin Lawrence, Esq.; Sampson S. Lloyd, Esq., President of the Association of the Chambers of Commerce of the United Kingdom; W. P. Marshall, Esq.; Lieut. Monkhanof; Andrew Murray, Esq.; Donald Nicoll, Esq.; Professor Owen, F.R.S.; P. C. Owen, Esq.; Samuel Redgrave, Esq.; Major-Gen. Scott, C.B.; Thomas Tapling, Esq.; Major De Winton; Seymour Teulon, Esq., Vice-Chairman of Council; with P. Le Neve Foster, Esq., M.A., and Rev. Basil Popove, as Secretaries—the Imperial Commission entrusted the selection of exhibits and the allotment of space. Some large firms, as Messrs. Platt and Co. and Messrs. Howard and Co., who had agents at Moscow, applied through them; but the greater number of the British exhibitors have been admitted by the London Committee. The total number of exhibitors is not large, but when the distance is considered, as well as the hindrances to business caused by the high customs tariff, it may be considered that a fair return resulted from the labours of the Committee.

A catalogue has been published by Messrs. J. M. Johnson and Sons, 3, Castle-street, Holborn.

The following is a brief summary of the British exhibits:—In the historical section, one of the contributions towards illustrating the life and times of Peter the Great was sent from England, in the shape of a picture, exhibited by Mr. Albert Dixon, of 10, Bedford-row, Holborn, London. It is a portrait of Peter the Great, painted from life by John Kupetzki. This artist was a pupil of Claus. He was born in 1667, and died at Nuremberg in 1740. He was compared by German and Swiss biographers to Rembrandt and Vandyke. His powers were almost confined to portraiture. He was appointed painter to the Emperor Joseph of Austria. It is stated that Peter the Great invited him to enter his service and go to Petersburgh, but the offer was declined.

In the marine section, it is to be regretted that the British contributions are so few, when they might have been at once not only numerous but pre-eminent. Messrs. Mitchell and Co., of Newcastle-on-Tyne, exhibit two series of models and half-models of steam and other vessels.

Amongst the British contributions to the military section are machine tools used in the important manufacture of rifles, by Messrs. A. Muir and Co., of Salford. Mr. Dougall also sends arms, illustrating the most recent improvements with respect to the arrangements of the breech, and the manufacture of sporting ammunition. A specimen of the Soper military breech-loading rifle exhibited has been loaded and fired 60 times in one minute; it has also been loaded and fired with a charge of 200 grains of best gunpowder, and four hardened projectiles, weighing 1,920 grains, without doing it the slightest injury. It has passed successfully through the sand test and exposure test, without interference with its action.

Agricultural implements are well represented. Messrs. Clayton and Shuttleworth exhibit portable steam engines suitable for agricultural purposes, with a great thrashing machine and double corn-grinding mill. Messrs. Howard, of Bedford, also exhibit, in an annexe of their own, a collection of their well-known implements. Messrs. Kearsley, of Ripon, exhibit three machines of their make—a combined mower and reaper, which won a first prize at Berlin, a one-horse corn reaper, and a self-raking corn-reaper. Messrs. Garrett show one of their patent steam thrashing machines, and a portable steam engine, the furnace of which has the valuable quality of consuming, not only coal, wood, turf, &c, but also, where these are scarce, straw alone. These and the other British exhibits give a fair idea of the finest qualities of English agricultural machinery and implements. Valuable flax and hemp machinery, breakers, scutchers, and softeners, are exhibited by Mr. Collyer, of London; the introduction of machinery of this class into the flax and hemp trade has, of late years, effected a complete revolution, and had a material effect on the markets for the raw material, as well as on the fabrics produced from it. Messrs. Bryan, Corcoran, Witt, and Co. exhibit a corn mill and millstones. The stone used in the millstones, in its natural state, is rarely to be found of good quality in large pieces. Each millstone has to be formed of several pieces. These are carefully shaped, and, when finished, are put together. The pieces of stone are so well and carefully cut that when they are put together in the shape of a millstone it appears to be made of one single piece.

The wax, oil, and candle trade of Great Britain is well represented. Messrs. Field exhibit, in every stage, from the raw material to the refined product, specimens of the oil, &c., obtained by them from that curious mineral, ozokerit, and paraffin and paraffin candles, together with fancy and toilet soaps. Messrs. Langton and Bicknells, of London, show illustrations of the sperm trade, with specimens of the oil itself, and spermaceti in the various stages of manufacture. Price's Patent Candle Company, Belmont Works, Battersea, show a series of specimens, illustrative not only of candle and soap-making on a grand scientific method, but also of the production of certain oils, and of that curious substance, glycerine, which has, within a few years, taken a most important place in manufactures and domestic economy. A few years since glycerine was a curious chemical principle—now it is a common commodity, in demand for numerous purposes, and by all classes of society. Young's Paraffin Company completes the British contributions under this section, and illustrates the uses which have been made of shale, under Mr. Young's patents.

Among the food products, Messrs. Keen, Robinson, Belville, and Co. contribute specimens of mustard in various stages of manufacture; they also send very pretty models of mustard machines. Messrs. Colman and Co. are also large exhibitors of mustard, starch, and starch products. Messrs. Fortnum and Mason exhibit specimens of dried and preserved fruits; and Messrs. Fry and Sons, of Bristol, have sent samples of chocolates and cocoas. Messrs. Hewitson and Co., of London, exhibited samples of Craig's patent solid soup, *purée* of peas with beef. The Condensed Milk of the Aylesbury English Condensed Milk Company is also shown. Its mode of preparation is as follows:—The milk is first run into a reservoir through a strainer, so as to remove all hairs and impurities, and is then transferred by large swinging cans into a hot-water tank, so as to keep it up to a certain temperature. The next operation is to add about one-third in weight of the best cane sugar, for without this the condensed milk would not keep more than four or five days, whereas with it, it will be available for as many months, and probably very much longer. The mixture of milk and sugar is then passed through a tube into a vacuum pan in the room above, where the progress of condensation is carried on. The object of this is to evaporate the water of the milk, which gradually becomes more and more pasty, and is finally drawn off with a consistence like very pale, liquid honey. It is next cooled and run into tins, which are soldered down, and the milk is then ready for sale. Messrs. Thompson and Sons exhibit samples of the tea imported not only from China and Japan, but also from India. Messrs. Younger and Co. are the only brewers exhibiting. Messrs. Grant, Chambers, and Co. represent tobacco; and the manufacture of lucifer and other matches is illustrated by numerous specimens shown by Messrs. Jonas Simondson and Co., as foreign agents to Messrs. Bryant and May, London. Messrs. Haynes exhibit a selection of garden engines, syringes, and other irrigating apparatus.

In Section 11, the important trade in iron wire is illustrated by a series of samples exhibited by Messrs. F. Smith and Co., of Halifax; the iron being shown in its transformations into wire for making cards, for cotton woollen dressing, for telegraphic, ship-rigging, and innumerable other uses. The iron trade is well illustrated by the contributions of Messrs. Budde and Co., of Birmingham, who exhibit iron in many of its most important forms, such as bar, hoop, and sheet, rails, boiler tubes, gas tubes, and gas fittings, and tinned iron plate. With these will be found also specimens of the important article of brass steam fittings. Solid drawn brass and copper boiler tubes for tubular boilers are exhibited by Messrs. Everitt and Sons of Birmingham, who also show specimens of ordinary brazed tubes for steam, gas, &c., and brass and copper wire. The Broughton Copper Company, of Manchester, exhibit not only the raw material, but copper and brass in sheet and drawn into tubes, and some of the most important products, such as copper plates, bolts, &c., for ship work and other purposes, and brass rollers for the printing of calico and other fabrics. The Kirkstall Forge Company exhibit no less than eighty-nine articles, seventy-nine of which are specimens of iron in every stage of manufacture—flat, bent, twisted, tied in knots, &c. There are also two steam-hammers, one of 50 cwt., suitable for preparing moulds for weldless railway wheel tyres, the other a 3-cwt. steam-hammer, shown in motion, besides a small model hammer, also in motion. These hammers are after Naylor's patent. The extraordinary development and improvements in the manufacture of large masses of iron and steel is owing mainly to the use of steam-hammers. The steam-hammer, as first introduced, and all the modified forms of it for some time after, were constructed on the same general principle of being lifted by steam and falling by its own unaided gravity. All such hammers were governed and regulated solely by the laws of gravity, and, although useful, were but slow and comparatively feeble, as compared with those which do not depend upon gravity solely, either for speed of working, energetic power of stroke, or effect of blow. A steam-hammer now, in addition to its initial weight, can be forced downwards, as circumstances may require, by any amount of steam upon the top of the piston, up to the full pressure of steam in the boiler. A comparison between the effect of an ordinary gravity steam-hammer of 2·5 tons, and 4-feet stroke, and a Naylor double-acting hammer of the same weight, and the same actual length of stroke, shows that the latter is 5,000 times more effective than the ordinary hammer. Messrs. Naish, Osborn, and Eden, of Birmingham, exhibit a specimen of a plain English amateur lathe for turning metal, wood, and ivory, with chest of tools for the same; also a punching press, such as is used in the button, steel-pen, and other trades, with photographs of other machines. Messrs. Whitley, Partners, of Leeds, have an interesting collections of exhibits, including a new kind of rasp for iron, wood, &c., a new steam governor, several improved valves, and a number of small machines and mechanical accessories. Centrifugal pumps and pumping engines, turbine water-wheels, and other hydraulic machinery, known all over Europe, are exhibited by Messrs. Gwynne and Co., of London.

Messrs. Merryweather and Co. exhibit a series of engines and other apparatus used in extinguishing fires, and they do so with the intimation that they may all be used should the unfortunate necessity arise. The elastic metal packing for stuffing boxes of steam-engines and pumps is one of the most important of the accessories invented of late years for the use of engineers; specimens of this packing are contributed by Mr. Greenwood, of Bromley, near London. Messrs. Clarke and Dunham show some useful adjuncts to the machine shop and engine-room, such as patent lubricators and oil cans. The saving of heat, and consequently of coal and time, two of the most precious materials in the world, has caused great attention to be paid in England to cheap non-conducting substances for clothing steam-boilers and other similar purposes. Messrs. Engert and Rolfe exhibit specimens of hair-felt for these purposes, and also other felts used for roofing, ship sheathing, and for covering damp walls.

Messrs. Greenwood and Batley, of the Albion-works, Leeds, exhibit a small plant of their celebrated machines for preparing and spinning "silk waste." This is a great and rapidly-increasing branch of the silk trade, the importance of which may be judged of from the fact that for every pound of neat or thrown silk (*i.e.*, the silk wound direct from the cocoon) produced there remains from 12 to 14 pounds of waste, technically known as "frisons," "galetta," pierced and double cocoons, bassinet, &c. By the use of machinery similar to that exhibited, the largest and best spinners of Switzerland, France, England, Germany, and other countries prepare and spin this "waste" into yarns, which being much cheaper, and possessing greater evenness of thread, enter largely into competition with neat silk, being almost exclusively used in the finest ribbons and velvets, and also extensively in the manufacture of piece goods and sewing threads.

In woollen machinery, Messrs. J. Platt and Co., of Oldham, are large exhibitors. This firm has a special annexe to itself, in which are placed the many spinning, carding, and other machines used in the woollen and cotton manufactures, for which it is famous. The interest which surrounded these machines, and drew thousands of persons to watch their complicated actions at the London International Exhibition of 1872, will doubtless also be attached to them in Russia, where the woollen manufacture is rapidly developing, and which must receive a powerful stimulus from the introduction of such machines. Amongst the English novelties in cotton thread, is the glazed, or polished thread, as it is called, of which examples in all colours are shown by Messrs. Dickins and Co., of Manchester. Threads of this kind attract great attention at the London International Exhibition, now open. Messrs. Swainson, Birley and Co., of Manchester and Preston, exhibit cotton goods. Messrs. Tapling and Co., of Glasgow and London, exhibit specimens of what are known in England as Axminster carpets for saloons; and also tapestry for the decoration of walls, a manufacture for which this firm has earned great reputation. Messrs. Cochrane, of Netherdale, Galashields, exhibit a collection of tweeds. The raising and shearing of the pile of woollen cloth has called forth much mechanical ingenuity, and the machines now employed in England for these purposes are most ingenious and effective. A machine for raising the pile, another for shearing it, together with photographs of various other cloth-dressing machines, are exhibited by Messrs. Kemp and Co., of Leeds. Messrs. Baxter and Co., of Dundee, contribute specimens of jute manufacture in the form of cloth, a comparatively new and important branch of trade for which Dundee and other towns have earned a name. Messrs. Cox, of the same town, also exhibit sackings, pocketings, and carpets of various kinds, made from jute fibre. In paper-making machinery, Mr. Potter, of London, shows models of the large machines and wire dandy rollers, specimens of the woven wire used by paper-makers, and examples of water marks of various kinds.

Platinum stills and other apparatus of great cost are used for the concentration of the cheapest, but at the same time, the most important of acids, sulphuric acid. Messrs. Johnson, Matthey and Co., of London, exhibit specimens of various workings in this difficult metal.

One of the most complete collections is that sent by the Macclesfield Chamber of Commerce, the members of which, upon the representations made to them, entered into the matter with spirit. Mr. Brocklehurst, M.P. for Macclesfield, took great pains to render the examples of the particular manufacture in which the district he represents is engaged, namely, silk, as complete as possible; and the result is that this manufacture is better exemplified than any other, no less than ten firms contributing specimens of raw materials or manufactured articles. If every branch of industry had done as well as that of Macclesfield, the British section would have trebled its extent.

Messrs. Wood and Ivery, of the Albion Blue-Brick Works, West Bromwich, exhibit a variety of bricks, copings, &c., made from the strong blue marl obtained in the immediate neighbourhood of the works, which is first ground by powerful machinery, and then moulded, partly by hand and partly mechanically. No colouring matter is used, the blue being peculiar to the raw material. The Wouldham Cement Company shows samples of their famous cement in the various stages of manufacture. The glass, porcelain, and earthenware trades of Great Britain are well illustrated by the large contributions of Messrs. Boucher, Guy, and Co., of London, who exhibit not only fine and decorative ware and cut glass, but also specimens of the strong granite earthenware, admirably calculated, and in great demand, for use on board ship and in the colonies, where the use is of the roughest. Messrs. Phillips, of London, exhibit a collection of china and earthenware, and of the beautiful majolica ware for which the English potteries have of late years won so much celebrity.

Among the hardware exhibits, Messrs. Phillips and Pearce, also of London, show a varied collection of plain and ornamental glass of all kinds; and Messrs. Chubb and Sons, of London, exhibit specimens, both of their detector locks, which not only resist felonious attempts, but register the fact for the benefit of the owner, and also of safes to which their locks are applied. Messrs. Blews and Sons, contractors to the City of Moscow Gas Company, exhibit a collection of gas tubes, fittings, and apparatus for which Birmingham is famous all over the world; they also show specimens of hardware. and also tools for the use of the gas-fitter. The collection of Messrs. Gausby and Co., consisting of all kinds of locks, fastenings and fittings for windows and doors, gives an excellent idea of this immense industry.

Among the useful inventions exhibited are the pyramid lamps of Mr. Samuel Clarke. Messrs. Clark and Co., of Rathbone-place, exhibit an enamelled cast-iron sash, intended to represent a section of a shop window, closed by a patent self-coiling shutter, in one sheet of steel, running in the grooves of the sash, which is so constructed to show its design when the shutter is closed.

Messrs. Brinsmead and Sons exhibit a pianoforte, and also models of some patented improvements. Mr. Rovedino, of London, exhibits illustrations of a system of mechanical aid in the teaching of the organ or pianoforte.

Messrs. Moir, Crane, and Co., of Manchester, exhibit samples of lubricating oils; and Messrs. Jenson and Nicholson, of London, exhibit specimens of coachmakers' and other varnishes, together with the gums of which they are made.

Messrs. Christy, the patentees of hat-making machinery, show a curious and useful collection of hats and caps, from the commonest peasant's felt hat to the most expensive and highly-finished beaver and silk hat. Messrs. D. Nicoll and Co., of London, exhibit specimens of waterproofed cloths. Messrs. Raebone and Son, of Birmingham, show a collection of ivory and other rules, measuring instruments, spirit levels, &c. The "Minerva" printing machine of Messrs. H. S. Cropper and Co. is a treadle machine, and the only printing machine sent.

Sandberg's rail sections have been designed to economise metal, and secure a strong and durable road by improved form of rail and fish-joint. The rails are designed with the base and height of equal dimensions, except in the lighter forms, such as 20 to 45lbs., calculated for lower speeds where the height is increased ¼ inch, thereby increasing the stiffness of the rail. They can be laid direct without base plates, on ordinary cross sleepers, 3ft. from centre to centre and 2ft. at the joint, sleepers to rest on good ballast, and the road well drained. Mr. Burke, of Dublin, has a collection of specimens of a large industry which has been created by the introduction of photography, namely, the manufacture of frames, or mounts, as they are called, for prints, photographs, and other works of art. These are cut out of card-board, and are, in some cases, decorated with gold, velvet, and other ornamental materials. Messrs. Colman and Glendenning exhibit a desk, called the "Eastern-Counties School Desk," with form, for schools.

Effects of the Exhibition upon Russia.

It is an important matter for consideration how far this Exhibition at Moscow will have an influence upon the social condition of the country, and upon its foreign commercial relations. It ought to be understood that though the Exhibition will bear no comparison whatever with those that have gone before it, and that to foreigners it possesses but little interest and gives no instruction, yet, that being one of the first efforts of a newly-awakened people, and the result more of private energy than of imperial enterprise, it must have a very important effect upon the habits and conditions of the Russian people. The Exhibition of 1851 had a marvellous and electric effect upon the manufactures of this country; the present Exhibition of Moscow will have much the same effect upon the manufactures of Russia. It will at least teach the people that there are means and appliances of civilisation far in advance of their own; that they may, if they will, take advantage of these means; and it will awaken them to the fact that, in nearly everything they are behind other nations. If only this last is accomplished, an immense good will have been achieved, and before the demands created by the new wishes and desires of the people the barriers that prevent the full benefit of the interchange of commercial products must fall. England can do much for Russia; so can Belgium and Germany; and, in return, Russia can offer an unlimited field for enterprise; and, with mineral wealth practically inexhaustible, with large tracts of country suitable for the cultivation of certain products that the rest of the world needs in large quantities, she has a great future before her. She has been, and is making progress; and it may be worth while considering what has been done in the last ten years.

Commercial Condition of the Russian Empire.

The principal articles of export are, grain of all descriptions, flax, linseed, hemp, timber, and tallow, all of which articles show a tendency to increase. Tallow, however, should be excepted, the export having fallen off considerably of late years. The continued ravages of the cattle plague in Russia have exercised a sensible decrease in the exportation of this article, as also in that of hides and bristles. It would be incorrect, however, to ascribe the diminished export of tallow entirely to the deterioration of the stock. The fact is, that, in proportion as the manufacturing industries and the railway and steamboat system of Russia are developed, so will the demand increase at home for all the oily substances she produces, and less of them will consequently be exported. On the whole, the export and import trade of Russian produce, for the year 1871, compared with those of former years, may in a measure be deemed satisfactory, inasmuch as a tendency to increase is shown. There can, however, be no doubt that Russia, a country of such vast magnitude and great natural wealth, ought to be capable of making a far stronger impression on the markets of Europe. It is equally certain that this great object, on which the development of the empire in reality depends, can only be attained so soon as the government shall be fully alive to the well-established principle that, in order to enable a country to export largely, it should have the benefit of such a fiscal system as will permit it to be a large purchaser of foreign productions. It may be observed that the Imperial family owns extensive lands, from which large revenues are derived, and it is, altogether, one of the richest families of the world.

Apart from the consideration of the finances of Russia, which seem to partake of a non-elastic character, in striking contrast to the vast extent and natural wealth of the country, there are certain points in connection with the commercial condition of the empire which have been brought into prominence by the report made by Mr. Ford, one of our secretaries of legation, now residing at St. Petersburg. Within the last ten years undoubted progress has been made in social and material improvement. At present nearly the entire revenue is derived from the direct capitation tax, including its accessory branches, and from the excise duty raised on drinkables. When a better system of levying the taxation of the country is adopted, and when real property and industrial revenues are made to take a greater share in contributions to the resources of the imperial exchequer, there can be little doubt that a more satisfactory tone will be imparted to the annual record of the finances.

In a circular despatch, dated Foreign-office, April 6th, 1872, the secretaries in her Majesty's diplomatic service are requested to notice in their reports the general question of British trade with the respective countries in which they may reside, and the means for its better development. With regard to the trade of Great Britain with Russia, Mr. Ford remarks that two measures would especially conduce in a considerable degree to its improvement, namely, a reduction of the present tariff under which the *ad valorem* relation of the specific duties in the principal articles of import into Russia ranges from 18 to 100 per cent.; and the elevation of the peasantry, or, in other words, the great mass of Russian producers and consumers, to a more advanced stage of material comfort and greater enlightenment. In reviewing the foreign trade, the encouraging fact may be noticed that the exchange has risen 10 per cent. in less than two years. As the prosperity of the country is developed, a further rise, should no political complications intervene, may be anticipated, which would lead in a short time to a practical resumption of specie payments. The extension, too, of the railway traffic of Russia has greatly tended to facilitate increased exports, owing to the greater ease with which the products of the country are moved. The progress made in the construction of railways has been rapid. It appears that in 1838 there were only 16 miles opened, and these had extended to 7,011 miles in 1870. The gross receipts, which were £5,819,000 in 1867, amounted to £9,362,000 in 1869. The quantity of goods carried in the same periods were 6,128,000 tons, as compared with 9,820,000 tons in the latter year.

In considering the present state of the bulk of the population of Russia, it should not be forgotten that it has quite recently been elevated from a state of serfdom. It would, then, be unjust to estimate the material requirements of the millions of inhabitants of this country by the same standard that would be applied in considering the wants of the inhabitants of Western Europe, or of the United States of America. If we cannot rank Russia as a very good customer of British produce, the gratifying fact must, nevertheless, be recorded that her purchases from us tend to increase every year. Thus, during the last ten years they have doubled in amount, and have progressed since 1867 from about £4,000,000 sterling to £7,000,000 in 1870. It may appear strange that Russia, an essentially agricultural country, possessing upwards of 70,000,000 of inhabitants, and situated at such an easy distance from the greatest manufacturing emporium of the world, should import goods only to so insignificant an amount. This fact, however, Mr. Ford accounts for partly in the following manner:—The Russian peasant and his family, unlike other denizens of the world, is at present more or less independent of cotton as an article of clothing. He uses flax instead, which he raises in his own plot of ground, and which is spun and woven in his own home. No doubt the Russian peasant would select a better kind of garment than the coarse one he at present wears could he afford to buy it, and he would, no doubt, prefer selling his flax to the exporter, and purchasing cheap, ready-manufactured cotton goods with the proceeds. But cheap cotton goods, or, indeed, any cheap goods, of whatever description, are not to be procured in Russia, nor will they be so long as the government sacrifices the interests of the majority of the inhabitants of the country to those of an insignificant number of native and foreign mill-owners and industrial potentates.

With regard to a reduction of the tariff, there is no immediate prospect of any being made. The Russian government, though disinclined, as a rule, to modify their fiscal arrangements, did effect some reductions of their tariff in 1868, which reductions might still with advantage be extended. Indeed, the lowering of duties on many important articles has not only resulted in an increased importation of them, but has been attended by no decrease in the Custom-house receipts. The maritime trade with Russia has likewise considerably profited by the removal of differential duties which were imposed formerly in favour of overland importations. It is notorious that free-trade doctrines are at present generally unpopular in Russia, and the introduction of foreign goods is opposed by an influential class, who would appear rather to seek their own personal aggrandisement than to regard the true interests of the mass of consumers in the country.

Commercial Relations with other Countries.

A consideration of the commercial relations existing between Russia and the countries represented at the Exhibition will show very clearly that a modification of the present tariff is essentially necessary. Startling. however, as are the figures in some respects, as far as the high rates are concerned, it should be borne in mind that where there is a high tariff there will be smuggling. With such a frontier as Russia has, it is impossible to prevent it; therefore, the trade returns do not represent fully the imports. It is a well-known fact that English and other firms consign their goods to a frontier agent, who forwards them on to their destination for a commission much less than the customs-duty. Such a fact speaks volumes.

It will also be necessary, in dealing with the statistics of the trade of the period, to bear constantly in mind that the last ten years has been a most eventful one in both the United Kingdom and Russia. England, on the one hand, had to sustain the disastrous effects of a cotton famine, caused by the late American war, which, both directly and indirectly, severely crippled the industrial resources of the kingdom; and Russia. on the other hand, while slowly recovering from the effects of the Crimean war, was called upon to abolish serfage, to remodel her army, rebuild her navy, construct a network of railways over her vast empire, and revise her customs tariff. Under such circumstances, the condition of exchanges between the two states could scarcely be regarded as a normal one.

It is not affirmed that the several acts of the Russian government were in themselves prejudicial to the trade of the empire; indeed, the formation of railroads, and the modifications of the customs tariff, so far as they went, were alike calculated to promote commerce. But the emancipation of the serfs, transforming suddenly, as it did, a large portion of the population from a state of dependency to one of freedom, arrested for a time the agricultural progress of the state. This will be more readily understood if it be remembered that Russia is essentially an agricultural state, and that any disturbance in the tenure of land in such a country is more surely attended with unfavourable consequences than would be the case in a country where the greater part of the national wealth is derived from other sources than those of the soil.

As regards the relative importance, in a commercial point of view, of the markets of each of the two states to the other, there is a considerable difference. The English market is entirely open to Russian produce, not one of the important articles of Russian produce being liable to duty upon importation into the United Kingdom. The contrary is the case as regards the admission of British produce into Russia, for, with the exception of coal and of industrial and agricultural machinery, which are admitted free of duty, the leading products of the United Kingdom are very heavily taxed upon importation into Russia. The result of this is that, although Russia sends large quantities of her staple products to the English markets, the Russian exports are not nearly as large as they might be, did not the policy of Russia prevent England from entering into more extensive commercial relations with her. The maintenance of the protective system in Russia is highly detrimental to the commerce of both countries, but more particularly so to Russia, as the English market is open to receive an almost unlimited supply of Russian produce.

A superficial glance at the Russian customs tariff is sufficient to prove that the commercial policy of that country is still substantially based upon the old protective system. The wants of the consumer are not provided for, but are sacrificed to those of the manufacturer or producer. The latter is permitted to obtain raw materials, fuel, and machinery free from all taxation. but the former is taxed at enormously heavy rates on articles of food and clothing. The high rates of import duty upon partly and wholly manufactured goods necessarily tend to keep up the price of Russian manufactures, and to throw the greater part of the trade of the country into the hands of a privileged few, who enrich themselves at the expense of the general community. There is nothing new in all this; it has occurred in almost every European state, and was, in fact, in practice in England until the adoption of the more enlightened policy of free-trade. The fallacy of the protective system has, however, been so generally recognised by most of the leading European states, that it is to be hoped Russian statesmen will ere long become alive to the impolicy of retaining it in Russia. The recent extension of railways in the empire will render a departure from the antiquated policy of protection more than ever necessary, if the government desire to turn those railways to good account in developing the general resources of the empire.

Before directing attention to the extent of the exchanges between England and Russia, it may be useful to give a summary of the total trade of Russia, so as to afford an idea of the importance of the British trade as compared with that of other states trading with Russia.

In the year 1870 the total value of imports for consumption into European Russia (exclusive of Finland), amounted to 318,570.000 roubles, the three principal countries of import being—

		Per cent. to total.
From Germany	136,420,000 ..	42
„ United Kingdom,	106,880,000 ..	32
„ France	19,120,000 ..	6

The total value of Russian produce exported during the same year was 342,850,000 roubles, the chief countries of export being the same as in the case of import, but in different order.

		Per cent. to total.
To United Kingdom ..	170,060.000 ..	50
„ Germany	76.070,000 ..	22
„ France	34,150,000 ..	10

The above figures indicate the importance of the English markets to Russia, as compared with the markets of Germany and France.

The following abstract of the Board of Trade returns shows the progress of the total trade of the United Kingdom, and also of the trade between this country and European Russia:—

Imports of Merchandise.

Average of 3 years.	Total into United Kingdom.	Total from Russia.
1860-1-2	207.910,000 ..	14,511,000
1869-70-1	309,580,000 ..	20,258,000
Increase over former period	91,670,000 ..	5,747,000

Exports of British Produce.

Average of 3 years.	Total from United Kingdom.	Total to Russia.
1860-1-2	128 382.000 ..	2,955.000
1869-70-1	206,019,000 ..	6,670,000
Increase over former period	78,691,000 ..	3,715,000

Exports of Foreign and Colonial Produce.

Average of 3 years.	Total from United Kingdom.	Total to Russia.
1860-1-2	35.111.000 ..	2,187,000
1869-70-1	59,883,000 ..	3,074,000
Increase over former period	24,772,000 ..	897,000

It will be observed that the value of imports from Russia is greatly in excess of that of the British exports to that country. The increase in the British exports in 1869-71 was caused by an exceptional export of railway materials, which has already (June, 1872), begun to decline. The unimportance of Russia, comparatively speaking, as a market for British goods may be inferred from the fact that the consumption of English produce in Russia, with a population of sixty-nine millions of people, is only about half what it is in Holland, having a population of about four millions.

The following table exhibits the nature of the goods which are imported into this country from Russia:—

Quantities and Value of the chief Articles imported into the United Kingdom from Russia in each of the Years 1860 *and* 1870.

Principal articles imported.	Quantities.		Value.	
	1860.	1870.	1860.	1870.
From Northern Ports.			£	£
Flax, rough or undressed ... ... cwts.	914,000	1,336,000	2,298,000	3,355,000
Linseed and flaxseed ... ... qrs.	321,000	670,000	782,000	1,723,000
Wheat .... cwts.	948,501	1,841,000	609,000	959,000
Oats .... ,,	2,453,179	4,018,000	983,000	1,685,000
Deals and boards, sawn or split . loads	226,000	488,000	783,000	1,474,000
Hemp.............. cwts.	585,000	542,000	877,000	890,000
Tallow... .... ,,	981,000	235,000	2,759,000	519,000
Bristles ... ... lbs.	2,043,000	1,482,000	284,000	217,000
From Southern Ports.				
Wheat .... cwts.	4,689,797	8,427,000	2,942,000	4,158,000
Barley .... ,,	453,839	2,222,000	184,000	778,000
Indian corn ..... ,,	1,111,976	2,488,000	447,000	863,000
Linseed and flaxseed .... qrs.	259,000	344,000	860,000	948,000

From this table it will be seen that almost the whole of the import trade consists of agricultural produce. The most important feature in the table is the great falling off exhibited in the quantities of tallow and bristles imported in 1870, as compared with the imports of the year 1860. It is stated by Mr. Mitchell, in his report upon land tenure in Russia, that less cattle has been kept since the emancipation of the serfs, and the present stock is estimated by some persons at about one-half what it was before the emancipation. If this be true, and if allowance be made for the effects of the cattle plague, which has been severely felt in Russia in recent years, the decrease in tallow and bristles is easily accounted for.

The exports from Russia are stated, by the same authority, to depend very much upon the competition of the United States, Egypt, the Danubian Principalities, and other States, and this competition is rendered more unfavourable to Russia by the high prices of goods and commodities maintained in the Russian markets by the commercial policy of the country, which prevents the price of Russian produce falling to a level that would enable it to compete on more favourable terms with the same descriptions of produce of countries which are less burdened with taxation.

It thus becomes evident that the imposition of high protective import duties acts most prejudicially upon the export trade of the empire.

Let us now pass on to notice in detail the value of the Russian market to the producers of the United Kingdom. The subjoined table shows the quantities and value of the principal articles of British produce and manufacture sent to Russia, and also the rates of import duty levied upon them in that country.

The chief exports in 1870 consisted of railway materials, viz., £1,872,000 worth of iron, £341,000 of locomotives, and £315,000 worth of railway carriages and trucks; but, as has been before observed, these exports were of an exceptional character. After deducting the

QUANTITIES AND VALUE OF THE PRINCIPAL ARTICLES OF BRITISH PRODUCE AND MANUFACTURE EXPORTED TO RUSSIA IN EACH OF THE YEARS 1860 AND 1870, AND RATES OF IMPORT DUTY LEVIED THEREUPON BY THE RUSSIAN CUSTOMS TARIFF.

Principal Articles of Export.	Range of Duty Imposed by Russian Customs Tariff in 1870.	Quantities.		Value.	
		1860.	1870.	1860.	1870.
		To Northern Ports of Russia.			
				£	£
Alkali (soda) ... ... cwts.	1s. to 2s. 11½d. per cwt.	135,000	234,000	72,000	120,000
Coals ... . tons.	Free.	287,000	647,000	127,000	306,000
Tin, unwrought ... ... cwts.	12s. 2½d. per cwt.	8,513	10,000	57,000	62,000
Yarn—Cotton ... ... lbs.	31s. 11½d. to 41s. 7½d. per cwt.	2,785,000	2,448,000	183,000	224,000
,, Linen ... ... ,,	32s. 9d. per cwt.	9,000	50,000	700	4,500
,, Woollen ... ... ,,	44s. 1d. ,,	2,283,000	2,044,000	363,000	276,000
,, Silk Twist ... ... ,,	49s. 1d. ,,	...	11,000	...	13,000
Iron, wrought and unwrought, tons.	(See below.)*	70,000	242,000	630,000	2,175,000
Railway carriages	£11 1s. 8d. to £15 16s. 8d. each.	125	2,844	22,000	315,000
Earthenware .. .. £	7s. 5d. to 24s. 7d. per cwt.	...	...	13,500	15,000
Porcelain ... ... £	39s. 2d. to 157s. 3d. ,,				
Hardwares and Cutlery .. cwts.	117s. 11d. to 225s. 10d. ,,	21,700	18,000	102,000	90,000
Machinery—Steam ... ... £	7s. 5d. per cwt.	...	...	193,000	362,000
,, Other... ... ... £	Free.	...	...	437,000	561,000
Tissues, &c. :—					
Cotton, entered by the yard, yds.	11¾d. to 4s. 2½d. per lb.	2,881,000	2,128,000	71,000	63,000
,, at value ... ... £		...	...	13,800	58,000
Linens, entered by the yard, yds.	6½d. to 2s. 4d. per lb.	...	412,000	40,000	19,000
,, at value ... ... £	Lawn, 30 per cent. *ad valorem.*	...	...		12,000
Woollens, entered by the yrd. yds.	Milled, 1s. 5d. to 4s. 2½d. per lb.	(Pieces) 16,000	2,105,000	64,000	160,000
,, at value ... ... £	Unmilled, 1s. 9d. to 3s. 10d. per lb.	...	...	3,079	9,357
Silks ... ... £	7s. 8d. to 17s. 6d. per lb.	...	...	17,000	10,000
		To Southern Ports of Russia.			
Coals ... ... tons.	(See above.)	69,000	182,000	33,000	93,000
Iron, wrought and unwrought, ,,		4,000	61,000	45,000	559,000
Machinery—Steam ... ... £		...	...	41,000	95,000
,, Other... ... ... £		...	...	24,000	73,000

* Iron—Pig, 10s. per ton; bar, 65s.; plates and sheets, 91s.; rails, 32s. per ton. Cast-iron wares, 4s. 11d. to 24s. 7d. per cwt. Wrought-iron wares, 9s. 9d. to 42s. 1d. per cwt. Cutlery, 117s. 11d. to 225s. 10d. per cwt.

above figures from those given in the table, it will be seen how very little Russia imports from the United Kingdom. As regards the protective character of the Russian tariff, the rates of duty speak for themselves, and it only remains to be repeated that, so long as the Russian government maintains its present commercial policy, the commercial exchanges between this country and Russia must continue to be very limited in extent.

The following comparison of the value of British produce taken by some of the leading European states, and by the United States of America also, shows how small a consumer of British produce Russia is as compared with other states having considerably less population :—

	British exports. Millions £ sterling.	Population. Millions.
Russia	6^9	69
Germany	20^4	41
France	11^6	36
United States	27^7	38^5
Holland	11^2	3^7
Belgium	4^4	5

The quantities and value of foreign and colonial produce exported to Russia in each of the years 1860 and 1870 are given in the subjoined table:—

Quantities and Value of the principal Articles of Foreign and Colonial Produce Exported to Russia in each of the Years 1860 *and* 1870.

Principal articles.	Quantities.		Value.	
	1860.	1870.	1860.	1870.
To Northern Ports.			£	£
Coffee .... lbs.	2,782,000	7,769,000	89,000	216,000
Cotton .... cwts.	496,000	318,000	1,413,000	1,435,000
Indigo .... ,,	7,000	7,000	236,000	246,000
Tea .... lbs.	261	2,789,000	20	200,000
To Southern Ports.				
Coffee .... lbs.	1,503,000	2,318,000	48,000	62,000
Indigo .... cwts.	113	355	4,000	12.000
Pepper .... lbs	550,000	810,0 0	10,000	18,000
Tea .... ,,	11,000	1,099,000	800	79,000

Note.—Tea was permitted to be imported by sea-ports in the year 1862.

VIENNA UNIVERSAL EXHIBITION.

Her Majesty's Commissioners for the Vienna Universal Exhibition have obtained from the Director-General of the Imperial Austrian Commission, Baron von Schwarz-Senborn, answers to a series of questions of importance to exhibitors in reference to various details in connexion with the exhibition, of which we herewith publish a summary, for the information of intending exhibitors.

As it is important to assure in time the engines and steam boilers intended to set in motion the machines exhibited in the English section of the Machinery Hall of the said exhibition, the attention of English manufacturers is called to this opportunity, to exhibit either fixed steam boilers fixed steam engines, or portable engines, and also steam engines and steam generators for service in the Machinery Hall.

Machinery and apparatus specially adapted to the requirements of the exhibition may also be supplied by exhibitors, as, for instance :—

Boilers for the production of steam for engines.

Steam-engines for driving the main shafting in the Machinery Hall.

Gas and water-power engines, for driving single machines and groups of machines.

Large and small pumps for waterworks and fountains.

Travelling cranes, with normal gauges of 1·5 metre (4ft. 11in.), for the service in the Machinery Hall.

Overhead travelling cranes, with winch and moving gear, with a gauge of 10·5 metres from rail to rail, for the erection of heavy pieces for the Machinery Hall.

Hydraulic lifts for raising persons.

Portable engines for the service outside the Machinery Hall.

Exhibitors supplying such machines and apparatus, intended for special service during the exhibition, will enjoy special privileges, to be arranged between them and the Director-General.

If British makers lend cranes, hoists, boilers, engines, &c., for use of British exhibitors, no fees will be levied by the Imperial Austrian Commission for the use of the same by British exhibitors. But if British exhibitors lend such machinery for the use of foreign exhibitors, arrangements will be made by the Austrian Director-General to indemnify British exhibitors for the use of their machinery.

The power required to set machinery and main shafting for driving machinery in motion will be supplied by the Austrian Commission, and exhibitors will in no case be charged for motive power supplied by the main driving shafts in the Machinery Hall.

The moving force will be transmitted by two horizontal shafts of a diameter of 0·09 metre (about 4·39 inches), and 120 revolutions per minute in the speed rate.

The exhibitors have to supply the pulleys for the main shafts, as well as any other gear and driving-bands, at their own cost.

Machinery intended to be worked will be placed in the central gallery of the Machinery Hall.

The preservation, cleaning, and oiling of the main shafts will be attended to by the Austrian manager, but exhibitors will have to attend to the preservation and oiling of the gear supplied by them, as also to the security of their straps.

Brickwork foundations in the Machinery Hall must be built at the cost of the exhibitors, and be finished and ready for receiving the machinery by the 15th of March, 1873 ; but the brick foundations and the stonework for engines and steam boilers, &c., employed for setting in motion the machines exhibited, will be constructed by the Austrian Commission, according to the plans of the exhibitors.

The main lines of pipes for water, steam, and gas will also be laid by the Austrian Commission, and the exhibitor has only to supply the connecting pipes with his machines.

Coals from the best Austrian and Prussian coal mines, and feeding water for boilers, &c., supplying steam-engines, driving machinery in the Machinery Hall, will be supplied by the Austrian Commission free of expense. Stokers will also be provided for the steam boilers lent for service in the exhibition, or, if the exhibitor should prefer to employ his own people, the wages of the latter will be paid by the Austrian Commission, according to the fixed tariff.

Should an exhibitor wish to burn wood, he will likewise be provided with it.

The whole exhibition ground will be drained by a system of drainage-pipes, carrying water and liquids to the Danube, and every measure has been taken to have a sufficient supply of water in all parts of the exhibition.

Water will be furnished at a pressure of about 24ft. at low pressure and about 120ft. at high pressure.

Gas will be furnished by the Imperial Continental Gas Company at the usual pressure.

Steam pressure generally at 5 atmospheres, about 70 to the square inch.

Steam pressure in foreign boilers is not limited, but they will be subject to the Austrian laws and regulations.

Single boiler-houses are erected at the rear of the Machinery-hall, about 40ft. distant, but a special boiler-house for British boilers will be built by the Austrian Commission.

Plans furnished by the British Commission for British boiler-houses will be adopted if the British Commission will undertake the execution of the same. The erection of British boiler-houses is especially desired, in order to show the ingenuity and workmanship of British construction.

Traction engines, locomotive steam carriages for ordinary roads, steam omnibuses, and similar kinds of self-propelling vehicles, will be allowed to run about during the exhibition, in some parts of the park and the exhibition grounds. In fact, traction engines, road rollers, self-propelling steam carriages, steam omnibuses, and steam pleasure-carriages, will be very welcome.

There will be some work of importance to be done by steam road-rollers, and, in case of any work performed for the installation by traction engines or road-rollers, all expenses will be paid by the Austrian Commission.

In case of railway locomotive engines and carriages being sent to the exhibition, the rails for them to stand upon must be provided by the exhibitors, and it is very much desired that rails from England should be sent to Vienna as exhibition articles.

There will be competitive trials with steam fire-engines, and the jury and exhibitors are invited to send special engines for this purpose. Such engines will be considered as objects of exhibition, and, if lent for use, fuel and care will be at the charge of the Imperial Austrian Commission.

There will likewise be special trials held with agricultural machines and implements in fields in the neighbourhood of Vienna, or in such places as can be easily reached by the Exhibition Railway.

Agricultural machines will not be exhibited in the Machinery-hall, but in a pavilion specially built for that purpose.

All machines, &c., intended for the exhibition will be admitted to the Machinery-hall from the 1st of February till the 15th of April, 1873, inclusive, and must be set up by the 25th of April.

Machines and apparatus arriving in pieces, and consisting of heavy and bulky parts, must be set up by the 15th of April.

Slate is particularly desired to be sent to Vienna to the exhibition; the slate will stand a chance of being sold at a good price at the close of the exhibition, the Austrian slate being only fit for roofing.

It is also desired by the director-general that fittings, show-cases, cloth for the covering of walls, window-glass, &c., should be sent from England to Vienna; these would be considered as exhibition objects, and could be sold at the close of the exhibition.

Considering the bad and very costly experiences of all foreign Commissions at past London and Paris Exhibitions in storing empty packing-cases, the Director-General of the Austrian Commission has made special arrangements in this respect, offering every possible facility. He has secured near the exhibition grounds a large space for "empties," which he offers gratis to the foreign commissions. On this space a modern building will be erected, and a very moderate rate charged, according to a fixed tariff based upon the actual outlay of cost. It will be connected by rail with the exhibition buildings, so that all empties can be sent direct to this shed. No previous exhibition has afforded such facilities for this purpose.

CORRESPONDENCE.

ACOUSTIC TELEGRAPHS.

Sir,—The effect of the late storms in disturbing the communications by electric-telegraph between the police and fire-brigade stations, which caused some inconvenience, have brought to my memory the acoustic telegraph, on which, in early days, Sir Charles Wheatstone and Francis Whishaw bestowed much consideration, and which occupied my attention.

It became well worthy of notice that the acoustic telegraph may afford alternative means of communications for short stations in addition to the electric telegraph, and the pneumatic tubes of the post-offices may also become means of subsidiary communication.—I am, &c., Hyde Clarke.

39, St. George's-square, S.W., 26th August, 1872.

SEWAGE.

Sir,—A solution of the sewage question is still a desideratum, notwithstanding its sanitary and pecuniary importance, and the many precipitating, irrigating, and other utilising processes that have been and are still being attempted. The interest the Society of Arts has long taken in the question, and its practical knowledge of it, induces me to think that a few remarks on its most recent phase, namely, that at Merthyr Tydvil, where what is called "intermittent" or alternate filtration is being carried out on a limited area of land, may be interesting to the readers of the *Journal*, and help them to leave another milestone behind on the toilsome road to sound conclusions. Many sanguine individuals believe that they have got the key to unlock the storehouse containing the boundless wealth of town sewage, or the secret for rendering it innoxious; but if any settled conviction obtained in the mind of the public in favour of any known process, 100 representative men from the Royal Agricultural Society at Cardiff, headed by their President, Sir Watkin Williams Wynn, would not have been so easily induced as they were on the 17th ult. to go out of their way to view the new filtering beds of Merthyr Tydvil. These were originally designed about two years ago, to get rid of an injunction, by freeing the sewage from pollution before discharging it into the river Taff; and now an attempt is being made, by the cultivation of crops, to obtain some return, if not a profit, from the filtering medium. But, from excess of moisture, no doubt, the various crops—cabbages, mangel-wurzel, &c., looked chilled and inferior to what they would have been under dry land cultivation on the same soil—a deep, rich *debris* from the hills which flank it on each side—and not to be compared to those of market gardens of ordinary sewage farms. The filtering medium consists of 20 acres of land, drained 6 feet deep, and divided into four areas of 5 acres each. Each of these receives daily, for six hours out of the 24, the sewage of 20,000 persons, represented by 900,000 gallons, or at the rate of 73,000 tons per acre per annum. To utilise advantageously, according to our present knowledge, the quantity of sewage thus dealt with, 200 acres of land are required, being at the rate of 1 acre for every 100 persons, or for 7,300 tons of this sewage. The reason for departing from this more economic application of the Merthyr Tydvil sewage in the first instance has already been stated, but as the local Board of Health has now obtained more than the necessary quantity of land—namely, 280 acres—for its utilisation to the fullest extent, the original operation may not be persevered with. If it is, the filtering powers of the soil will have to be renewed by alternate dry and deep cultivation for at least, two years at a time, and by the production of gross-feeding crops, such as cabbages, mangel, celery, and seakale. These operations must ultimately become necessary on all sewage farms, and also the application of mineral phosphate to the soil, to supply that removed by the crops, and not restored by the sewage. Before Dr. Frankland, three or four years ago, had demonstrated in the laboratory of the Rivers Pollution Commissioners that one acre of soil, naturally dry, or rendered so by drainage, for 6 feet in depth, was capable of cleansing the sewage of 3,300 persons by alternate or intermittent filtration, Mr. Lawes had asserted at the Society of Arts, after elaborate investigation, that

10,000 tons of London sewage might be annually applied to one acre, which, at the time, Professor Way said was much too high, and Mr. Denton characterised as monstrous. Now, the one has lived to sanction, as a government Commissioner, and the other, as an engineer, to adopt the application of seven times that quantity per acre to the soil! But then, in the Merthyr Tydvil case, it is fairly alleged that as all precipitating processes had been, and must in all probability, for ever continue to be commercial failures, it was merely a question with the community concerned whether it was least injurious to their interest to waste sewage on the land with impunity, or in the river with a penalty attached. The question, I think, has been fairly solved in favour of filtering beds by the experiment at Merthyr Tydvil, and, as it is well carried out, it is both interesting and useful to communities where land cannot be obtained, or where neither Parliament nor the Rivers Pollution Commissioners will sanction the acquisition of a sufficient quantity for a legitimate sewage farm. The waste of sewage, both here and generally, is to be regretted, but in many cases it is inevitable. Its disposal, while the most urgent, is the most difficult question of the day. We have created a Frankenstein which we cannot lay. Mr. Lawes said, many years ago, after investigating all known processes for its utilisation, "Away with it to the sea," and, unfortunately, most of it goes there; but many towns are not within reach of the sea, and if they were, I believe its discharge even there will ultimately be restrained by legal injunctions. I have always advocated land as the filtering medium for the purification of sewage "with a profit if possible, without it if not," and see no reason to change my opinion. At Lodge Farm, in Essex, our earliest, and perhaps best, illustration of the utilisation of London sewage by irrigation, 4,000 tons, valued at £16, are applied annually per acre, and £32 realised for crops. At Merthyr Tydvil, 73,000 tons, worth £304 at the same rate, or £416 at 8s. 4d. per head of the population, are applied per acre, and the produce likely to be obtained is estimated at £30. From the great disparity in the latter case between the means at command and the result obtained, it appears clearly, for the pecuniary interests of ratepaying town populations, where a sufficient area can be obtained, that filtering beds should be made subservient to sewage farms, and not sewage farms to filtering beds. Thos. C. Scott.

19, King's Arms-yard, Moorgate-street, August 8, 1872.

THE SPORADES.

(Continued from page 812.)

The island of Halki is only five miles distant from that of Rhodes, on which it depends mostly for its subsistence during the winter season. Of all the islanders in the Archipelago the Halkiotes have turned out to be the best divers with the apparatus. While at Symi, they hardly cover their expenses, the Halkiotes make on an average £500 each. Every Halkiote is a diver. It is a kind of apprenticeship through which they must pass in their young days, even if they intend later to addict themselves to other trades. In summer the sea-shore swarms with naked children of both sexes, some of them not older than three or four years of age, for whom garments are almost unknown, and who seem to be amphibious beings, as they live as much in the water as on the shore. Babies are carried all day long quite naked in their mother's arms, and get thus accustomed from their younger days to resist the heat of the sun. Nothing else but sponge is exported. Leros is, under all respects, one of the best of the group. There is flat ground susceptible to cultivation, and spring water in abundance. The Leriotes addict themselves more to shipping than to sponge fishing; but their principal occupation is shopkeeping in Egypt, to which country proceed all those not engaged in maritime pursuits. Their numbers in Egypt are always about 1,000 individuals, who, when they gain money after several years' work, return to their island, and usually invest their capital in shipping. These vessels are not engaged in any particular trade, but their countrymen at Alexandria find freights for them from thence to the Black Sea and Europe. On their return they bring back to their island foreign goods, part of which are re-exported to Anatolia and the other islands of the Archipelago. The produce which is exported yearly consists of wine, figs, raisins, and cheese. The average of the sponges fished by the Leriotes annually is £5,000. They send them annually for sale to Calymnos and Symi, from thence about two-thirds are forwarded to Great Britain. The best part of the island—about one-fourth of the arable land—belongs to the Convent of Patmos. Leros, which has upwards of 6,000 inhabitants, is the only island of the Sporades where there are negro servants. As the Leriotes live mostly in Egypt, they purchase these slaves, and on their return some of them bring them to their island; but the 25 or 30 Africans, exclusively females, being Christians, are considered to be quite free women. Emery, but of a bad quality, is found in the island.

Patmos is renowned for having been the place of exile of St. John the Evangelist. A grotto, over which a Greek chapel is built, is stated by tradition to be the spot where he wrote the Apocalypse. In the year 1088, the Emperor Alexis Commene, having given a monk named Christodrilo the island of Patmos, which was then uninhabited, he, together with a few other monks, erected a convent, which is still in existence. It is now inhabited by about sixty monks, who lead an idle life, and possess extensive landed property in many parts of Turkey, and even so far as Wallachia. The first settlers at Patmos have been the masons and other workmen brought, especially from Crete and Trebizond, to erect the convent in question. They built their houses round it, and in cases of emergency sought refuge in it. In the last century Patmos had a thriving mercantile marine, whose principal trade consisted in carrying to Europe from Anatolia twisted cotton, specially of red dye, which it appears was in great demand, as the process of giving it that colour was then unknown there. Articles of furniture, pictures, even Gobelin tapestry, which are still to be seen in most of the houses, attest the welfare of the inhabitants at that time. However, shipping, which by some unknown cause had been decreasing since the beginning of this century, received the last blow during the Greek insurrection. The inhabitants have never addicted themselves to sponge fishing; however, a diving apparatus was purchased two years ago by a native, and the results obtained have been such that others will no doubt follow the example. Within the last two years six boats have also been fishing sponges with drags. This mode of fishing, although not to be compared with that of diving apparatus, has the advantage of cheapness. With £10 the necessary gear for a drag is procured, while nearly £150 is required for a diving apparatus. Contrary to the general practice in the islands of the Sporades, the women at Patmos perform no hard work. Their principal occupation is to knit stockings and night-caps, which constitute the only important article of trade in the island. These are now exported to the amount of £6,000 a-year, against £400 in 1856. These articles, which are chiefly sent to Constantinople, are manufactured with twisted cotton from Great Britain. Before their exportation, they are washed several times with soap, to give them a bright white colour, a circumstance which accounts for the large quantity of soap which is imported to Patmos. The agricultural produce of Patmos is rather limited. Besides the fresh vegetables and fruits (the principal of which are figs) required for the consumption of the inhabitants, it yields only about 3,000 bushels of wheat, 1,500 of barley, 10,000 gallons of wine, and 1,000 of raki. There are on the island 4,000 goats and 2,000 sheep, which furnish cheese, wool, and a few hides.

The island of Nikaria has made considerable progress within the last ten or twelve years. The Nikariotes, who, fifteen years ago, had only a few small boats, possess now 64 vessels of all kinds, employing 500 to 600 men, who are considered to be the worst sailors in those seas. The crews of the Nikaria boats are rather numerous, and foreigners are never employed with them. Their vessels are built at Nikaria, with timber cut in the forests of the island, but by shipwrights from Syra, from which place they also purchase all the required gear. As they have no harbours, they are obliged in winter to haul on shore the smaller boats, and anchor the larger vessels at the neighbouring island of Fourni, which possesses safe anchorage. In all times the inhabitants addicted themselves to charcoal making, but of late years they have greatly extended this trade, in which are engaged all the vessels and boats they possess. About 2,000 individuals proceed yearly to the coast of Anatolia for the purpose of making charcoal, and their vessels go even as far as the coast of Roumely for it. They usually make in summer large deposits of charcoal in the principal towns, specially Constantinople, Smyrna, Alexandria, Crete, Scio, &c., and sell it in winter, during which time they are seldom at sea. From the island itself they do not export more than 20,000cwt. out of 250,000 to 300,000cwt., in consequence of the Porte having prohibited their cutting down for the purpose the pine and oak trees, of which there are still extensive forests in the interior of the island. Fifteen years ago few foreign articles were imported. The inhabitants used to wear coarse cotton and woollen stuffs, woven by the women, and luxuries, such as sugar and coffee, were unknown to them. Now, although trade is limited, European articles, especially British cotton manufactures, are imported by the seamen, who bring back with them, for their families and friends, the necessary articles. The quantities of corn produced on the island are only sufficient for three months' consumption, and those imported are not in proportion to the population, which probably numbers upwards of 10,000 souls. This fact is explained by the large quantities of potatoes which they use for food. Properly speaking, there are no villages at Nikaria; the houses are scattered about all over the island, and in the places most propitious for agriculture. The inhabitants have always been considered as half-savages, and have the reputation of being thieves. They still sleep on goats'-skins. The use of lamps is almost unknown to them, they sitting at evenings by the light of the fireplace. The island is so hilly and deprived of roads, that no beasts of burden can be used. Everything has, therefore, to be carried by the women, who walk for miles with as much as two cwt. on their backs. Some years ago a mine of emery, which exists at two hours' distance from the seashore, was worked, and the women extracted and carried the emery to the shipping-place for 2s. per cwt. However, for some cause unknown—perhaps the bad quality of the mineral—the undertaking has been abandoned. About 800 women proceed yearly to Smyrna, Constantinople, and Syra, where part of them are employed as nurses, the others as servants. Within the last few years a school has been established, and is attended by a few children only. The Nikariotes say that to make charcoal no reading nor writing is required. The Island of Nissiros is a truncated cone, the sides of which, with the exception of the southern—which is all rock of volcanic formation—are under cultivation, and covered with trees. The centre of the island—that is the summit of the cone—is a large crater of an extinct volcano, so much impregnated with sulphur that agriculture is impossible. It would seem that the sulphurous substance is encroaching yearly on the arable land. In the spring, the island, being covered with verdure, presents a fine aspect, in which the eye reposes with pleasure after having been accustomed to the barrenness of the other islands of the Sporades. A few years ago the Ottoman Government established a manufactory for refining the sulphur found in the crater of the volcano; but hitherto little has been produced. If this establishment were worked on a large scale, it would procure employment to the inhabitants in carrying the sulphur from the mountain to the sea-shore. Some Nissiriotes had been at work in the manufacture of sulphur, but all of them having died in a short time, the inhabitants are unwilling to get employment in it from fear of a similar fate. Scarpantos, although one of the best-gifted with natural resources, is one of the most wretched of the Sporades. It is in general hilly, but well watered and susceptible to agriculture; however, the natives have allowed for many years their arable lands to be covered with trees, which the Government is now claiming as Crown forests. The inhabitants prefer to emigrate annually, for several months, to different parts of Turkey and Greece, where they work as masons, carpenters, &c., rather than addict themselves exclusively to agriculture. A circumstance worthy of remark is, that even in the poorest islands British cotton manufactures are being introduced instead of the woollen and cotton stuffs woven by the women, and which were formerly their exclusive garments.

"The position of Stampalia makes it a place of resort for vessels trading between Turkey and Greece. There is no regular trade; the necessaries of life are mostly landed from the vessels which call occasionally. The principal articles exported are sponges, to the value of about £3,000 a-year. The fine sponges of Stampalia are considered to be the best fished in the Archipelago. They all go to Great Britain, as well as most of the common; and together their value may be reckoned to amount to £2,500 a-year. Stampalia cheese is considered to be very good, and its reputation was such that formerly a Turkish vessel of war was sent annually to get some for the Sultan's own use. The women wear still the ancient costume, which is very picturesque. It consists of a petticoat made with square pieces of different colours, and embroidered shirt with long and wide sleeves, which they tie up behind their necks when at work, an embroidered breastpiece, sandals instead of shoes, and, lastly, a red furred jacket with gilt buttons, and a turban of light yellow colour, the end of which falls with grace on one side of the face, passes under the chin, and is thrown back over one of the shoulders. When this turban is not in silk, it is dyed by the women themselves with saffron, which grows in the island. Symi is in all respects the most important of all the islands of the Sporades. The number of foreign shipping calling yearly at this island can be reckoned to be 3,000, representing together 40,000 tons. Most of them are under the Turkish flag. Since September, 1868, the British steamers of the Asia Minor Steamship Company call at this island every fortnight. The amount of sponges exported in them for Europe *viâ* Smyrna, during the year, is about £70,000, together with £1,000 more of other goods. The sponge-fishing boats have about 18,000 divers and rowers; many of these boats take part in winter in the coasting trade of the island. The general occupation of the Symiotes is sponge fishing. Their boats are the best of all those engaged in this industry in the Mediterranean Sea. The sponge-divers are also in a more independent condition than those of the other islands of the Sporades. The average value of sponges fished by the Symi boats is £50,000 yearly, which, together with other £15,000 brought for sale from other places, even from Greece, are exported to Europe. Within the last few years the trade has much increased. The Symiotes, as soon as they manage to collect a small capital, purchase sponges, start with them for Europe, and procure foreign goods, with which they return to the island. Little by little their commercial operations are extended, owing to the credit they obtain in Europe when they are known. Hence the Symi merchants, who, in general, do not possess much ready money, are enabled to carry on business on a large scale. In consequence of the extension of trade, and of maritime pursuits, the Symiotes prefer living near the sea-shore;

but there being no space for building, they are compelled to blow up, at great expense, whole sides of hills to make room for constructions.

The island of Telos is the less important of the group. However, there is here much arable land, but the soil seems to be very poor, and to yield a very scanty produce. It is an undeniable fact that those of the inhabitants of the Sporades who are agriculturists are in a condition not to be compared to that of their more daring countrymen, for whom agriculture is but a secondary occupation, left almost to women, and who addict themselves to seafaring pursuits. At first sight, Telos appears to be a promising island, but the illusion is soon dispelled when the houses, or rather huts, which are at nearly half an hour's walk from the seashore, are approached. Nothing more miserable nor dirty can be imagined. Of late years the Teliotes have addicted themselves to sponge fishing, and they possess eleven boats, but as there are not at Telos people with capital to lend the divers the required money for a season's fishery, they cannot proceed to distant places, where sponges are more abundant, and are obliged, in general, to limit their explorations to the Archipelago. It is the only island of the Sporades where the population is not on the increase, and this is attributed to a local custom relating to inheritance, which prevents most of the younger daughters from marrying. The dowry of the mother is given to the eldest daughter, and that of the father to the eldest son, whom the second daughter is also obliged to serve during her lifetime. If there are other daughters they are left to a miserable fate, as, having no money nor property, they cannot find husbands. Most of them go and work at Symi.

GENERAL NOTES.

The Turners' Company.—The Worshipful Company of Turners, in continuation of their effort to promote technical education among turners, propose to give this year their silver medal and the freedom of the Company and of the City of London to any one workman or apprentice in England who may send in the best specimens of hand-turning. The material to be used is varied in different years, so as to include wood, ivory, metal, stone, spar, &c. The competition for this year will be in turning in hardened and tempered steel. The subject of the competition will be horological turning, whether exhibited in the turning and finishing of pinions of chronometers, watches, &c., or in any of the various escapements used in the same. The character of the work will be judged of by the perfect truth, finish, and squareness of the parts; and, in any escapement submitted, by the complete accuracy of form and proportion for the purpose intended. Competitors will be at liberty to select their own subject for exhibition in turning and finishing, whether in wheel work or the escapement; but the complete escapement or train of wheels planted in position, to show the truth and accuracy of the same, will be desirable. The successful candidate will be required to supply a satisfactory certificate of the work having been done by his hands only, and of its being done during the period of competition, and may be required to do, in the presence of the judges, a portion of the work similar to the successful exhibit. The award of the judges will rest entirely upon the truth and perfection of the turning of the steel work submitted. In addition to this prize, the bronze medal of the Company will be given to the competitor second in merit, and the Company's certificate of merit to the third. The different objects must be delivered free at the Mansion-house, London, during the week beginning Monday, October 21st, and ending Saturday, October 26th. The judges of this year will be the following citizens and turners:—Sir William George Armstrong, C.B., of Newcastle; Sir J. Brown, of Sheffield; Mr. John Jones, of the Strand, London; Mr. S. Jackson, of Red Lion-street, Clerkenwell.

Population of the United States.—According to the latest census, the population of the United States is now 38,500,000.

Telegraphs in the United States.—The number of telegraph offices in the United States is about 5,000, the total length of lines 75,000 miles, employing 7,000 persons, and transmitting annually upwards of 11,500,000 messages.

Machine for Drying Porcelain Clay.—A machine has recently been invented by Signor Leopoldo Henrion, a mechanical engineer of Sampierdacena, near Genoa, for drying porcelain clay or potter's earth. This operation, which is a most tedious one in our damp climate (England), can be effected in a few hours by this machine at a relatively small cost. The importance of this invention can readily be imagined, as by the present system eight months are required to dry the clay to the required consistency, and fit it for the market.

Gold Mines in Australia.—The statistics published by the mining department of Victoria give the following as the production of gold in that colony during the last three months of 1871:—The gold produced was 352,698 ounces, of which 174,362 ounces was obtained from quartz. The number of miners was 58,279, of which 42,610 were Europeans. The mines extend over 985 square miles. At Clunes, gold is extracted from quartz obtained at a depth of 790 feet below the surface.

The St. Gothard Railway.—The contractor for the tunnel, M. Favre, is making extensive preparations for commencing the work as soon as possible, and orders for boring machinery, and for machinery for compressing air, have been given out within the last few days. The length of the tunnel is now definitely fixed at 14,900 metres, in consequence of certain modifications that have been made in the gradients, the culminating point in the tunnel being now 1,152·40 metres above the level of the sea, or somewhat lower than it was formerly intended. With the exception of 145 metres at the station at Aviolo, the tunnel will be driven in a straight line. The appointment of the principal engineers of the company has been made, the chief engineer being the Chevalier Gerwig, with the Chevalier Ehremfreund as next in command, who will act as his deputy, with a residence at Zurich. M. Schrafl has been appointed engineer of division at Lugand, and MM. Arnaldi and Fraschina chief of the divisions of Lucerne and Bellinzona.

The Polytechnic School at Zurich. — This school, which now has been established 17 years, numbers, during the present scholastic year, 689 students, as compared with 648 in the previous year, of which 168 were students of the University, against 281 of the previous year. In the school of architecture the number of students was 22—11 being Swiss and 11 foreigners. In the school of engineering the number of students was 262, of which 60 were Swiss and 202 foreigners. In the mechanical department, 135 (62 Swiss and 73 foreigners). In the school of chemistry applied to manufacture, 91 (41 Swiss and 50 foreigners). Forestry, 18 students (14 Swiss and 4 foreigners). Agriculture, 7 (2 Swiss and 5 foreigners). In the school for professors, 33 students, of which only 1 foreigner. The number of students in the preliminary course was 121, being 20 Swiss and 101 foreigners. Out of the total number, 689, there are 242 Swiss and 447 students of other nations; of this number, 191 are Austrian, 94 Russians, 50 Italians, 42 Germans, 17 Roumanians and Servians, 13 French, 9 English, 9 Swedish or Norwegians, 6 Dutch, 5 Danes, 4 North Americans, 3 Turks, 2 East Indians, and 1 West Indian, the only European States not represented at Zurich being Belgium, Spain, and Portugal

Journal of the Society of Arts.

No. 1,033. Vol. XX.

FRIDAY, SEPTEMBER 6, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

THIRD COURSE OF CANTOR LECTURES.

SILICATES, SILICIDES, GLASS, AND GLASS PAINTING.

By Professor Barff.

Lecture V.—Delivered Monday, May 6, 1872.

This evening I propose to continue the subject with which I concluded my last lecture, namely, the colouring of glass by metallic oxides. It is necessary that this should be understood before entering upon the consideration of the various styles of glass-painting. We have to-night the advantage of Mr. Ladd's presence with the electric light, and we have arranged a series of experiments, which are so beautiful that they should take precedence of everything, therefore I may have to complete this portion of my subject at our next meeting. I commenced my course with the chemistry of silicates, as introductory to the manufacture of glass and glass-painting, and it is, therefore, necessary, to make my story perfect and complete, that I should speak to you somewhat at length on the subject of staining glass with metallic oxides. We notice a considerable difference in the ancient glass which adorns the old cathedrals of this and other lands and the glass which was made some 20 or 30 years ago. We notice this difference in the blues and reds, but more particularly in the latter, and we ask frequently in what does this difference consist? I have already noticed this point, but it is now my business to go into it rather more fully. The exture of the ancient glass is very different from the texture of modern glass, and I shall give some experiments later on to show this, and you will need no further remarks, as the illustrations will speak for themselves. But when old ruby glass is examined you find that there is a thicker coating of the colouring matter upon it than there is upon modern ruby. The ground, of course, is different, *i.e.*, the white glass—that I have already shown—and to that is owing, in great measure no doubt, the lustre of the ruby. But it appears as if the operation of dipping and coating had been repeated several times—as if the glass ruby had been taken and dipped into the pot, and coated with white and ruby glass more than once. It appears as if the coloured coating had been put on the outside and not on the inside, and that after the glass had been dipped into the ruby it was again dipped into the white, so that striæ of white glass are formed between the thin films of ruby glass. That would very materially increase the brilliancy of the effect produced by transmitted light. All the old ruby glass is remarkably thick, and, no doubt, in former times, those who made windows took the greatest possible care in firing their ruby glass, and a great deal depends upon the firing. I have here a disc of ruby which was lent me to-day by Messrs. Powell, in which we have portions of it perfectly white; but if this white glass is fired carefully it becomes ruby, and if this ruby, which is perfectly red on this side, is overfired, it becomes almost opaque. Great care is therefore necessary in firing ruby glass. In some instances glass painters, if they are not careful in using a flux with their painting colours, which is sufficiently soft to run down before the temperature rises so high as to affect the ruby glass, spoil their ruby. Glass painters know that, in spite of all their care, this does sometimes happen, and that ruby becomes so dark with the firing that they have to reject it, and paint fresh pieces. I mentioned, I think, that ruby glass is usually coloured with sub-oxide of copper; it is also coloured with oxide of gold. I have here two specimens, which have been lent me, of ruby glass, obtained from the heating of an almost colourless glass. I shall show you those presently by the aid of the electric lamp, and you will see that one piece is colourless, whilst that which has been heated has become of a beautiful ruby colour.

Before leaving the subject of ruby glass, I must say one word about splashed ruby. As many of you, no doubt, are aware, there are some pieces of old glass taken from French windows, I believe, in which there is clear, white glass with dashes of ruby upon it, just as if the maker had taken ruby glass in a liquid state, and dashed it on the white glass. This is called splashed ruby. The way that can be imitated, and no doubt the way in which it was originally obtained, is this. Portions of this copper ruby are broken up into small pieces and thrown upon the iron implement, which is called the *marbre* or *marver*, and which is used in the manufacture of flint glass. The workman then gathers white glass from the pot on the end of his blow-pipe, and rolls the hot glass on the marver; the small pieces of ruby adhere to it, and are softened by the heat. The mass is then exposed at the mouth of the glass pot, and the pieces of ruby melt and become perfectly united with the white glass and spot over its surface. When the mass is in the proper state it is blown and made (as already described) into a disc, or cylinder, and the spots by this operation become elongated, and produce the same sort of effect as would be obtained by throwing a red liquid obliquely on a sheet of white paper.

Another point to be noticed in connection with ruby glass is that we do not always get a ruby-colour with the oxide of copper. Sometimes the sub-oxide becomes oxidised into the higher oxide, and that higher oxide gives a green—not a ruby—colour; so that we get an intermixture of green and red sometimes, and also purplish and bluish tints. Specimens of these I shall show you by-and-bye.

The blue glass which is considered by many to be so beautiful, this sort of purple blue, is stained with oxide of cobalt. I have arranged an experiment or two to-night, to show you how—by running down certain mixtures which we have here, the composition of which I will tell you of presently—we are enabled to obtain coloured glass. Of course, in so short a time we cannot obtain it in a state perfectly homogeneous; but, at all events we shall be able to show you how blue glass is obtained. Green glass is coloured by various metallic oxides. For instance, even as I have already mentioned, in a certain state of oxidation, iron colours glass green, and the green colour of ordinary bottle glass is owing to the presence of the protoxide of iron. Green is also obtained with other oxides of metals. We have here a beautiful piece of green glass, which goes by the name of signal green, because it is used for railway signal lamps. It is coloured by the higher oxide of copper, the protoxide, not the suboxide. Oxide of chromium also colours glass green, and it has a very powerful colouring effect. Opaque greens are made with it for enamels, and some transparent greens, for if this opaque green be coated upon white glass, we have a similar effect produced to that which we have when the ruby glass is coated upon white, a coated green is obtained. Then with regard to yellow glass, there are different kinds, which I shall show you presently. Some cold yellows are obtained with sesquioxide of iron, the oxide containing more oxygen than the protoxide. Another yellow is got by silver stain. It is said that the ashes of certain woods colour glass yellow. It is the iron contained in the ashes which, in the state of sesquioxide, imparts the yellow colour to the glass.

Mr. Lewis has now melted a piece of glass coated with a particular composition, and on putting it into the electric lamp, you will see that it is of a beautiful blue colour. There is another piece, of a purple colour, obtained from manganese. It is a peculiarity of manganese, that if you have a moderate quantity present, you get a purple colour, but if you have too much it converts the purple into a brown. Manganese purple has generally a brownish tint; it is not the pure purple known by the name of mauve or magenta. I need not show you other experiments, as I think these two are sufficient to prove how easily, with the source of heat we have here, we can obtain this colouring effect by metallic oxides. The yellow silver stain, which we did not succeed in obtaining last time, because the muffle was not sufficiently hot, I shall show you next week.

Now, I will describe to you a very good way of mixing fluxes, and of insuring a very rapid colouration of silicates with metallic oxides. I have here some silicate of potash, and in this bottle some chloride of cobalt. Putting these two together you will see we shall get a blue precipitate, which is silicate of cobalt. Here we have two substances mixed in what are called equivalent proportions, and intimately mixed (for they are chemically united). Here, again, I will add to the silicate a copper salt, and we shall get silicate of copper formed, which is of a green colour. These two illustrations are enough, but if I took an iron salt I should get a dark brown-coloured precipitate, and I should also get characteristic precipitates with salts of other metals. Now, if we filter off the liquids from these substances, we shall have the silicates left in the best condition for fusing, for we have their constituents in equivalent proportions, and chemically united, for the silicate of potash and the chloride of cobalt are no longer there, but we have silicate of cobalt, there having been an interchange of acids and bases. If, then, these be dried, and mixed with some of the substance which I will now preciptate — and that is how the materials which have been used this evening have been prepared — some nitrate of lead and borax, putting these together we have a white precipitate, and we get here borate of lead — another interchange of acids and bases. This borate of lead is excessively fusible, and renders any silicates' with which it is mixed particularly fusible. You see in how short a space of time, and how easily, we were enabled to produce the blue purple colours which were shown on the screen. But some person may say, "you have an intense heat there, for you have nearly perfect combustion of the coal gas." That is true; but in making silicates by fusion you do not require such an intense heat at the time; what you want is prolonged heat—a long, soaking heat; and if these glasses which we have been making now had been fused for an hour or so at a lower temperature, we should have had a very much more perfect incorporation of the substances. I advise any one engaged in these matters to try these experiments, as I think they would find that they would lead to satisfactory results. I have not given you the proportions of flux and silicate to be employed, but you will easily find by experiment which mixture suits your purpose best.

Now I pass on to harmony of colour, for there is a harmony of colour to be observed in glass-painting as well as wall-painting, for if colours are not harmoniously arranged, and in proper quantity and order, with proper intervening white spaces left, you do not get a pleasing effect. Before speaking of the harmony of colour, I must get Mr. Ladd to be kind enough to illustrate the subject by experiment; and while his experiment is being got ready I will explain to you the object of it, so that when you see it you may direct your attention to the conclusions which I wish to draw. The experiment which Mr. Ladd is going to show you is one which has never been shown before, except at the London Institution a week or so ago. It is one which he devised on that occasion, and it is exceedingly beautiful. You see there is a spectrum shown on the screen. Inside the lantern are two carbon points, which are burning by means of an electric current, and between those two points there is an arc of light passing, which will be shown presently upon the screen, but he will not show you this under the effect of white light, but of coloured light, and in order to produce that coloured light he will burn some substances which have the property of giving a colour to flame. We find most metals have the property of colouring flame, and while some of the colours are pure and simple, others are compound. First, Mr. Ladd will burn thallium, which gives a simple green, that is, it cannot be decomposed. We shall see in the spectrum a bright green band in the place where the green occurs. You see the carbon points, and at the same time you see the arc, with green light playing between the points; and I think you will agree with me that the spectacle is a very beautiful one. After the thallium has been burnt, sodium or lithium will be used in the same manner. Sodium gives a perfectly monochromatic light; and lithium gives a purple tint, in which you get blue and red. Lithium is now being burnt, and you see two bands, one in the red, and one in the violet part of the spectrum. I introduced these experiments, first, because they are so beautiful and instructive that I determined they should be brought in somehow or other, and now I have thought of a way by which I can bring them in, and make them bear directly on our subject. In the case of thallium, we had a green light which was not divisible into two other colours, and we get, therefore, one green band in the green portion of the spectrum. Here we have a colour which is composed of two other colours, which is analysed, and we get the two colours of which it is composed, marking themselves by the brilliancy of their tints in the bands to which they belong. In the sodium, again, we have only one colour. Those who are engaged in the art of glass-painting should examine scientifically the colours which they employ, because, by that means, they will be able to tell—not empirically but really—how to make their arrangements of colour so as to produce the desired effect with certainty and truth. Here, you see, we can analyse a colour in this way, and by-and-bye I hope to be able to show you that we can examine these apparently simple coloured glasses which are used in glass-painting, and put them to the test, to see whether they are really what they represent themselves to be, or whether they are compound colours. I shall have then to speak of the care which should be taken in arranging pieces of glass of different colours together, so as not to produce confusion in effect by using two glasses which have a common colour, or produce an intermixture which is not in the intention of the artist. Last year, when I had the pleasure of addressing you, I introduced to your notice a theory of colour, which was originated, I believe, by Mr. Clarke-Maxwell, but has been spoken of, and enforced, and taught with wonderful effect, particularly in his later book, by Mr. Benson. It has been held, as you know, that the three primitive colours are red, yellow, and blue. It is now proved, beyond doubt, experimentally, and also, I believe, mathematically, that these are not the primitive colours, but that red, blue, and green are the primitive colours. A friend of mine, Mr. Wormell, has devised one or two experiments to illustrate this, which Mr. Ladd will show us next. He will arrange the prism so as to throw a small spectrum on the screen, and will introduce between the lantern and the prism some coloured medium which will shut off certain rays of light. The colours that are being used in this experiment are, first of all, the yellow colour which is obtained with what is called a solution of neutral chromate of potassium. It is, as nearly as possible, a prismatic yellow. The ray of light will be passed through this solution, and you will see that it will shut off from the spectrum certain coloured rays. You will see no blue; you will see yellow, you will see red, and you will see green, so that this yellow medium allows the red rays, and the yellow rays, and the green rays to pass through it, but it shuts off the blue and the violet. Now, as that yellow lets the green, blue, and red pass through it, they are constituents of the yellow, for if we bring them (the green and red) together in the centre, and allow them to overlap, we get a yellow colour, so that yellow light is resolvable into green and red. That experiment shows us very clearly that we have yellow produced by the admixture of green and red, and you noticed that when Mr. Ladd so placed the intercepting medium as to cut off only the upper portion, in the lower part, where the coloured medium did not interfere, we had the whole of the spectrum complete and perfect. The next solution through which the light will be transmitted is purple; it is a dilute solution of permanganate of potash, which cuts off the yellow and green rays, and we have there the red and blue colours which form purple. There you see, again, on the screen the red, blue, and purple. We have prepared other experiments of the same character, but I think it is not necessary to take up more time by showing them, as we have so much more before us, and these are so conclusive. Enough has been shown to prove that by passing light through certain colours and through a prism you are able to analyse the constituent tints of which that colour is made up. Now, inasmuch as I do not expect that every one engaged in glass-painting will go to the expense of a lantern and large apparatus to try these experiments on this brilliant and costly scale, I have consulted my friend Mr. Wormell, a gentleman of high authority on these matters, and have, in consultation with him, devised a plan by which any one will be able to analyse the colour of a piece of glass. Mr. Benson devised a method of doing this for opaque colours, which I explained to you last year—an account of which will be found in the Society's *Journal;* but we have now to deal with transparent colours. If you take a prism and hold it thus, so that the ray of light passes in at one side and out again at the other, and hold it between your eye and the piece of glass which you wish to analyse (of course, this is best done by daylight), you will see certain bands fringed with prismatic colour, and if you move the glass until it comes over these, it will destroy such of these bands of colour as it does not itself contain. If, for instance, the glass be one which professes to be blue, but if it has a purple tint in it, then you will not see the blue distinctly, or the red distinctly, but you will see the red and blue also; whereas if the blue is a prismatic blue, it will shut off the red entirely. I shall have the pleasure of showing you experiments to prove this on a large scale on the screen. But this is a simple way in which any person can analyse the purity of colour of a piece of glass which he is going to use in a stained glass window. We have here some samples of different kinds of glass; some ordinary blue and yellow glass used in green-houses, public-houses, and so on. and for decorating windows, and some very beautiful glass, such as is used for stained glass windows. These are specimens from Messrs. Powell's. I will begin with the ruby. Here are two pieces—a piece of common ruby, and a piece of pure ruby, though both are coloured with the same metallic oxides. But I showed this experiment at the London Institution a fortnight ago, and there I made a mistake, which I now desire to correct. It was a mistake resulting from ignorance on my part. I believed then that I had a piece of glass stained with gold, and I so stated, and founded upon that a remark that gold ruby is nearer the prismatic red than copper ruby. But I was wrong there, as they were both coloured with copper oxide. Now, I think I can show you how it is that, though both these glasses are stained with the same metallic oxide, yet one has the power of cutting off absolutely every other ray but the red, whereas the other has not. Here is a piece of ruby which is cutting off all rays but the red. It is a most magnificent piece, its colour being perfectly prismatic. Now, we will try another piece of ordinary ruby, and you will see how many more rays of light that lets through than the other did. That shows you the different effects which these different kinds of ruby have upon the light. Next, we will take yellow. There are two yellows, one stained with oxide of silver, which has not the power of cutting off very much of the spectrum, for all the rays except the deep violet pass through it. The other, stained with oxide of iron, has a more perfect action in cutting off the rays, for it abstracts the blue, but it lets the red, yellow, and some of the green pass through it. That shows that it approaches nearer to the prismatic yellow than the other. The same with the blues. One of these is stained with the same colouring matter as that we have used this evening. You see it has a purplish tint, and it lets some of the red rays pass. Now we have another which shuts off the red almost entirely, but lets a small portion of the green light pass through it.

Now, having spoken of the method of analysing colour, I must speak on the texture of glass, for this is a subject of immense importance. It is on the texture mainly, I think, that the richness and beauty of effect which we see in the old window glass depends. I shall have to show this by direct light, putting the various pieces of glass in front of the lantern, and you will see by direct light the difference of effect produced by the texture of the glass; and you will yourselves, I think, be able to see in an instant how very beautiful is that glass which is made according to the system which the ancients adopted in the manufacture of their glass. First, we begin with white. On putting a piece of common glass before the lantern, you see no change whatever in the light thrown on the screen; but now I will put a piece of Messrs. Powell's white glass, used for church windows, in front of the light, and you see how beautifully the light is refracted. And if you get this brilliant effect by passing the electric light through this medium, how very much more beautiful will it be when produced by the sun's rays passing through it. You notice these numerous luminous points all of which add to the brilliancy of the effect. Here is a piece of ordinary green glass, through which the light passes uninterruptedly. Here is another piece, on which I experimented just now, and you observe how brilliant it is. Now, I will show you a piece of ruby glass, which will illustrate the point I mentioned before. You see there is a border to it, which is deep in colour but the main portion of it is white, with small streaks of ruby in it. That is the disc which I mentioned had been fired more on one side than on the other, and I said that those parts of it which are now white would become ruby if they were cautiously fired. This is most interesting to me, because it supports the theory which I have held for some time past, in conjunction with many other chemists, namely, that it is not to the presence of the metal, as a metal in the regular state, that the colour of glass is owing, but to the presence of a metallic oxide. This is a subject which I will not go into this evening, because it would take us too far. Here is another specimen of ruby, which has also greenish, greyish, and bluish streaks in it. That is coloured with suboxide of copper, but, no doubt, some of the suboxide has become oxidised into the protoxide, which gives the green and blue colour. You remember the green I showed just now—a bluish green, the signal green—it is coloured by the protoxide of copper, so that you can quite understand how there are streaks of blue there, and how you get streaks of greenish blue and gray mixed up with the ruby colour. I believe it is owing to the presence of these different tints that certain of these rubies which are sold ordinarily, and some of those which are manufactured for stained glass purposes, when tested by the prism allow other rays, such as a green and blue, to pass through them. Here is another very interesting specimen. You see what beautiful colours and forms there are upon this piece of glass. You will be astonished to hear what they are, and how they are produced. It is a piece of glass which Mr. Powell was kind enough to lend me, and which had been for many years in his stable at Clapton. It is a pane of common crown-glass, taken out of the stable window. It is perfectly smooth on one side, and colourless, but on the other side it is rough and very irridescent indeed. It looks like some of the glass vessels which are taken out from Roman excavations, or from the bottom of rivers. Its surface looks like opal, and most beautiful colours are seen on it as you move it about. These colours must have been produced by the action of certain substances on the glass carried as spray in the air, which were in the stable, and which were deposited on this window from time to time, through a long course of years. The action of these substances is such as to destroy the texture of the glass, or at least the texture of that surface with which they came in contact, and having seen this you will not have much difficulty in understanding how it is that, through a lapse of years, certain effects are produced by atmospheric influences upon the church windows, of which we are so justly proud, as representing a state of high art and sentiment in the middle ages. In our next lecture we will consider the principles of glass-painting, and I shall then have to refer to this sort of action upon glass, as a reason why our glass painters, seeking in every possible way to imitate effects which are the results of an action continued through a length of time, have failed to produce the effects they desired to obtain; for in art, as in everything else, what is not true is unsatisfactory, and attempts to produce effects by other than legitimate means must always result in disappointment and failure.

I must, before we part, say a few words about these experiments which have passed in rapid succession before you. You saw the beautiful effect produced by that irregular white glass, how it broke up the rays of light which passed through it, and how lustrous and luminous the disc became. The same applies to all the other colours, especially prepared for stained-glass painting; and I want you to remember this, for much depends upon it, as I hope to show, when we come to consider the arrangement of the coloured glasses that are used in glass-painting. If the rays of light pass directly through a clear transparent medium and are not refracted, they come in direct lines to us; but if they get refracted, they cross one another. So, if you put two coloured glasses together with the view of producing a certain effect, and you get these two colours mingled together upon your retina, they will produce a compound effect, and everything which tends to produce that must be wrong, if a simple effect be desired. You see here is a piece of glass which has little or no colour. I mentioned it before as that which, when heated, produced ruby. It has a very beautiful lustre. Here is a piece of the same glass, which was broken off and heated in the fire, and it has a beautiful ruby colour. This piece of glass was lent to me by Mr. Green, of Messrs. Powell's. Here is a glass, in the first instance, which has not the slightest trace of ruby in it, but which, when heated, becomes red. In what condition, then, is the material in that glass which gives a ruby colour on heating? The ruby piece was heated, no doubt, in the entrance of the glass pot in the presence of atmospheric air, and the material that has produced the colour must have been oxidised, not in the metallic state. If, then, it exists at all as oxide in the colourless glass, it exists in the form of a lower oxide which does not impart colour to glass, or it is in a metallic state, and it is by oxidation in the mouth of the furnace that this ruby colour is produced.

It is usual to divide the glass-painting of the middle ages into three periods. Some call the first period the "Early English," and others call it the "first pointed style," then the middle pointed style, or decorated, and then the perpendicular, or third pointed. To call the first period early English is evidently a mistake, for the very best specimens we have of early glass-painting are seen abroad, and not in this country. We may take somewhere about the year 1280 as the termination of this earlier period of glass painting; any windows executed before that time would be considered as belonging to the first style. Then the second style goes on for a century or thereabouts beyond it. Of course this classification is only made for convenience sake, because it is impossible to draw distinct lines of demarcation between the styles of different periods, for any one who studies the subject must notice that the transition between the styles of different periods is gradual, and that certain peculiarities of one style are carried on into another, and then they gradually disappear.

The artists of the earliest period did not aim in any degree at what is called artistic effect. The earliest treatment of glass is more like mosaic work. If you notice the windows in the St. Chapelle, Paris, there is no attempt at artistic effect in them. If the artists had intended to produce such effects they would not have broken up the windows into small compartments, and so have reduced their subjects to the small dimensions which they have allowed themselves for each. It appears to me that those who lived in the earlier times of glass-painting had the most correct view of how windows ought to be treated, for they looked upon them as open spaces, through which light was to pass; they did not regard them as an artist regards a canvas, as that upon which they were to depict the highest impressions which they had of the subject which they wished to delineate. They rather adopted a conventional treatment, taking at the same time from those sources of art which they had studied the leading principles of their art. We find in the earliest period of glass-painting that there was evidently a knowledge, on the part of those who designed the figures, of classic forms, for the treatment of draperies in early windows, more or less, shows that those forms had been studied. You see numbers of folds drawn transversely across the body, not longitudinal folds, as you see in the later styles, long folds of flowing drapery which are evidently copied from lay figures very artificially clothed, but folds drawn across the body, just as you see them in Greek statues. These folds, too, are represented by numerous faint lines, the lines being increased in thickness to denote greater depth of shadow. But in this style you find little or no attempt at shading. The whole effect of the figure is obtained by good outline, just as we have seen in later years that wonderful effects can be obtained by drawings in this style. You remember the famous drawings of Richard Doyle; you know how, in a few lines well drawn, he was able to give a most striking representation of events occurring in our day. So here, in this style, the whole effect of the subject seems to depend on lines. I do not mean to say that shading was not used; it was used occasionally to heighten, or rather to deepen, the shadows, but I do not think in any case that it was used, at least I am not aware of any, so as to needlessly interrupt the passage of light through the glass. I mention this because it is one of the principles I wish to inculcate, viz., that no system of glass painting should be used in which the passage of light through the glass is unnecessarily obstructed. The general arrangement of these early windows was a series of medallions. You may see instances in the illustrations on the wall, which are taken from a book published by Pere Martin; that was the general arrangement, each subject was generally confined to its medallion, but a series of subjects were often depicted in the same window. Because these windows were broken up into medallions, it necessitated a certain treatment of the solid framework of the window, so that the iron work which was necessary to retain the window in its position also took a picturesque form, and entered into the artistic design of the whole window. Again, yellow stain was not used at this period, so that all yellows employed were of hot metal. For this reason, and because the subjects and ornament were made up of small pieces of different coloured glasses, the leading employed to hold the glass together was extremely complicated. Here is a window executed by Messrs. Lavers, Barraud, and Westlake in the style of this period; it is for a church near Abingdon. You see how very full of lead work it is. When, however, it is illuminated from behind you will not notice this great amount of leading, for it has been so arranged by the artist who designed the window, that it really gives distinctness to the design and beauty to the whole composition. It was this judicious use of the materials at his command which marked the genius of the ancient glass painter; and in such revivals of ancient windows as we see before us, we distinguish on the part of the artist a due appreciation of the nature of the materials which he is compelled to employ; and in this consists the true secret of success in glass-painting.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

THE EXHIBITION OF 1873.

The general rules and regulations have been issued as follows:—

Her Majesty's Commissioners for the Exhibition of 1851 announce that the third of the series of Annual International Exhibitions of Selected Works of Fine Art (including Music), Industrial Art, and Recent Scientific Inventions and Discoveries, will be opened at South Kensington, London, in April, 1873, and closed in October, 1873. The precise dates will be duly announced. It will consist of three divisions—1. Fine arts. 2. Manufactures. 3. Recent scientific inventions and new discoveries of all kinds. The productions of all nations will be admitted, subject to the decision of competent judges as to their being worthy of exhibition, and provided they have not been exhibited in the previous International Exhibitions of this series.

The three divisions of this exhibition will be subdivided into the following classes. For each class a separate Committee of Selection will be appointed:—

Division I.—Fine Arts. Fine Arts applied or not applied to Works of Utility executed since 1863.

Class 1.—Painting of all kinds, in oil, water colours, distemper, wax, enamel, and on glass, porcelain, &c. Mosaics; drawings of all kinds.

Class 2.—Sculpture, modelling, carving and chasing in marble, stone, wood, terra-cotta, metal, ivory, glass, precious stones, and any other materials.

Class 3.—Engraving, lithography, photography as a fine art, executed in the preceding twelve months.

Class 4.—Architectural designs and drawings, photographs of completed buildings, studies or restorations of existing buildings, and models.

Class 5.—Tapestries, carpets, embroideries, shawls, lace, &c., shown not as manufactures, but for the fine art of their design in form and colour.

Class 6.—Designs for all kinds of decorative manufactures.

Class 7.—Reproductions—*i.e.*, exact full-size copies of ancient or mediæval pictures, painted before A.D. 1556. Reproductions of mosaics and enamels; copies in plaster and fictile ivory. Electrotypes of ancient works of art, &c.

Division II.—Manufactures. Machinery, Substances and Processes.

Class 8.—Silk and velvet fabrics.

Class 9.—Steel:—(*a*) Steel manufactures, other than cutlery and edge tools; (*b*) cutlery and edge tools.

Class 10.—Surgical instruments and appliances.

Class 11.—Carriages not connected with rail or tramroads.

Class 12.—Substances used as food:—(*a*) Agricultural products and manurial substances used in cultivation; (*b*) grocery, drysaltery, and preparations of food; (*c*) wine, spirits, beer, and other drinks, and tobacco; (*d*) implements of all kinds for drinking, exhibited for peculiarity of shape or for novelty, and for the use of tobacco.

Class 13.—Cooking, and its science.

Division III. Class 14.—Recent Scientific Inventions and New Discoveries of all kinds.

All industrial objects submitted for exhibition must be new. With the view, however, of increasing the educational value of the Exhibition, her Majesty's Commissioners will, wherever possible, set aside certain spaces for collections of ancient works in the industrial division.

The arrangement of objects will be strictly according to classes.

Foreign governments which desire to have space guaranteed to them can obtain such guarantee upon making application before the 1st January, 1873. Such guaranted space will not, however, be reserved for any foreign objects which are not delivered at the time appointed by her Majesty's Commissioners.

Objects produced in the United Kingdom, as well as those objects produced in foreign countries, for which space has not been guaranteed, must be sent direct to the building, for the inspection and approval of judges appointed for the purpose. All objects must be delivered at the proper places in the building, which will be hereafter advertised, and into the care of the appointed officers, free of all charges for carriage, &c., unpacked, labelled, and ready for immediate exhibition.

No rent will be charged for space. Her Majesty's Commissioners will provide glass-cases, stands, and fittings, steam and water-power, and general shafting, free of cost to the exhibitors, if their requirements in these respects be notified to her Majesty's Commissioners before the 31st January, 1873, and the Commissioners will carry out the arrangement of the objects by their own officers, except in regard to machinery, and other articles requiring skilled assistance and special fittings, which must be provided by the exhibitor.

Her Majesty's Commissioners will take the greatest possible care of all objects, but they will not hold themselves responsible for loss or damage of any kind.

Prices should be attached to all works of art, and (whenever possible) to all other objects intended for sale at the close of the exhibition. Price clerks will be appointed to register the selection of objects for purchase, and to introduce the seller to the buyer.

Every object belonging to Divisions II. and III. must be accompanied by a label, stating the name and address of the exhibitor, the special reasons, such as excellence, novelty, cheapness, &c., why it is offered for exhibition, and (whenever possible) the retail price at which the public can obtain it.

The latest days appointed for receiving each class of objects are as follows:—On Saturday and Monday, March 1st and 3rd, paintings in oil and water-colours; on Tuesday and Wednesday, March 4th and 5th, sculpture; Thursday, March 6th, fine art furniture and all decorative works, stained glass, reproductions, and substances used as food; Friday, March 7th, fine art furniture and all decorative works, architectural designs, and substances used as food; Saturday, March 8th, engravings, &c., tapestries, &c., cooking, and its science; Monday, March 10th, steel, cutlery, and edge tools, cooking, and its science; Tuesday, March 11th, surgical instruments and appliances, machinery and raw materials, and scientific inventions; Wednesday, March 12th, designs for decorative manufactures, machinery and raw materials, scientific inventions; Wednesday, 19th March, silk and velvet; Monday, April 7th, carriages.

That the necessary arrangement for meetings of the Committees of Selection may be carried into effect, strict punctuality will be required in the delivery of all objects, both foreign and British. Objects not accepted for exhibition must be removed according to notices, which will be hereafter given. Objects exhibited cannot be removed until the close of the Exhibition, except under the orders of her Majesty's Commissioners. Prizes will not be awarded, but a medal will be given to each exhibitor, certifying that he has obtained the distinction of admission to the Exhibition. A catalogue will be published in the English language, but every foreign country will be free to publish a catalogue in its own language. Tickets of admission will be issued to each exhibitor or firm exhibiting, after the opening of the Exhibition. The above rules apply to the Exhibition of 1873. All persons contributing to that Exhibition shall be considered thereby to render themselves subject to the present rules, and to such other rules and regulations as her Majesty's Commissioners may, from time to time, lay down.

EXHIBITIONS.

The Lima Exhibition.—The exhibition announced in 1869 by the Peruvian government was opened on the 1st of July, at Lima. The buildings were commenced on the first day of 1870, under the direction of General Vivanco, after the plans of M. Antonio Leonardi. The principal edifice is a long quadrangle; the vestibule is paved with Carrara marble, and decorated with colour and gilding. Besides this main building, there is a machine court, a theatre, a grand café, and gardens with cages for animals, and other annexes, covering altogether a space of about 200,000 square yards. Amongst the contents of the exhibition are a collection of Peruvian antiquities, consisting of mummies enclosed in glass cases, woven fabrics, feather ornaments, stone hatchets, and other implements, bows, arrows, and many other objects. Amongst the industrial products are five hundred objects contributed by Chili, through the medium of the Agricultural Society of that country. There is also a gallery of art, the pictures being principally by Peruvian and Chilian artists.

Italy at the Vienna Exhibition.—The amount of space required by the Italian committee at the exhibition at Vienna has been granted by the Imperial Commission, being 450 square metres in the central gallery (industry), 1,000 square metres in the agricultural gallery, 536 square metres in the machinery department, and 2,570 in the grounds attached to the building, making in all a total of 4,556 square metres, or about 1½ English acres.

Exhibition of Fine Arts at Milan.—The exhibition of works of modern painters was opened by the King of Italy on the 26th ult., and will remain open until the end of September.

The Luxembourg Gallery.—It is asserted in Paris that the government has determined to suppress the Gallery of the Works of Living Artists at the Luxembourg, the whole of the space in the fine old palace being required for the service of the Prefecture of the Seine. Anyone acquainted with the feeling of our neighbours for art and artists ought not for a moment to credit such a statement. A more unpopular or a more injudicious act could not be performed by a government. If there be any truth in the rumour, it may simply be that the collection is to be removed to some other place while the Hôtel de Ville is being rebuilt, and till the Prefect and other officials of the city of Paris return to the site of their old home.

The Paris Marine and Colonial Museums.—These museums, the former of which existed for many years on the upper floor of the Louvre, and was somewhat difficult of access, and the latter, which was not many years old, and occupied a portion of the galleries of the Palais de l'Industrie, on the river side of the building, are now being installed together on the upper floor of that part of the old Louvre the colonnade of which faces the church of St. Germain l'Auxerrois. The arrangement is entrusted to M. Barbet de Jouy, the conservator of the *objets d'art* in the museum.

PATENT LAWS.

The following is the report of the Committee appointed by the British Association to consider the mode in which new inventions, and claims for reward in respect of adopted inventions, are examined and dealt with by the different departments of government, and to report on the best means of removing any real cases of dissatisfaction, as well as of silencing unfounded complaints:—

Having regard to the evidence taken by the Committee of the House of Commons on the subject of the Patent Laws, in 1871 and 1872, on the relations between inventors and the government, as well as to complaints made in Parliament and elsewhere, your Committee were of opinion that they had before them sufficient information "as to the mode in which new inventions, and claims for reward in respect of adopted inventions, are examined and dealt with by the different departments of government." They, therefore, did not think it necessary or desirable to examine witnesses on the subject.

The Committee considered it as fully established that the present methodical mode of dealing with inventions submitted to the different departments of government was uncertain and unsatisfactory in itself, frequently unjust to inventors, and generally detrimental to the public administration. They considered it as established, to their satisfaction, that real injustice was frequently done to inventors, not only by neglect and procrastination in dealing with their claims, but also by the undue preference of other conflicting claims urged by officers of the different departments. Without entering into the merits of any cases in point, it appeared beyond doubt that the practical judges of the inventions have been very often rival inventors within the departments. The Committee considered it obvious that this placed both the inventor and departmental officers in a false position, and that the consequent decisions could be satisfactory to nobody. As matter of evidence, they considered that these departmental decisions had failed to give satisfaction either to inventors or to the public.

It remained for the Committee to consider and report on the best means of removing "any real causes of dissatisfaction, as well as of silencing unfounded complaints."

The Committee are of opinion that the primary means of effecting this object is to bring the adjudication of these claims within a jurisdiction independent of the adminstration of departments of the public service. As long as the Patent-law remains as at present, the Committee are of opinion that the only satisfactory method of determining what compensation should be given to inventors, in cases where the government makes use of their inventions, is to have recourse to arbitration. Any inventor whose patented invention is used, or believed to be used, by any government official, or agent under government authority, should be at liberty to apply to the proper government department, stating what is the invention used, and how and where, and requesting that the application be referred to the decision of two arbitrators, who shall be appointed, one by the applicant and one by the government department, with power to appoint an umpire, and that the proceedings be assimilated to ordinary compensation cases.

The Committee, hoping that the recommendations of the House of Commons Committee will, at an early period, be made the subject of legislation, recommend that steps be taken, by petition to Her Majesty or otherwise, to make the grant of Royal Letters Patent for inventions of effect as regards the servants and officers of the Crown in the same way, and to the same extent, as Letters Patent are of effect as regards all others Her Majesty's subjects.

Your Committee feel that, if in every case officials appointed to investigate new inventions were required to affix their signatures to their reports, very beneficial results would follow, as the personal responsibility thus attaching to them would ensure their full attention, and deter them from rejecting hastily, or on insufficient grounds, any proposition or invention brought before them.

The Committee consider that their report would be incomplete if they did not call attention to an Act for preserving secrecy in the case of inventions connected with warfare.

This Act is the 22nd Vic., cap. 13. Its principal provisions are:—

Section 1. Improvements in instruments or munitions of war may be assigned by inventors to Secretary of State for War.

Section 2. Foregoing enactment may extend to assignments already made.

Section 3. Secretary of State for War may certify to Commissioners of Patents that the invention should be kept secret.

Section 4. Where he so certifies, petition for letters patent to be left with Clerk of Patents, under seal of Secretary of State.

Section 5. Such packet to be kept sealed.

Section 6. To be delivered on demand to Secretary of State or Lord Chancellor.

Section 7. At expiration of patent, to be delivered to Secretary of State.

Section 8. Where Secretary of State certifies after filing of petition, documents already filed to be put into sealed packet.

Section 9. Copy *not* to be sent to Scotland or Ireland, nor published, but otherwise provisions of Patent Acts to apply.

Section 10. No *scire facias* to be brought.

Section 11. Secretary of State may waive benefit of Act.

Section 12. Communication of invention to Secretary of State not to prejudice letters patent.

F. J. Bramwell.
Charles W. Merrifield.
Edward Easton.
W. Hope.
P. Le Neve Foster.

THE NEW FRENCH TARIFF.

The Law containing the details of the new duties to be laid—to quote the term of the title—on raw materials, manufactured fabrics, and other things, has at length been promulgated, and the list is far longer than was generally anticipated. These new rates do not come into force against British products until the expiration of the existing treaty, but they most seriously affect the prospect of our future commerce with our neighbours.

The list of duties is too long to transcribe fully here, but a little classification and condensation will allow all the main features to be exhibited.

The duty on raw hides is fixed at 5frs. the 100 kilos. (2 cwts.), on dried, and others at 7frs. 50c. to 10frs., and on kid skins to 20frs. Furs and fur-skins are to pay 5 per cent. *ad valorem.* Horsehair, 35frs. per 100 kilos.; human hair, undressed, 10frs. per kilo. Fur for hat-making, &c., 65frs. the 100 kilos. Bristles, 25frs. per 100 kilos. in the rough, and 50frs. if assorted. Feathers from 1fr. 50c. to 10frs. the kilogramme; quills, in the rough, 20frs. per 100 kilos.; and bed-feathers, in the rough, 200frs. per 100 kilos. Wax of all kinds, 100frs. per 100 kilos.; residue of wax, 20frs.; and vegetable wax, 10frs. Paraffin, raw, 20frs.; and refined, 50frs. per 100 kilos. Salt meat, 4frs. per 100 kilos. Cheese, 15frs. and 18frs.; and butter, 20frs. the 100 kilos. Honey, 10frs.; fish of all kinds, from abroad, 15frs. per 100 kilos.; fish oils 20frs., spermaceti 35frs., and whalebone 120frs., per 100 kilos. Coral, 1fr. per kilo.; and all other products of foreign fisheries, except pearls, 3frs. per 100 kilos. Sponges, 150 frs. per 100 kilos.

Ivory, 1fr. 20c.; and tortoise and turtle shell, &c., 2frs. 70c. per kilo. Mother-o'-pearl, rough, 10frs., or separate from the shells, 50frs., and other shells used in industry, 10frs. the 100 kilos. Bones and hoofs, 30c.; and horns, 5frs. per 100 kilos.

Grain, all except wheat, 25c.; flour of, ditto; dried vegetables, chestnuts, millet, &c., 50c. per 100 kilos. Sago, salap, and foreign fecules, 15frs.; fresh table fruit, 10frs.; figs, 10frs.; raisins, 20frs.; pistachios, 160frs.[*]; other fruits, fresh or preserved, 30frs.; anise, green, for distillation, 20frs.; and other fruits for same uses, 5frs. per 100 kilos.

Oleaginous seeds, from 2frs. 50c. to 6frs.; and oleaginous fruits, from 3frs. to 5frs. per 100 kilos.

Seeds for sowing, and molasses for distillation, 25c. per 100 kilos.

Schist oil and petroleum, from beyond Europe, raw, 32frs.; refined, &c., 52frs.; from other countries, 37frs., and refined, 57frs. per 100 kilos.

Gums, exotic, 10frs.; from Europe, 6frs; resins, from Europe and America, pitch, oil resin, &c., 1fr. 50c.; purified resins and turpentine, 10frs.; distilled resins, essence of turpentine, &c., 12frs.; and boghead of Scotland, 8frs. per 100 kilos. Scammony, 1fr. 50c. per 100 kilos. Gum lac, 20frs.; copal and Damar, 30frs.; other resinous exotics, 25frs.; gum benzoin and copalum, 20frs.; storax and styrax, 10frs.; other gums, 50frs.; fine oils, pure, 20frs.; camphor, 50frs., refined, 70frs.; india-rubber and gutta-percha, 40frs. rough, and washed 50frs. per 100 kilos.

Aloes, 10frs., and opium, 5frs. the kilogramme; Spanish liquorice, 6frs.; vegetable juices, other than oils, not elsewhere named, 20frs.; jalap and rhubarb, 25frs.; ipecacuanha, 100frs.; sarsaparilla, 8frs.; ginger 3frs.; quinquina bark, 10frs.; senna leaves, 10frs.; exotic medical fruits, broken but not prepared, 5frs.; tamarinds and pulp of ditto, 5frs.; badiane, 60frs.; folicules of senna, 25frs.; lichens, 1fr.; other medical roots, herbs, flowers, seed, and fruits, 25frs.; liquorice root, of Europe, 80c.; other medicinal European roots 3frs. per 100 kilos.

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[*] Probably a misprint for 16 francs.

Chloroform and ether, 3frs.; musk, 8frs.; manna and methyline, 2frs. per kilogramme.

Woods:—Oak, elm, and walnut, rough or squared, 6frs. 50c.; ditto, sawn, 10frs.; other woods, rough or only squared, 3frs.; ditto, sawn, of nine centimeters or more thickness, 5frs. the stere, and when of less thickness, from 2frs. 50c. to 8frs. per 100 metres. When oak, elm, and walnut are planed, rabbeted, or moulded, as well as merely sawn, there is an extra duty of 8frs. per stere; and, in the case of other wood, of half that sum. Finished woodwork is to pay 15 per cent. *ad valorem*, with an additional sum of 10frs. per stere in the cases of oak, elm, and walnut, and of 6frs. per stere in the case of other woods. Masts are to be charged from 18frs. to 52frs. each, according to diameter; spars from 2frs. to 14frs. each. Coopers' wood, 8frs. the stere; cork, 5frs. per 100 kilos.; fine furniture woods, 30frs. per cubic metre, and veneer woods 50c. per square metre; scented woods, 15frs.; dye woods, 1fr. to 4frs.; rattan, cane, jonc, &c., 7frs., if prepared for chair-makers, 70frs.; trimmed rattans, 28frs.; European rushes, &c., 50c. per 100 kilos.

Curcuma, 5frs.; orchil, &c., 10frs.; quercitron, 2frs. per 100 kilos.; saffron, 10frs. per 100 kilos.; safflower, 60frs.; nut-galls, &c., 10frs.; sumac, fustic, &c., 4frs.; divi-divi and other dye-stuffs, 3frs. per 100 kilos.

Hops, 60frs. per 100 kilos.; beer, 7frs. per hectolitre.

Linseed cake, 50c.; other cake, 25c. per 100 kilos.

Slate, &c., in the rough, 10c.; tiling, drawing, &c., slates, 1fr. 60c.; slate tables or slabs, 2frs.; bricks and tiles, 10c.; round, square, and gutter tiles, 20c.; other materials, at present exempt and not specially named, 5c. per 100 kilos. Graphite or plumbago, 75c. per 100 kilos. Jet and amber, 50c. per kilo.

Copper, pure or alloyed, in the rough, and old metal, 7frs. 50c.; lead, ditto, ditto, 2frs., or alloyed with antimony, 3frs. 75c.; tin, ditto, ditto, 15frs., or with antimony, 12frs. 50c.; bismuth, 30frs.; zinc, rough and old, 2frs. 50c.; cadmium, rough, 15frs.; nickel, 5frs., pure or alloyed, 50frs.; sulphuretted antimony, 50c., metallic ditto, 7frs. 50c.; cobalt in the mass, smalt, 10frs., in powder, 5frs.; metallic arsenic, 8frs; native mercury, 25frs.; vermillion, 12frs. 50c.; potash, 1fr. 50c.; bichromate of potash, 25frs.; iodine, 60frs. per 100 kilos.

Acids:—Crystallised citric, 12frs. per 100 kilos.; gallic, 1fr. 50c.; tannic, or tannin, in spirit or ether, 7frs. per kilo; nitric, 1fr.; arsenious, 3frs. 60c.; benzoic, 80frs; boracic, 6frs. per 100 kilos.

Litharge, in the mass, 2frs., ditto in powder, &c., 4frs.; oxide of zinc, 3frs. 50c.; oxide of tin, 15frs.; oxide of uranium, 80frs.; oxide of copper, 12frs. 50c.; compound of cobalt, 7frs.; nitrate of potash, 1fr. 50c.; nitrate of soda, 1fr; chlorure of potassium, 50c.; sulphate of potash, 1fr. 20c.; sulphate of barytes, 20frs.; sulphate of magnesia, 50c.; borax and tinkeel, 2frs. 50c; borate of wine, 2frs.; carbonate of magnesia, 2frs.; carbonate of barytes, 20c.; carbonate of potash, 1fr. 50c.; carbonate of lead, 3frs. 75c.; white lead, ground, 5frs. 75c.; sugar of milk, 15frs.; sulphites of arsenic, 5frs. 75c.; iodide of potassium, 50frs. per 100 kilos.

Chemical products and colours derived from coal, 3frs. per kilo.; cochineal, 10frs.; lac, 35frs.; animal kermes, 70frs.; indigo, blue balls, indigo pastel, &c., 100frs.; coarse pastel, paste, 2frs. 50c.; catechu, 5frs.; rocoa, prepared, 15frs.

Extracts of dye-woods.—Black and violet, 20frs.; red and yellow, 30frs.; tanning extracts, from nutgalls, &c., 30frs.; from chestnut, 3frs. 50c.; Prussian blue, 25frs.; crystallised prussiate of potash, yellow, 20frs., red, 30frs.; ultramarine, 15frs. per 100 kilos. Carmine, fine, 4frs. per kilogramme; common carmine, 50c.; Indian ink, 100frs.; writing and printing inks, 20frs. per 100 kilos. Varnishes, 10 per cent. *ad valorem*; blacking, 4 per cent.; bone black in all forms, 50c.; copper-plate printers' black, 7frs.; Spanish and smoke black, 1fr.; mineral black, 50c. per 100 kilos.

Slate pencils, 20frs.; lead or other pencils, in white wood, 45frs.; ditto in cedar, 150frs. per 100 kilos. Colours not otherwise named, 10 per cent. *ad valorem.*

Perfumery:—Scented waters with alcohol, 20frs.; others, 40frs.; pomades, 120frs.; other kinds, soap excepted, 60frs. per 100 kilos.

Mustard, 20frs.; other prepared spices, 80frs.; rice starch, 4frs.; wheat ditto, 2frs.; albumen, 12frs.; glue, 60frs.; isinglass, 150frs.; sealing-wax, 60frs.; extract of meat, 30frs.; gelatine, 6frs.; gingerbread, 20frs. per 100 kilos.

Sporting cartridges, with or without priming, miners' matches, fire-works, carriages, and small wares, 20 per cent. *ad valorem.* Buttons, common, 1fr.; fine, 2frs.; worked human hair, 15frs. the 100 kilos. Wearing apparel, artificial flowers, umbrellas and parasols, musical instruments and parts of same, and made-up furs, 20 per cent. *ad valorem.*

Coral, cut, but not mounted, 2frs. per kilo. Straw hats, bark, and other hats, and plaits, 2 per cent. *ad valorem.*

Orange juice to pay as sweet wine. Mineral waters, 15c. per litre. Broken glass, 40c. per 100 kilos.

Silk:—Cocoons, fresh or dried, 25c.; raw, 1fr. 25c.; thrown, 2frs. 25c.; spun silk in the mass, and waste, 15c.; ditto combed, 50c.; fleurets, 2frs. per kilogramme.

Cotton:—Raw, ginned, from the East Indies, the basin of the Mediterranean jummel excepted, 7frs. 50c.; ditto, American and jummel 10frs.; raw, unginned, including the duty on the seed, 4frs. per 100 kilos.

Flax and hemp, raw, green, dry, or broken, 50c.; tow, 2frs.; hemp, 250frs.; flax, 3frs.; hemp and flax, dressed, 4frs.; jute, 1fr.; combed, 1fr. 15c., per 100 kilos. Abaca, New Zealand flax, &c., the same as hemp.

Wool, in the fleece, &c:—In the grease, 3frs. 5c. and 7frs., according to quality; cold washed, 6frs., 10frs., and 14frs.; hot washed, 7frs., 12frs., and 17frs.; waste, 10frs.; woollen rags and list, 5frs.; cow and other coarse hair, 1fr. per 100 kilos. Goat-hair, cashmere, &c., the same as wool.

Wool to be combed or washed is admitted under temporary bond, but the amount of waste bales allowed is left to be determined at a future time.

Temporary admission, as at present, is also to be allowed to lead imported to be converted into carbonates.

The second article refers to the drawbacks to be allowed on re-exportation.

The third contains the supplementary duties to be levied in future on manufactured articles. The principal items being as follows:—

In the case of cotton yarns, fabrics, fishing-nets, and wadding, the supplementary duty is identical with the drawback, viz:—Yarn samples, to No. 40, unbleached, 12frs. 70c.; bleached, 15frs. 25c.; dyed, 14frs. 85c.; from No. 40 to No. 80, 13frs. 50c., 16frs. 20c., and 15frs. 80c.; above No. 80, 14frs. 5c., 16frs. 90c., and 16frs. 35c., per 100 kilos. Worsted yarns, not higher than No. 40, 14frs. 50., 16frs. 90c., and 16frs. 35c.; from No. 40 to No. 80, 14frs. 85c., 17frs. 85c., and 17frs. 30c.; above No. 80, 15frs. 40c., 18frs. 50c., and 17frs. 90c., per 100 kilos. Unbleached cotton cloths, from 13frs. 90c. to 15frs. 10c.; bleached, 16frs. 70c. to 17frs. 10c; printed, 17frs. 95c. to 22frs. 20c., per 100 kilos. Fabrics, with either the warp or weft of twisted yarn, or both, to be charged 54c. or 1fr. 8c. more than the preceding rates. Mixed yarns and fabrics, the cotton predominating, but not to the extent of 75 per cent., half the rates charged on pure cotton; or if the cotton exceed 75 per cent., three quarters of those rates. Wadding, 12frs. 50c. per 100 kilos., &c.

Linen yarns :—Simple, 3frs. 95c. ; dressed, or dyed, 4frs. 55c. ; entirely bleached, 5frs. 15c. ; twisted, 4frs. 10c., 4frs. 75c., and 5frs. 45c. ; jute yarns, 1fr. 50c. per 100 kilos.. Linen cloths, unbleached, 4frs. 15c.; dressed or dyed, 5frs. ; bleached or printed, 5frs. 70c. ; jute of all kinds, 1fr. 50c. ; fishing-nets, 4frs. ; twine, &c., 3frs. 40c. ; cord, &c., not tarred, 3frs. ; ditto, tarred, 2frs. 50c., per 100 kilos. Yarns and fabrics of New Zealand flax, &c., the same as flax and hemp.

Silk fabrics, dyed silk for sewing, &c., 2frs. per kilogramme. Silk to be admitted temporarily for manufacture and re-exportation.

Wool, washed, combings, yarns, tissues, mohair, and other yarns and tissues, 2 per cent. *ad valorem.* Fabrics composed of goat, kid, or camel's hair, Indian shawls, &c., remain at the old rates.

Soap of all kinds is augmented by 11frs. per 100 kilos.; tallow candles, by 22frs. ; stearic acid in the form of candles, or otherwise, 35frs. ; oleic acid, 15frs. ; manufactured wax, 100frs. ; objects in india-rubber, 50frs. per 100 kilos.

Copper, rolled, beaten, or worked, and bronze, 10frs.; pure copper, 7frs. 75c. ; copper alloyed with zinc, 7frs. ; lead, beaten, rolled, or worked, 2frs. 20c. ; ditto, alloyed with antimony, 4frs. 10c. ; tin, 16frs. 50c. ; alloyed with antimony, 13frs. 75c. ; zinc, 2frs. 75c. ; nickel, pure or alloyed, 55frs. per 100 kilos.

Leather, 9frs. ; waxed calf, 13frs. ; varnished, &c., 26frs. ; gloves, 130frs. ; other leather manufactures same rates as the material of which they are made.

Ships, boats, &c., sheathed and nailed with copper, 7frs. per ton measurement; sheathed with zinc, 5frs. ; not sheathed, 4frs. Iron vessels, 5frs. per ton.

Felt, 5 per cent. *ad valorem ;* work in horse-hair, 10 per cent. ; dressed whalebone, 5 per cent. ; prepared horns, 6 per cent. ; objects made from horn, 20 per cent., &c.

RICE-GROWING IN FORMOSA.

Amongst the remarks made by Mr. Vice-Consul Gregory upon the agriculture of the locality where he resides, we find an interesting description of the manner in which the Tamsuy rice, which bears a high character in the Chinese market, is cultivated. The chief agricultural crop in the island of Formosa is rice, grown in irrigated, or rather inundated, fields. Much labour and skill must have been bestowed upon the levelling of the fields and the provision of the supply of water, which is conducted by artificial channels from elevated springs, or from the upper courses of streams. The rice fields of the plain of Bangka, ten or twelve miles inland, are chiefly supplied by a stream which is conducted from a higher part of the Tamsuy River, and is carried across another stream at Kiang-beh, by a wooden aqueduct of 100 yards or more in length. Two harvests in each year are obtained from the irrigated fields. In November or December, after the removal of the autumn crop, the fields are ploughed up. The plough is drawn by one buffalo, and managed by one man, holding the plough-handle in his right-hand, and the whip and halter in his left. The fields remain vacant for about four months, save that about the end of January seed is grown in nursery patches sheltered from the north-east. In February or March, the fields are in course of preparation for planting. Besides the plough, two kinds of harrows are used, namely, (1) the "blade harrow" (locally called "Kiva-pay "), a wooden frame, holding beneath it two sets of metallic blades, which makes parallel cuts through the clods or mud as the implement is drawn along by a buffalo, the driver standing on the frame ; (2) the "hand harrow" (or "Chew-pay "), of iron, with a long row of spikes. This seems to complete the stirring of the ground. In the latter part of March, or the early and middle part of April, the fields, now in a state of soft mud, are planted out with the young rice plants. In taking up the strong plants from the nursery patches, a sort of flat spatula is passed underneath, so as to take off a very thin slice of earth with the plants upon it.

In the immediate neighbourhood of Tamsuy, about a fortnight before the harvest, the rice is laid down, four adjacent rows being folded together, and so laid that the ears of each cross-row shall rest upon the cross-row in front of it. It does not appear that this practice is followed in the more sheltered inland country. In July the crop is reaped. The grain is thrashed out immediately in the fields. There is a tub, within which is placed obliquely a set of wooden bars. The operator takes by the lower end a handful of rice stalks, and gives it a few smart blows upon the bars, detaching the grain, which is received in the tub. A curtain, supported by bamboo sticks, keeps the grain from flying overboard. The tub is dragged forward as the progress of the work requires. The ground is then speedily got ready for the planting out of the second crop, the young plants of which are are already growing upon nursery patches. In preparing the fields for the second crop, the implement chiefly used in the locality is the "lah-tak." This is a wooden roller, four or five feet long, and twelve or fifteen inches in diameter, very deeply grooved longitudinally, so that its rectum would be a seven-pointed star, and mounted in a wooden frame, in which the driver stands. The lah-tak is drawn by a buffalo, over or through the wet land, the rollers revolving and stirring the soft surface by the action of its grooves and ridges. The second crop is planted out in the latter part of July or earlier part of August, and is reaped in or about the first week of November. This completes one year. In some cases the second crop is planted before the reaping of the first crop, the young plants being placed among those of the first crop. The planting out of the first crop in the spring, and the harvesting of the second crop in late autumn, are liable to interference from the chill blasts and driving rain of the north-east monsoon. The frequent prevalence of wet weather in winter is a well-known peculiarity of this region. In summer there is sometimes an unfavourable continuance of dry weather. Inundations of the river do not seem to occur except, perhaps, under the influence of a severe typhoon, nor are the ravages by locusts or other insects common. In the plain of Banjka, and in the regions to the south, the seasons are somewhat earlier, and there seems to be some difference in the mode of procedure. The dry ground rice, grown without irrigation, locally called "e-neap" or "i-liap," may be seen occasionally inland, and it is said to be cultivated by the wild aborgines of the mountains. It appears to be very fine rice, but to yield only one crop a year, and not to succeed well if the weather be dry. There are flour-mills worked by the overshot water-wheel. The wind-mill, which might be very useful in China, seems to be unknown to the Chinese, as it was to the ancient civilised nations of the west.

As regards mechanical appliances for raising water for irrigation, Mr. Gregory mentions that he has seen a water-wheel with pieces of bamboo set obliquely on its circumference, to serve as buckets. The wheel dips in a stream which turns it; the buckets take water from the stream at the lower part of each revolution, and as they reach the top they come into a horizontal position, and discharge the water. A simple contrivance, called the "water-hammer" or "water-pestle," is used for the pounding, to clean away the integument of the rice. The pestle is fixed like a hammer-head in the end of a beam which moves on an axis. The other end of the beam holds a bowl or shallow bucket, into which falls a small stream of water. When the bucket is full, its weight and the impulse of the falling stream send it downward, raising the pestle; but in sinking it pours out its contents and passes out of the course of the stream. The pestle then falls, bringing the bucket under the stream again, and so the process repeats itself. Bullock carts of good size, drawn by a buffalo in the shafts and a bullock on each side, are used in the sea-coast country near

Teukcham, but not at the port of Tamsuy, nor anywhere in the basin of that river, nor at Keelung. The mode of conveyance in the neighbourhood is either by boat or by human porterage.

CHINA OPIUM.

The report of Mr. Consul Markham, the British representative at Shanghai, upon the commercial relations at that port, contains some remarks upon the relative production and consumption of Chinese and Indian opium, which have a pertinent bearing upon the possibility of hereafter maintaining the commerce in an article that furnishes such a large share of the revenues of India. The imports of opium for 1870, it appears, had increased considerably over that of 1869. This increase was, to a certain extent, due to the natural development of the trade, but chiefly to the partial destruction of the native crops on the Upper Yang-tse by the overflow of the river. The price of native opium ruled much higher, and the consequence was that the foreign drug entered more freely into competition with it. When Indian opium is nearly of the same cost as the native article, it is always preferred by the consumer. Any striking disparity in price leads to an augmentation or reduction of imports, as the case may be. Mr. Markham anticipates the rapidly-increasing growth of the native poppy will have a most disastrous effect upon the importation of opium from India; for although the consumption in China increases year by year, yet year by year does the cultivation of the poppy also increase, and as this native drug is far cheaper than the Indian, the natural consequence will be that the Indian drug will be driven out of the market unless it can be put into the consumer's hands at a reduced cost. The Chinese are always willing to pay more for the Indian opium, for it is at present superior to that grown by themselves, but every year the quality of the native drug will improve, and unless the price of the former can be brought nearer to that of the latter, the Chinese drug will take its place altogether. It is very probable that the dues to which the native drug is subjected are much below what the foreign drug is charged with, and it is positively known that the "lekin" tax collected by the mandarins is only half that collected on the foreign drug. A quantity is also smuggled into Shanghai, having no duties or dues of any sort or description.

There is no obstacle whatever to the cultivation of opium throughout the length and breadth of China; indeed, it is already grown in many provinces, but, from a commercial point of view, its cultivation may be said to be confined to the provinces of Yunan, Szechuen, Shensi, and Kiocichow. Owing, however, to the rebellions and disturbances which have distracted the Yunan and Shensi provinces for so many years (as might be expected), the great bulk of the opium is produced in Szechuen, 10 per cent. being the estimated produce of Yunan; 30 per cent. of Shensi; and 60 per cent. of Szechuen. In consequence of the irregular manner in which the Chinese levy their inland dues, it is utterly impossible to arrive at a correct estimate. The production may, however, probably be taken to vary from 50,000 to 80,000 piculs. Shensi opium is considered to be the best, having the taste of Patna opium, while Yunan is only second to it. The genuine drug of Shensi gives an out-turn of 85 or 90 per cent. in boiling; good Malwa gives 80 per cent., while that of Szechuen gives 70 to 75 per cent. Szechuen opium is sold at Chung-Kiang at 15 taels per 100 taels weight, or 240 taels per picul—the latter quotation being 300 taels per picul. The genuine Shensi drug is sold in the Shanghai market at an equivalent of 600 taels per picul; and there is no doubt that this high rate, combined with the increased quantity of land brought under cultivation, will increase the present yield at least 20 per cent. At least, one-half of the opium produced in the province of Yunan is consumed on the spot, while the other half is exported to the adjacent provinces of Kwang-tung, Kwang-se, and Kwa-chow. Of the Szechuen opium, about 25 per cent. is kept for local consumption, 40 per cent. goes to the northern provinces, and 35 per cent. is disposed of in the provinces watered by the Yangtsze. It is generally believed that the present quotations of the China drug will not be maintained, as the cultivation of the poppy is daily increasing. For centuries it has been the proud boast of the Szechuen province that, not only is it protected on all sides by its geographical configuration, but that it produces in itself most of the products required for human use, without importation from other provinces; whereas at the present day, owing to the conversion of the hill-side and valley paddy-grounds to poppy cultivation, this province imports rice largely at incredibly high prices.

OBITUARY.

Frederick Carpenter Skey, C.B., F.R.S., &c., died at his residence in Mount-street, Grosvenor-square, on the 15th ult., in the 73rd year of his age. The *Times* says:—Having received an excellent preliminary education, the last year or two of which were spent at the University of Edinburgh, he returned to London, and became the pupil of the celebrated John Abernethy, surgeon to St. Bartholomew's Hospital, to whom he was articled at the Royal College of Surgeons on the 5th of April, 1816, on the payment of the usual premium of 500 guineas. On the completion of his hospital studies, he offered himself for examination, and was admitted a member of the College on the 5th of April, 1822. He continued to remain with Mr. Abernethy, assisting him in his large practice, and receiving most substantial recognition of the value of his services from the eccentric but kind-hearted surgeon, who, about the year 1826, appointed him demonstrator of anatomy at St. Bartholomew's—not, however, without causing feelings of considerable jealousy. On the death of Mr. Abernethy, the Anatomical Lectures fell into the hands of a successor who claimed the emoluments of those given by Mr. Skey, in consequence of which he resigned, and associating with him Drs. Todd, Hope, Marshall, Pereira, and Mr. Kiernan (now the only survivor), established the Aldersgate-street School of Medicine, which soon became one of the largest in London. Here he lectured for ten years, his audience being largely increased by many of the Bartholomew's men, who preferred his lectures on surgery to those of Lawrence. With the public he was not less popular, and about this time was elected surgeon to the Charterhouse. Early in his career he was offered the double appointment of surgeon and professor at King's College on condition that he would resign them in three years. This he declined, and the negotiations fell to the ground. Mr. Skey's practice increasing rapidly, he removed to Grosvenor-street, where he obtained a large connexion. Having been elected an honorary Fellow of the Royal College of Surgeons, in 1843, he was nominated and returned by the Fellows to a seat in the council of that Institution in 1848, and in 1850 he was appointed Hunterian orator, when he delivered a most eloquent address, an abstract of which appeared in the *Times*. Mr. Skey, who "never ate the bread of idleness," at once accepted the appointment offered by his colleagues in 1852, of Professor of Human Anatomy and Surgery, and three times a week lectured to large and discriminating audiences. In 1855, he was elected a member of the Court of Examiners, and never was there a more upright member of that Board. In 1863 he obtained the highest honour his colleagues could offer him—the Presidency of the College. In 1843 he was invited to return to St. Bartholomew's, and accept the Chair of Anatomy, Mr. (afterwards Sir William) Lawrence retaining that of Surgery, and Mr. (now Sir James) Paget that of Physiology. It was not until after holding the appointment of assistant-surgeon for about a quarter of a century that he was elected full surgeon, when after nine years, he retired, having reached the age of sixty-five years. On the formation of a committee to inquire into the prevention of contagious diseases in the navy and army, which held its meetings at the Admiralty, and consisted of eight eminent members of both departments of the public service, Mr. Skey was appointed chairman, Mr. Spencer Smith, surgeon to St. Mary's Hospital, another member of the College of Surgeons, acting as secretary. The result of the deliberations of the committee, which sat for about eighteen months, was the passing of the Contagious Diseases Act, a Bill, though strongly opposed in some quarters, still doing good service throughout the land. For his great and valuable labours on this occasion Mr. Skey was made a C.B. Mr. Skey was a valuable contributor to the advancement of professional knowledge, and a paper on "Muscular Fibre," published in the *Transactions of the Royal Society*, obtained for him the Fellowship of that learned Institution. His last work, "Lectures on Hysteria," went through three editions. He was the author of several standard works, and a constant writer in the medical and other journals. His letters on athletics, especially in reference to excessive training for rowing, and on "Alcohol Diseases," published in the *Times*, are, perhaps, well known to many readers. Mr. Skey was elected a member of the Society of Arts in 1853.

CORRESPONDENCE.

HEYWOOD'S WASHING MACHINE.

Sir,—At a time when everything connected with household maintenance and management is dear, servants independent, and washerwomen have been on the strike, it may interest some of the members of the Society of Arts to learn that there has recently been sent to the Society's House a washing machine, suited to the requirements of private families. Having had an opportunity of seeing the machine thoroughly tested upon almost every description of fabric, I am able to bear witness to its efficiency in cleansing lace curtains, ladies' fancy articles —such as collars, cuffs, muslin handkerchiefs, also tablecloths, bed-linen, diapers, towels, and all the ordinary articles of attire, which are free from stains, in clear cold water only, and without injury to the fabrics themselves. That it is equally efficacious in removing stains from linen after it has been soaked in warm soapy water for a few hours; and other articles, which are of a more greasy nature, merely require to be looked over, and treated according to the usual methods employed in washing, short of tearing, wringing, and scrubbing the clothes to effect a thorough cleansing of them.

The machine itself is of the most simple character, and consists of a rocking boat, or wash-tub, in which the clothes to be washed are placed, and over which two heavily-weighted spongy india-rubber balls are rolled up and down. A boy or girl of fourteen years of age could easily do the washing of a family of eight or ten persons in three or four hours, with great economy of soap and firing, and thoroughly efficiently.

The machine is equally applicable in the washing of lace fabrics, counterpanes, sheets, blankets, and heavy woollen goods, such as carpets, gentlemen's trousers, &c.; and having also seen the machine tried as to its cleansing power in the washing of heavy canvas and sacking, I cannot refrain from expressing my belief that it will be found highly economic and useful wherever it may be adopted. One of the machines can be inspected by any person desirous of seeing it, by calling at the Society's House. The washing machine has a wringer appended to it; or a mangle, which can be used as a wringer, is in some cases substituted; but as wringing and mangling involve essentially different principles, I am of opinion that the two machines are required.

The machine is the invention of Mr. Edwin Heywood, of Levinshulme, Manchester.—I am, &c.,

S. T. Davenport.

GENERAL NOTES.

Memorial to Elias Howe.—It is proposed that a monument shall be erected in the Central-park, New York, in memory of the late Elias Howe, jun., the inventor of the sewing machine, and that the money should be raised by voluntary offerings of not more than one dollar each, from ladies who have known the benefits of the invention. A committee has been organised, consisting of the following:—William Parker, Henry W. Bellows, William C. Bryant, Frederic de Peyster, Howard Crosby, E. H. Chapin, Henry Ward Beecher, John Cotton Smith, Charles O'Connor, Cyrus W. Field, and J. S. Gibson, with the Rev. Dr. Samuel Osgood, chairman; Dr. R. Ogden Doremus, secretary; and Alexander Masterton, Esq., treasurer. The following gentlemen compose a committee that has been formed in England, in conjunction with that of New York:—Sir William Fairbairn, Bart., C.E., F.R.S., LL.D.; David Chadwick, Esq., M.P., F.S.S.; Donald Nicoll, Esq., Com. Lieut. of London; Bennett Woodcroft, Esq., F.R.S., Great Seal Patent-office; P. Le Neve Foster, Esq., M.A., sec. Society of Arts; Thomas Webster, Esq., Q.C., F.R.S.; Theodore Aston, Esq., Q.C.; George Haseltine, Esq., C.E., M.A., L.L.D.; William Booth, Esq., Mayor of Manchester; William Batty, Esq., C.C., Manchester; James Stuart, Esq., banker, Manchester; William Muir, Esq., C.E., Manchester; Ernest Reuss, Esq., C.C., Manchester; and William Clarke, Esq., Glasgow. At the first meeting of the committee, held at the Adelphi Hotel on the 15th of August, Bennett Woodcroft, Esq., was chosen chairman; Donald Nicoll, Esq., treasurer; and George Haseltine, Esq., honorary secretary. Subscriptions will be received at the London and County Bank and branches. Provincial bankers, John Stuart and Co., Manchester.

Artificial Butter.—In an extract from the *Revue Hebdomadaire de Chimie*, given in the *Chemical News*, it appears that Monsieur Mège-Mouriez, some years ago, was requested by the Victualling Department of the French Navy to try to find a wholesome substitute for butter, which would not become rancid by keeping. Experiments made with cows submitted to a very severe and scanty diet, led to the discovery that these animals continued to give milk, although in very much smaller quantity, and that this milk always contained butter; the author surmised that this butter was due to the absorption of the fat contained in the animal tissues, which was converted into butter under the influence of the milk-secreting glands. This led to experiments on the splitting up of animal fats, and, further, to the following process for making butter artificially. Best fresh beef-suet is first mechanically cut up, by means of circular saws fitted to a cylinder, and is next placed in a vessel containing water, carbonate of potassa, and fresh sheep's stomachs previously cut up into small fragments; the temperature of this mixture having been raised to 45°, the joint influence of the pepsine of the stomachs and heat causes the fat to be separated from the cellular tissue; the fatty matter floating on the top is decanted, and, after cooling, submitted to very powerful hydraulic pressure;

the stearine is used in candle-making, and the semi-fluid oleomargarine is used for making the artificial butter in the following manner:—Fifty kilos. of the fat are poured, along with 25 litres of milk and 20 litres of water, into a churn, while there is added 100 grms. of the soluble matter obtained by soaking for some hours in milk from cows' udders and milk glands; a small quantity of annatto is also added, and the operation of churning then proceeded with. The butter thus obtained is well washed with cold water, and, if required to be kept for a long time, melted by a gentle heat, to eliminate all the water. According to reports of sanitary committees, as well as of the authorities of the Victualling Department of the French Navy, this artificial butter is really an excellent substitute for genuine butter, and can be exposed for sale if the vessels are marked to distinguish the artificial from the genuine butter."

French Academy Prizes.—The French Academy has just awarded its annual prizes for the session 1871-72. Amongst these are a medal of the value of 500 francs for poetry; a prize for eloquence, of the value of 1,000 francs, with an *accessit* and an honourable mention to two other competitors. The Montyon prizes, for virtue and acts of devotion, include three first prizes of the value of 2,000 francs each, four medals of the value of 1,000 francs each, and eleven other medals of half that value. The Montyon prizes for works calculated to have the greatest moral effect, consist of a prize of 3,000 francs, awarded to M. Ollé-Laprune, Professor of Philosophy at the Lycée of Versailles, for his work entitled "The Philosophy of Malbranche;" three prizes of 2,500 francs each, awarded to M. Bruno for his work, "Francinet, General Principles of Morals, Industry, Commerce, and Agriculture," to M. Paul Albert, for his "History of Roman Literature," and to M. Rambosson, for his "Laws of Life, or the Art of Lengthening our Days;" a prize of 2,000 francs to Madame Guerrier de Haupt, for her romance entitled "Marthe;" and three prizes of 1,500 francs each to M. Faure, for his work on "Antoine de Laval, and the Writers of the Bourbonnais of his time," to M. Imbert de Sainte-Amand, for his memoir of the Abbé Deguerry, cure of the Madeleine, assassinated during the Commune, and to M. Delpit, for a collection of poems entitled "The Invasion." Six medals, of the value of 300 francs each, were also awarded for virtuous conduct, under the bequest of Madame Marie Lasne. Three prizes of 2,500 francs each were awarded to the "Popular Poetry" of M. Manuel; to M. Coppée's collection of poems, entitled "Les Humbles;" to M. Verne's "Five Weeks in a Balloon," and five other works for their moral tendency. Four prizes of 2,000 francs each were awarded on the same ground to M. Hémardinquer for his work, "La Cyropédie," an essay on the moral and political ideas of Xenophon; to Madlle. Clarisse Bader, author of "La Femme Greque," a study of antique life; to Madame Craven, for her romance, entitled "Fleurange;" and to M. Rozan for his work, "La Bonté." The Academy also awarded a prize of 1,500 francs to Professor A. Ricquier, of Limoges, for five volumes on elementary education. The grand prize Gobert, both of 1871 and 1872, were awarded to the "Letters, Instructions, and Memoirs of Colbert," by the late M. Pierre Clément; eight volumes of this work are published. In the same way the second Gobert prizes for both years were awarded to M. Ernest Maurin, for his "Comtes de Paris," a history of the commencement of the third race. The Bordin prizes, of 3,000 francs each, were awarded to Professor Fouillée, of Bordeaux, for his "Philosophy of Plato;" and to M. Jules Gauthier, for his "History of Marie Stuart." The Thiers triennial prize of 3,000 francs was awarded to Professor Rambaud, of Caen, for his "History of the Greek Empire in the Tenth Century." The Langois prizes for translated works were given to Professor Sadous, of Versailles, for his version of "Grote's History of Greece;" and to M. Braun, for three volumes of Schiller's plays, in French verse. There were several other prizes for literary productions. These prizes of the Academy are held in high estimation, and are, doubtless, of practical value to their recipients; they are the steps which lead to the *estrade* of the forty *fauteuils* of the Académie Française. It will be remembered that the city of Boston made an offering of the sum of £32,000 to France; the whole of this was expended in aiding sufferers by the war, except £80, which the Academy was requested to apply in favour of a person who had greatly distinguished himself by acts of devotion; the Academy, finding it impossible to select any one person especially, has awarded the amount to the Institute des Frères de la Doctrine Chrétienne, whose devotion and courage won the admiration of all the world. With their reverend chief, the Frère Philippe, who is eighty years of age, they went fearlessly on to every battle-field, where many fell heroically. "This prize," said the Duc de Noailles, "will be like the Cross of the Legion of Honour attached to the colours of of a regiment."

Exportation of Italian Wines to France.—Since the opening of the Mont Cenis Tunnel, the quantity of wine exported from Piedmont to France by this route has amounted to 117,350 litres, and this trade is daily increasing.

School Gymnastics.—The French government lately issued a circular respecting the introduction of a course of gymnastics in the primary schools, and a credit of 100,000 francs has been opened at the Ministry of Public Instruction, in order to assist those schools which have not the means of purchasing the necessary apparatus, when requests for such aid is made by the communes. In addition to this, a commission has been formed, by a number of professors of gymnastics, to solicit voluntary presents of apparatus of all kinds for poor village schools.

Washing Sheep, Wool, &c., with Soluble Glass.—MM. Baerle and Co., of Worms, have published the following on the employment of soluble glass as a detergent. The employment of soluble glass in the washing of wool is an important fact in this industry. The treatment is so simple and so economic, that it is only necessary to make an experiment to recognise its advantages. Take 40 parts of water, at the temperature of 50° to 57° centigrade, and 1 part of soluble glass; plunge the wool into the mixture, stirring it about for a few minutes by hand, then rinse it in cold or tepid water, and it will be found completely white and void of smell. The wool, after this operation, remains perfectly soft, and loses none of its qualities, even when left for several days in the solution of the silicate, and being washed in hot water. Sheep may also be washed with the same preparation, care being taken to cover the eyes of the animals with a bandage, to perform the washing with the solution instantaneously, and to remove the surplus with tepid water. In the case of combed wool, the wool should first be steeped in the solution above given, and afterwards in another bath composed of 80 parts of water, at 37° centigrade, and 1 part of soluble glass. In this way the effect is excellent and economic, without the employment of soap or soda, and the wool is rendered at least equally white, clean, and soft as by other methods. Soluble glass may also be employed advantageously for domestic washing. A bath must be prepared overnight, with 20 to 30 parts of water, at 50° to 57° centigrade, and of 1 part of neutral soluble glass; the linen is plunged into this bath and left there till the following morning, when, after the bath has been reheated with additional hot water, it is to be worked with a wooden stamper. The aspect of the solution tells when the linen is nearly cleaned, when the former is to be drawn off, and the linen drained. The operation is then completed by rinsing with a little soap; but it is well to pass the linen again through a weak solution, consisting of 1 part of soluble glass to 50 parts of water at 45° to 50° centigrade, and then to rinse it out in pure water.

Journal of the Society of Arts.

No. 1,034. Vol. XX.

FRIDAY, SEPTEMBER 13, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

ENDOWMENT FUND.

Members and others who propose to contribute by donation or subscription to the Endowment Fund for the Society of Arts, are requested to cross all cheques through Messrs. Coutts and Co., the Society's bankers, and to forward the same to the Secretary or Financial Officer at the House of the Society of Arts, John-street, Adelphi.

SUBSCRIPTIONS.

The Midsummer subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

THIRD COURSE OF CANTOR LECTURES.

SILICATES, SILICIDES, GLASS, AND GLASS PAINTING.

By Professor Barff.

Lecture VI.—Delivered Monday, May 13, 1872.

This evening I shall have to be somewhat desultory in the course which I shall pursue, but I cannot help it, as I must necessarily occupy some of our time in firing the specimens which I did not succeed in doing at one of our previous meetings, owing to the muffle not being sufficiently hot. It is now hot, and we will proceed to fire several pieces of glass. One piece, that which was painted by Mr. Yeomans the other evening, we will fire first. Part of it is painted with tracing brown and enamel colour, the composition of which I have explained to you; there is also some silver stain on parts of it, and those parts will be yellow when it is fired, whilst the enamel, which could now easily be removed, will become perfectly fixed to the glass and incorporated with it. In large glass-painting establishments large muffles are generally used; they are made of iron, and are fitted with iron doors, which are luted up with fire-clay, only a small hole being left in order that the workman may look in and see whether the kiln is at the proper temperature, because it is of considerable importance to regulate its temperature carefully. A muffle is fired for a considerable length of time, and then is allowed to cool down gradually, that the glass may be annealed. If this little muffle were used commercially, we should require to have a hot-chamber by the side, into which to put the glass, which would, in it, be gradually annealed. My object in showing this sort of muffle is to induce some of you to try the experiment of glass painting. I do not mean that I would have you take it up as a business, but you would, as a recreation, be able to paint and stain glass with very little trouble for the ornamentation of your own windows, and I am sure there are many ladies who are now spending their time and working hard in painting little bouquets of flowers, and small sketchy subjects, for sale, who might make a good living by doing work of this kind. With the assistance of such gentlemen as Messrs. Lavers and Barraud, who, I am quite sure, would be willing to lend their aid to any one who wished to earn a livelihood in this way, they might meet with considerable success. These specimens which I hold in my hand will be fired in succession; first of all, a piece of silver stain, then a piece of ruby-glass, and then the painted piece which was prepared the other evening. While this is going on, I will take up my subject where I left off at our last meeting—the styles of glass-painting. These lithographs on the wall are taken from a very valuable work by Père Martin. There are good examples of clerestory windows with canopy arrangement, and there are also specimens of medallion windows. Here is one with some of the medallion left blank, because the glass in the original has been destroyed. You will in these see the various forms which have been devised for filling up window spaces. Ornamental windows are also illustrated in this work. Time will not allow of my speaking of simple, ornamental, and diaper windows, I must confine myself to the leading features of the various styles, in order that we may deduce from them some sort of information for ourselves as to how stained windows ought to be now treated. As regards figures, if you notice, in these early specimens, all the lines marking the features—all the lines marking the hair and the folds of the drapery—are such as I spoke to you of last week; they are very sharp and expressive. The folds of the drapery are complicated, and are of the Grecian type. There is little or no shading upon the body, and the expression of the countenance, which is very striking indeed, is got by the varying thicknesses of the lines which indicate the features. There is no attempt at anything like artistic effect, the whole effect, such as it is, being produced entirely by the outline lines. I mentioned the other night, as an illustration of this, Mr. Doyle's etching, showing what can be effected by lines only. It appears to be the style adopted by almost all the early glass-painters, as best suited for carrying out their views, for had they attempted, in windows such as you see before you (medallion windows) anything like a pictorial effect, the result, from the size of the figures in the subjects, would have been a confused mass when viewed at a distance.

There was also another system which was very much in vogue at this period, which was used for clerestory windows. If you notice in these illustrations, all the figures are very large, but their treatment is the same as in the smaller subjects. You have no straight folds in the drapery, such as are got in the present day by lay-figures and flannel drapery, but the folds are quite in the antique style. The figures are simple in their treatment, with no shading, and the colours are judiciously selected and arranged to produce a pleasing effect. I will now also call your attention to the way these figures are painted, and the kind of backgrounds from which they stand out. In this period the figures are always placed upon clear backgrounds (diapered backgrounds were not used), though occasionally in some of these specimens, where there is a blue background, you will see it broken up by small rosettes of ruby leaded in; still there were no diapers such as prevailed in the next period. Then, again, the canopies consist of representations of buildings, chiefly roofs and towers, but there is no attempt at any perspective effect, nor did the painters feel themselves bound to represent the existing style of architecture. The whole of the treatment was simply flat, and that is the point I want to enforce more particularly, because I believe that this is the most successful treatment for stained glass windows in our own days. By that treatment I mean that the figures should be as nearly as possible on the same plane, and that distant effects should never be attempted, or if they are, it should be managed in such a way that shading to any extent is not required.

A very beautiful arrangement was used at this time in what is called the Jesse window. A tree was represented branching through the window, and in it were oval medallions, and in these were, generally speaking, represented scenes out of the life of our Lord. The artists did not always confine their figures to the medallions; sometimes you will find the figures standing outside on the boughs bearing the medallions, and giving a very pleasing effect to the window, causing lightness and brightness, and distributing the colour about, so as not to have too much of one tint collected in one spot. The collection of colour in large masses should always be avoided. I will not give my reasons for this statement now, but will leave it until I have given you a brief notice of the other styles, and then we will draw our conclusions as to how far we should adopt them or modify them for our present wants.

The next style is the second pointed, or, as some call it, the decorated, style. Here we notice a change of style taking place in the work of the glass-painters of this period. Of course the change was not rapid. You will find in the early period of this style that there are many features of the first style; and one of the most striking features of the early style, which is carried into the early period of this second style, is the form of the ornamentation. In the early style you never get natural leaves; but in the earlier period of this second style you find that you have the same peculiar forms that you see in the architectural carving and ornament of the period. These were carried into the second style, but gradually; the forms, instead of being massive, became attenuated; and a little later on you will find them replaced by the forms of natural foliage, oak leaves, and ivy leaves, and so forth. In this style the ornament is generally executed on clear, plain glass as the background; but in the previous style the ornament used for quarry-glazing was cross-hatched in the background—that is by cross-hatching lines drawn at right angles to and close to each other. In this style you do not find this so much adopted; but the glass was left clear, with a simple flower upon it, and with the enrichment in the flower and in its stem, of what appears in this style for the first time—namely, silver stain. In the early style no silver stain was used, but in this style stain was largely employed, so that you will often see a piece of white, or greenish coloured glass with an outlined flower which is stained yellow, together with leaves which are simply put in in lines without any background. In the treatment of the figures in this style we also find a difference. Gradually the great boldness of outline was lost. In the early style, if you notice, you cannot at a distance distinguish that any lead whatever is used, because the lead is there made to take the outline of the figure, and to mark the folds of the drapery where darkness and shading are required. But in this style you find that the artists gradually begin to depart from this principle, and to forget that the lead ought to be treated as part of the design of the window, and you find introduced into the drapery thin leads, so that two pieces of the same coloured glass are leaded together quite irrespective of the design. Again, as to the treatment of the draperies. The shadows are more intensified, the drawing is not so grotesque as in the early period, and the details are much more elaborated. For instance, enriched borders begin to appear on the draperies; the nimbuses round the heads begin to be enriched by ornamentation, the backgrounds are painted, and picked out in representation of diapered patterns, and the draperies are much more enriched. Frequently you find that, by some process which they had in those days in lieu of the very objectionable process used in ours, namely, etching out with hydro-fluoric acid, they used to scrape off in some way or other the flashing in the case of ruby glass, and put a stain upon it. The borders of the windows were a striking feature in the early period. They were generally very wide, and elaborately ornamented. Here is a specimen of an early border running alongside of this diaper. In the early style they were particularly rich, and it was a rare thing to find a narrow border, unless it were simply a beaded line running round a light containing a figure. But in this later style the borders are narrow and differently treated; they are broken up into square patches, a flower, and then a piece of ruby glass, and then, again, a monogram above that. The canopies also over the figures are different from those in the early style. They are much more elaborate, and imitate more the architectural details of the period. Pinnacles, crockets, and finials were used, and the whole was considerably more enriched than in the previous style. Again, owing to the use of stain, many effects could be produced which could not be produced in the earlier style, so that we see in the canopies of this period a large quantity of yellow stain, varying in tone from deep orange to straw colour; in the crockets, for instance, and representations of roofing, the lines being dark and the imitation of the tiles being done in stain, and so forth. Therefore, any one going into a church and noticing canopies of this kind, with a great deal of stain in them and very elaborate ornamental details, may make a rough sort of guess that the work belongs to this period or the next later, only if it belongs to the latter period there will be features sufficiently striking to indicate that it does belong to it.

I will now pass round the piece of glass which has been fired, and you will find the colour is firmly fixed on it.

I must now pass on rapidly to briefly notice the third style; and the differences between the second and third are very clear. First of all, you have great poverty in the glass, which is very thin and smooth, not at all like the glass I showed you last Monday by means of the electric light. A large amount of stain is used upon the draperies, and there are very elaborate diapers; the backgrounds are frequently rendered almost opaque by them and by the shading. The canopies are extremely crowded, and there is plenty of white and yellow glass in them. There are also grotesque perspective effects. Some of them are excessively beautiful in their architectural details, and altogether they agree very well with the more meretricious character of the architectural ornamentation of the period. In the figures, the draperies are very elaborate. You will find sometimes an attempt at imitating embroidery and tapestry—even the stitches are imitated by lines. At this time subjects extended through a whole window, and were therefore cut up by mullions; a most objectionable practice, I think. There are some very splendid windows at King's College, Cambridge, and many times I have stood and admired some of their beauties, long before I took any interest in art or science. I used to look at these windows, and puzzle my head to find out, even in those which had been restored, what the subject was. For instance, there is a head and shoulders of a figure in one light, and the feet and legs in another. That was a mode of treatment which much prevailed at that time, and it appears to me to be most objectionable. Another very striking feature is the poverty of colour in the glass—the want of lustre and brilliancy, and that jewelly effect which is to be seen in the older glass. There is plenty of shading—too much of it—attempts to get artistic effects, and frequently you see that the artist has tried to get a perspective effect by depth of shadow, which I, in common with others, maintain to be entirely wrong in principle in the treatment of stained glass.

These very brief considerations, sketchy in the extreme, of the various styles of glass-painting which prevailed between 300 or 400 years, lead us to a consideration of what style of glass-painting we ought to adopt now. I know there are many artists and architects who say that now we ought to stick slavishly to the old styles, and imitate them, if the churches where they are to be used are built in those styles. I see in the room a gentleman who is, to a certain extent, a strong advocate for that system, a gentleman who designed that very beautiful window of which the cartoons are on the wall; it was designed by Mr. Bentley, and executed by Lavers and Barraud. It is one of the finest windows of modern time which I have seen, and will bear comparison with any ancient work. What style are we to use? As to the arrangement of the ornament and canopies, that must be left for the architect. As for the arrangement of the groups of figures, and the general style of treatment, it appears to me that there is one general style for all. We can learn much from our forefathers, they had great experience, and in some respects knew more than we do. We have a transparent substance—which is our medium of decoration. Now, are we to obliterate its transparency; is the window to be put there to be stopped up by something which prevents the light passing through it? Certainly not. I think you will all agree with me that to do this is wrong in principle. Here is a design for a window—a really beautiful design no doubt—which you may see executed in St. Paul's. It was painted in Munich. But if you go and look at it you will not see a piece of clear glass in it. The whole thing has been obscured with enamel, so as to make it a transparency hardly superior to a well-painted blind. It may be beautiful, but is it right in principle that that through which light should come should be the means of blocking the light out? But you may say you do that with coloured glass in all instances. I say, no, we don't; what we do is this—we sift the light as it comes through; we choose to break up the ray of light into its constituents, and send some of its rays through the blue, some through the red, and some through the yellow. But the true artist in glass, the man who understands the end for which he is working, will say we are only doing with our glass what you would do with the prism, and we expect in our arrangement to do what you would do with another prism—cause the refracted rays to meet again and produce white light. We only take from the intensity of the light somewhat—we do not destroy it. We give you the effect of white light, and any treatment of stained glass, the composition of which producing an effect upon the eye of purple, green, red, or blue is, I take it, wrong in principle and unsatisfactory in practice. We must have such an arrangement as will produce upon the eye the effect of subdued white light, and this effect is very easily produced; there is no difficulty in it, if you remember what I told you the other night. Why did I tell you that by means of a prism you could analyse your colours? Why did I throw those coloured glasses upon the screen? I showed you, if you remember, that there were certain coloured glasses through which, if you passed a ray of light, they would not cut off from the prismatic spectrum all the colours except those which they were supposed to represent. For instance, the cobalt blue glass allowed the red rays to pass through in quantities; and some of the green and some of the rubies allowed blue to pass through them. Now, when you put those glasses together, and the sun, or even a subdued light, is coming through them, at a little distance those two glasses will produce the effect of purple upon the retina. If you have such an arrangement of glass as will do this, you are doing by accident what you do not intend to do—you are producing a purple effect. If you want purple, why not put purple glass in? If you want to produce a mixed colour, produce it by using different coloured glass. Do not let it be an accidental effect which comes by mere chance. The windows I alluded to—the maker of which is now dead, and, therefore, I can speak of them with more freedom—in the Temple Church, were made after the revival of Gothic art, and were very meritorious, because they were steps in the right direction; but if you go into that church and look at the windows over the Communion Table, you will see there purple windows. But the artist did not mean them to be purple. Go and look at the windows in St. Chapelle, Paris, which were executed by a mediæval artist with a different kind of blue glass, such as I showed you on the screen, which shuts off nearly all the other rays but blue, and you do not see purple windows. That glass is coloured with protoxide of copper, as well as oxide of cobalt. If glass-painters would take the trouble just to apply that little arrangement which I explained last Monday, they would be able to analyse their colours, and see whether they were pure prismatic colours or not, and if they are they will not produce upon the retina that combined effect which, to my mind, is very unpleasant.

Glass-painting is an art. I do not put it at all on the same level with the painting which we use for decorating walls; it is not the same as wall-painting, and any man who attempts to produce the effect of wall-painting on glass makes a very great mistake. For instance, here are specimens of landscape-painting on ground glass. They are well done, but they are simple transparencies, and it is impossible to get the effect of this kind of painting upon glass unless you go in for the same amount of intense shadows you have there, and if you do that you destroy the transparency of your glass. Then we come to the question as to what churches are suited for stained glass. Some architects and artists hold the opinion that stained glass should be confined entirely to what is called pointed architecture. Now, I know there are churches without end on the Continent in which windows are painted in the style which has received the name of cinque-cento, and on the wall there is a design of a circular-headed window, designed by Messrs. Lavers in that character. It is a system of glass-painting adapted to that particular kind of window, and to churches which do not belong to the pointed style of architecture. Question has been raised as to whether stained glass should be introduced into St. Paul's, that is, stained glass representing subjects. I see no reason why it should not. It is asserted that the walls are to be decorated with frescoes, and that subject windows would destroy the effect of these. Certainly such windows as those which I have just alluded to are most objectionable; but there are some there, executed I believe by Messrs. Clayton and Bell, which would produce no injurious effect on any fresco. If the colours be so arranged, and the subjects so designed, that the effect of white light, as nearly as may be, be produced, the introduction of stained glass would greatly add to the beauty and solemnity of the proposed decorations, and would not interfere with that dim religious light which people so much admire in ancient cathedrals—and admire with so much justice—a light which tones down the whole of the building, and throws into prominent light and deep shadows those beautiful details of architectural moulding which the architect himself has taken so much trouble to design, in order that he may be able to add to the enrichment of the building, but which is destroyed by the cross glaring lights coming in from all quarters, as we see in so many of our more modern ecclesiastical buildings.

The piece of glass which was painted by Mr. Yeomans has now been fired, and you will see the yellow stain upon it. It is not very strong, but it is sufficient to show you that it is burnt into the glass, and forms part of its substance.

I think I must now leave the subject of glass-painting, for if I went into it as fully as my inclination would lead me, I should detain you too long. The subject requires a course of lectures to itself; I have only had time to treat it very briefly. I must now proceed to fill up some gaps that were unfortunately left in some of my previous lectures. It has been asked why I did not explain the process of polishing plate-glass, and why I did not explain many other matters. The simple answer is, that I had not time to do it, and was obliged to stop short. I mentioned to you that there was an elbow movement on an iron plate, and that a boy stood by the side and threw sand upon the rough plate of glass, which was firmly bedded in plaster of Paris. When that first process of grinding is finished, the second is the smoothing process, which is performed by means of emery; and through the kindness, which has been exceedingly great, of the chairman, and others connected with the Thames Plate Glass Company, I have several interesting things to show you connected with polishing. Here are different specimens of emery, and if you feel them you will find how exceedingly fine some of them are. This emery is used for the smoothing process with water, and plate is ground upon plate, so that one plate is worked upon another. After the smoothing is over, the polishing, which is the most interesting process, next commences, and I am able to show you a drawing of the apparatus for polishing, which has been drawn upon the board on a large scale by Mr. Lewis. Here is a travelling beam, which is moved by an eccentric arrangement, so that it gets a movement backwards and forwards. Connected to it below are a number of blocks, one of which I have here, which are covered with felt so as to make them soft. There is a hole in the top of the beam through which this iron rod passes up, and it is pressed upon by a weighted lever. These cushions are passed backwards and forwards, over a large table, upon which the pieces of glass to be polished are placed, the table being covered with pieces of all sizes, bedded so that their surfaces are in the same plane, and this table has a transverse movement. If the block meets with any very severe hindrance to its progress, the weighted lever is pushed up, and allows it to move over it, so that you have a most sensitive power pressing on the surface of the glass. The substance used for polishing the glass is called by some crocus, whilst some call it rouge, but the scientific name of it is peroxide of iron or ferric oxide, it is used with water. After the glass has been polished in this way, it is carefully examined; and any defects that may exist in its surface are removed by hand polishing, and the glass is then taken into stock.

I shall now speak of a very interesting process which I have also been asked to explain, viz., the method of silvering glass. There are two methods in which glass is now silvered, though until a few years ago there was only one, the mercurial process, which depends upon this fact that mercury dissolves certain metals, forming with them what is called an amalgam. Here is tinfoil, and if I pour upon it a little mercury it will run about it at first; but as I rub it, it wets the tinfoil, and very soon goes through the tinfoil and dissolves it. I have here some more mercury which has had some tinfoil amalgamated with it already, and if I rub this upon the tinfoil it will not go through it, nor eat it away so rapidly as the other did, but it will regularly wet it. The way that looking glass is silvered by the old process is this. There is a large table of stone, made perfectly smooth, any little crevices being filled up by means of whitening and size, or some material of that kind, so that the stone may be perfectly flat, and its surface perfect. Upon that a piece of tinfoil, larger than the plate to be silvered, is laid down and rubbed very carefully. After it is quite flat, mercury is poured over it—not pure mercury, but such as I showed you in my second experiment, with a certain amount of tin amalgamated with it, so that it does not act so rapidly on the foil. After this has been rubbed carefully until the whole sheet is wetted with it, strips are put round it on three sides, so as to prevent the quicksilver from running off. A quantity of quicksilver is then run upon the tinfoil, until the whole is covered. Then the plate-glass is very carefully put at the free edge of the table, carefully brought to a level, and pushed upon the surface of the mercury, a piece of glass being put in front, to take away any dross from the surface, so that when the glass is completely on the quicksilver it appears to float, and the glass looks exactly like a mirror. The excess of mercury is got rid of by weighting the glass, and I believe in about twelve hours time adhesion takes place, and the process is completed.

There is another process, however, which proceeds on much more scientific principles, which is this:—Certain substances, which are called reducing agents, are able to precipitate, from solutions of their salts, certain metals. Here I have a solution of nitrate of silver, and here I have some formic acid. If I warm this, you will see it turns quite black, owing to the precipitation of metallic silver. The formic acid has reduced the oxide of silver, dissolved up in the nitric acid, and we get a precipitation of metallic silver. But the silver so precipitated is not precipitated in the form of a mirror; it is precipitated simply as a granular powder. You see it is gradually blackening, and the reduction when completed will send down the silver in the metallic state. Here again is another experiment, which I hope will succeed, but it does not always do so. In this glass globe I have some acid tartrate of lime. I will put into it two crystals of nitrate of silver and a drop of ammonia. Now we will warm it, and see what success we meet with. You see that the globe is silvered. This shows you the principle by which silver can be precipitated on a glass globe. Upon this principle silver processes have been patented and used. I was the other day at the works of Mr. Bailey, in the Wenlock-road, where the process is going on, on a very large scale, and here are some specimens of glass treated by his process. The composition which is used for precipitating the silver is a secret, and therefore I cannot tell you what it is, nor do I desire to pry into any trade secret. I have no doubt, with a little trouble one might find out several methods as effectual, but I hope the gentleman who has adopted this may meet with every success, for it is a very good one, judging from results. The objection to this mode of depositing silver is, that by some processes the silver gets the appearance of being mouldy, spots, apparently of mould, appearing after the lapse of two or three years; and Mr. Simons, who was good enough to let me look over the silvering process, where I saw the mercurial process going on—for I went to see if any change had taken place in the method since I was conversant with it practically many years ago—showed me some plates which were all over spots. Of course, that is most objectionable; but the gentleman who showed me over Mr. Bailey's establishment, told me that nothing of the sort ever happens with their process; and when one sees that the deposited silver is really hard and firm, and that it will bear rubbing, it leads one to suppose that what they say is correct, and that with such a thick film, and with the care that is used in the deposition, such catastrophies will not happen to their looking-glasses. The way the process is performed is this. A plate of some size, no matter what, is laid down perfectly evenly upon a table, or rather over a trough. The glass, of course, has been perfectly cleaned beforehand by the processes known to all conversant with this sort of work. Then the solution used for depositing the silver is poured over the glass; it remains upon it, and does not run off the edges, so that it is probably an eighth of an inch in depth, or rather less, all over the plate. I noticed that the room was hot, and was informed that the temperature was about 70° centigrade, at any rate it was artificially heated, because it is found that a certain temperature is necessary to cause a proper deposition of the metal. I watched several plates, and I noticed that a grey film seemed to come over the glass, and gradually spread, so that a plate of about 34 inches by 18 inches would be covered in four or five minutes. It is left, however, rather longer, in order that a thicker deposition may take place. When that has taken place, what remains of the liquid is poured off, and passed through some process by which the silver remaining in it can be recovered and used again. The advantage of this second process of deposition of metal is very great, because you are able to silver irregular surfaces with it. I do not know whether I need do more than allude to the mixtures that are used, but I think I must content myself with giving you references to the works on the subject. Anybody who may feel disposed to try the experiment will find, I believe, in the "Transactions" of this Society receipts for making mixtures for silvering glass, first of all by the grape sugar process, as it is called, and then, if you look in Miller's "Chemistry" or Watt's "Chemical Dictionary," you will find receipts for Liebig's process, in which milk sugar is used. I have told you what I have used here, and if you perform this experiment with due care, not heating the glass too rapidly, you will get most satisfactory results. All that you have to do is to take some chloride of calcium in solution, add to it some tartaric acid, make it ammoniacal, and get a precipitate thrown down, wash the precipitate carefully with distilled water, then take a crystal or two of nitrate of silver, drop in a few drops of ammonia, and gradually warm it up to a proper temperature, keeping the vessel moving so that the liquid may come in contact with it in all its parts, and you will have a perfect deposition of silver. I should mention that the silver deposited by Mr. Bailey's process, which I have described, is protected at the back by a coating of paint.

There is another most interesting matter connected with glass manufacture, it is the drawing of glass tubes. I show you this because it illustrates many of the operations in glass making. Here is a piece of lead glass tubing, containing a quantity of oxide of lead, so that it is easily melted. If I soften this in the flame, so as to be able to draw it out to a thread, that thread will be a tube, however fine it may be; if you examine it with a microscope you would find it to be a tube. The glass is now soft, and I have drawn it out excessively fine, but each of these hairs is a perfect tube, and to prove that to you, here are some of them which have been so drawn out arranged vertically, and on putting them into a liquid of a red colour, you will see it will run up them by capillary attraction. Glass tubing is made in this way:—A certain quantity of glass is gathered by the workman, who blows it, and draws it into the proper form. On the opposite end of the blown piece of glass, which is hollow inside, an iron pontil is fixed by another workman, and then they run away from one another, and thus the tube is drawn out. Whatever form is impressed upon the glass in its soft state, when you draw it out it will retain that form all through. Of course, it becomes elongated, but it is the same shape transversely. For instance, if you start square it will always continue square; if you start round it will continue round; if you start oval it will remain oval. Some of these ornamental objects that have patterns on them, are put into moulds, and then drawn out in that way. I have here a mould from Messrs. Powell's, in which bottles are blown. The glass-blower gathers a quantity of glass on the blow-pipe, puts it inside the mould, the mould is closed, he then blows into it, the mould is opened out, and there is the glass in the form of the mould. That is how all blown moulded objects are formed. There is, however, another method of moulding glass, which has been brought into use for decorative purposes, in which the glass is stamped in a mould. The glass is dropped into the mould and pressed in it, and this method has been used most successfully for ornamental windows, for domestic and other purposes.

Here is a specimen, and windows made of this material are very lustrous and beautiful. You can have a series of pieces of hexagonal or any other forms, with squares of coloured glass between. I do not know that I quite admire it for church work; but that is a matter of opinion, but here is a specimen of another kind of glass better adapted for that purpose, which is very beautiful indeed.

Now, I want to explain to you a most interesting method of burning in photographs on enamel, of which there are some samples on the table. First of all, a negative is taken in the ordinary way; from that a transparent positive is printed, also in the ordinary way. Then after that positive is printed, fixed, and developed, a plate of glass is covered over with a solution consisting of bichromate of potash, some dextrine (common gum), and glucose. The action of this substance is to reduce the bichromate of potash. This is put on a glass, in the same way as collodion is put on, and extends over the whole surface of the glass. The plate is then carefully dried over a spirit lamp, and, when it is dried, the positive is put upon it, and the two together are put in a printing-press and exposed to the light for some time. Mr. Solomons has been kind enough to send his assistant here to show you the processes; and he will expose it to the action of the magnesium light, though daylight, of course, is better. In the course of a few seconds the negative is printed on that film of bichromate of potash, &c., and the action of light upon it appears to be this, that it renders portions of it more soluble than those portions which are not exposed to the light. Both are soluble, but that exposed is more soluble; so soluble is it that the moisture of the atmosphere is sufficient to soften it. Enamel colour is now brushed over it, which adheres to the softened parts. When this is done, collodion is floated over the film, and is allowed to dry. The film is then detached from the surface of the glass, which is done by placing it in a bath of dilute hydrochloric acid. The film soon floats away from the glass, and then a piece of enamel, like this, is placed underneath it, and it is dexterously made to assume the position which you desire. It is taken out of the water with the film upon it; the edges of the film are bent round the side of the plate, and the whole is placed upon a piece of fire-clay, and heated gradually until the collodion is burnt away. After all, the disc of enamel is put into the muffle, and heated for a few minutes, and you get the photograph fired in and completely fixed in the state you see it here, only that there may be little blemishes perhaps in the background, which are touched up with the same enamel colour, and it is then fired again to complete it. The process is one really deserving of considerable attention. At the side of the room there are other specimens, which have been kindly sent for inspection by Mr. Henderson. I do not know whether he adopts exactly the same process which I have been describing, and which, through the kindness of Mr. Solomons, I have been able to show you exemplified. This enamel plate contains a large quantity of arsenic, not that there is any danger in using it, and it is placed upon copper; there is another process, which is also an interesting one, which is this. The silver in the photographic process is changed for platinum. For instance, a silver film is put into a bath of platinum chloride, so that the platinum gets precipitated in the place of the silver, and the silver goes into solution. These platinum photographs cannot be fused upon this arsenic enamel, because arsenious acid has an action upon platinum. Therefore, when the platinum process is used porcelain plates must be employed, and a porcelain plate is the one being used this evening, because a greater heat and more regular firing is required to fire the image on the copper enamel than upon porcelain. Wherever porcelain is used you are obliged to lay over the photograph a quantity of what is called flux. I showed you how to make it the other night, by precipitating a solution of borax by a lead salt. This, which is being used, is made in the same way. This process can, I think, be used very extensively, and it may be used by private individuals. Anyone who can photograph can do it. It is perfectly simple, and a little instruction will enable you to do it from beginning to end, and very beautiful works of art can be thus made; and it would be a very interesting occupation to fill up spare time. At the same time it has this advantage, that it gives to one's recreation and amusement a scientific turn; and anything which engenders a scientific turn of mind, even in a child's amusement, is not thrown away, but will bring forth some good fruit. Before concluding, we will put the magnesium light behind the stained glass window, and you will see that all the colours are pure, and that there is none of that objectionable mixed effect which I have already spoken about. Here is also a piece of ruby stain which has been stained with black oxide of copper. The sheet is coated in the way I told you of; it was put into the kiln and acted upon by a reducing agent, and we have got a perfect ruby stain, the colour of which is as good as any specimen we have examined. At our next meeting I shall refer to the specimens of wall and artistic decoration which have been lent us by Messrs. Powell.

EXHIBITIONS.

VIENNA UNIVERSAL EXHIBITION.

It is proposed to hold an International Congress for discussing the question of uniform numbering of yarn, at the suggestion of the Chamber of Commerce and Industry of Lower Austria, in connection with the Universal Exhibition at Vienna, to which, in accordance with the annexed special programme, will be submitted:—

(a). The investigation of the question, Whether the variety of systems for numbering yarn at present in use, and which by their great diversity impede the trade in woven materials, can be amalgamated and rendered uniform, or at least reduced?

(b). The discussion and adoption of measures for carrying out the plans which may have been proposed and agreed upon as the most practical.

This congress will be held during the time of the meetings of jurors of the Exhibition, and the date of its being opened will be made known sufficiently in time previously.

Every exhibitor in either branch of the textile industry classified under Group V., Sec. *a—d*, will, on application, receive a card of admission to the general meeting of the congress, as well as to the special committee meetings, and be entitled to take part in the proceedings and in the voting.

Applications for admission to the congress must be addressed to the respective commissions appointed for the Exhibition. In accordance with these applications, which must be sent by the respective commissions to the Director-General of the Exhibition before the 15th of March, 1873, cards bearing the exhibitor's name will be forwarded.

The Director-General reserves to himself the right of inviting also other experts to take part in the congress.

An *exposé*, drawn up by the preliminary committee, which, following the questions of the special programme, will contain certain propositions, will be sent to the respective commissions for the Exhibition for distribution in January, 1873, and be kept ready for the members of the congress.

In the first general meeting, which will be opened by the chairman of the preliminary committee, a president and secretary will be elected, the rules of proceeding submitted, and sub-committees formed for the different kinds of spinning materials, which sub-committees will each appoint a reporter to prepare a report, to be submitted to the general meeting of the congress.

The language to be made use of in the congress will be, as a rule, the German, but every member is at liberty to make use also of either the English, French, or Italian languages.

All communications, essays, and propositions, having reference to the items of the programme must be addressed, previous to the opening of the congress, to the Director-General of the Exhibition, but during the time of the meeting of the congress to the bureau of the same.

The proceedings and resolutions of the congress will afterwards be published and distributed to the respective members.

The Director-General,
Baron von Schwarz Senborn.
Vienna, 42, Prater-street, July 10th, 1872.

Programme of Questions.

What disadvantages result to the trade in woven materials from the many different systems in use for numbering yarn?

Is it possible to adopt a uniform system of numbering for all woven textures, *i.e.*, silk, woollen, card wool, linen, cotton, and jute yarns?

Should that not appear possible, cannot a uniform system of numbering be adopted for at least some textures, or is it recommendable to adopt for each kind a separate system?

Which system or systems for numbering does it seem practical to propose?

What difficulties obstruct the introduction of the intended innovation in the separate branches of woven materials, and by what means can they be removed?

What means are to be employed to carry into practice the plans which have been deemed desirable of adoption.

CORRESPONDENCE.

THE VIENNA EXHIBITION.

Sir,—I am glad to see you are calling attention to the apathy which is so manifest in Britain to the forthcoming International Exhibition in Vienna.

Having just returned from a visit to the Exhibitions of Moscow and Copenhagen, and thus been brought into contact with a large number of our foreign friends who are interested in exhibitions, I am able to testify that a very different feeling pervades the intelligent communities of Northern Europe, for the greatest anxiety is felt respecting the exhibition in Austria—not anxiety for its success, because no one doubts that, but anxiety to partake in the benefits which it is sure to confer.

In Russia, where the whole nation, from the Czar down to his humblest subjects, seems alive to the necessity for taking an active part in the great struggle for commercial prosperity, the most active preparations are being made to secure that country a fair representation of its vast resources; and a Commission, comprising a large number of the most influential and intelligent of the public officers and others, has been formed, for the purpose of securing a result held to be so desirable.

Here there is much difference of opinion respecting the value of exhibitions in a commercial point of view; but a careful examination of the subject by those who are competent to judge, will, I am sure, prove that this difference arises much more from our national vice of fault-finding, and a tendency to be disputatious, than from any real belief in the inutility of what may now fairly be regarded as an established institution of social life.

We taught the world the value of open and fair competition in trade, and the emulation to produce the best manufactures, and we have certainly proved that, whether it be in the humble rivalry at a village flower-show, or in a "World's Fair," such a stimulus benefits all concerned in it, either directly or indirectly.

No one who has not been blind to the advance in every kind of manufacture during the last twenty years can deny that there is abundant evidence to prove that this advance has been most materially aided by the exhibitions held at home and abroad.

I know too well that amongst those who are most eager upon all occasions to seize upon the advantages I allude to, there are many who are also loud in their condemnations; but their assertions never stand the test of argument, and generally arise, as I before hinted, from an insular vice of fault-finding.

With respect to the Vienna Exhibition, it ought to be remembered, especially by our government, that we are morally, as well as by self-interest, bound to support it. The Exhibitions of 1851 and 1862 are events of which we, as a nation, are justly proud, and our success in both, but especially the former, is envied by the rest of the world. But that success was assured by the cordial cooperation of other nations, and none took a warmer or more effective interest in them than Austria, which, notwithstanding all the difficulties of transport, was better represented than any single country except France.

She, at all events, learned that we benefited by such gatherings of the world's industry, and is now anxious to copy our example. It is only right, then, that a great nation like this should act with fairness, and take part in the forthcoming Austrian Exhibition with something like generous enthusiasm.—I am, &c.,

Thomas C. Archer, Director.

Edinburgh Museum of Science and Art, Edinburgh,
2nd September, 1872.

THE VENTILATION OF OUR HOUSES OF PARLIAMENT.

Sir,—Your correspondent, Mr. Reveley, in his letter which appears in your issue of the 16th August, touches on the ventilation of our Houses of Parliament. If you can spare room for a few remarks on this head I should like to call attention to one or two points connected therewith; but before doing so let me call attention to some of the remarks of your correspondent on ventilation, which deserve notice.

Although ventilation is a very important subject, although a good deal of attention has been given to it, and although the general principles appear to be pretty well understood, there yet seems to be, somehow or other, a difficulty as to their practical application. Some propose to accomplish the matter by means of certain methods, and others, again, by certain other methods, and yet it but too often happens that, when put to practical test, they all fail to accomplish the end proposed, as appears to be the case in the matter of our Houses of Parliament.

The principle which your correspondent advocates—that of ventilating downwards—is a very pretty one in theory, but in practice it has some rather formidable objections. For instance, at the very outset it goes directly against the action of natural law, by which heated air always ascends. To attempt to attain certain ends by going in the teeth of this, when you might have it working with you, is assuredly, whatever it may be, not a natural course.

Again, your correspondent would appear to believe that the exhalations and vitiated air from the body will be drawn down and away before they can get mixed with the pure heated air coming down from above. He, however, forgets that the carbonic acid gas, &c., which we exhale, coming as it does from immediate contact with the blood at 98°, must be thrown off at a temperature not far short of that, but say at 90°. Now, if the pure air, which your correspondent supposes to be drawn downwards, is at a lower temperature than that, then the lost vitiated air will rush up through it—will mix with it—and so be, after all, inhaled again and again, the hopes of your correspondent to the contrary notwithstanding. The only likely way to prevent this—and even then it would be very doubtful—would be to keep the temperature of the pure air above that of the foul. In this case, the foul air being the colder of the two, and having now a natural tendency to fall, might be drawn off before it got mixed with the pure. But just fancy a principle of ventilation which, before it would work as proposed, required our fresh air to be brought in at a temperature not lower than 90°. Very few would consider this pleasantly cool.

But further, this principle can only be carried out by means of machinery possessing a force sufficient to overpower that of the natural law to which it has opposed itself. Now, it is very seldom that you get even large manufactories, with steam-engines on their premises, willing to put up special machinery for ventilation; and to expect private houses to keep each their own steam-engine, to work the fans necessary in such a system, is, it is feared, hopeless.

A system of ventilation which cannot be adopted by private houses, and which cannot work as proposed, unless the fresh air it brings in stands at a temperature of about 90°, can never prove a popular one. These are only some of the objections to it; but it is satisfactory to think that, from your correspondent's well-known views on the matter of patents, there is no chance of his taking out one for this.

With your permission, Mr. Editor, the remarks on the subject of the ventilation of our Houses of Parliament may be deferred till next opportunity, as I have taken up too much of your space already.—I am, &c.,

H. F. Alexander.

Edinburgh, 28th August, 1872.

ACOUSTIC TELEGRAPHS.

Sir,—My attention has been called to a letter by Mr. Hyde Clarke, which appears in your *Journal* of August 30th, suggesting the use of acoustic telegraphs as an alternative means of communication for the telegraphs connecting together the police and the fire-brigade stations, which have suffered from the effects of the late storms.

In the *Journal of the Society of Arts*, of September 30th, 1870, you did me the honour of publishing an extract from a paper read by me before the meeting of the British Association, at Liverpool, "On the Action of Lightning on Telegraphs, and on a New Method of Constructing Telegraph Coils."

The needle telegraph of Cooke and Wheatstone, by means of which for many years by far the greater portion of the telegraphic correspondence of the United Kingdom was transmitted, and which is still largely used for secondary stations and for railway purposes, had the drawback of being very liable to being temporarily deranged by atmospheric electrical disturbance.

In that paper I described a method of constructing needle telegraphs which had not the drawback referred to, and also a protector applicable to all telegraphic apparatus, which I termed a "lightning bridge," as it bridges over, or shunts, high tension discharges.

I also demonstrated that the fusion of telegraph apparatus was more often due to the secondary current developed by the demagnetisation of the line wire, which immediately follows the lightning discharge through the circuit, than to the main discharge itself, and that the failure of most of the lightning protectors which had been tried from time to time arose from the fact of this not having been recognised.

These needle-telegraph coils and lightning protectors have been very largely adopted, for the postal telegraphs and railway circuits, with success.

My object in writing is to point out that it is now quite practicable, at a comparatively very small cost, to protect the working of all telegraph apparatus from being interrupted by lightning storms.—I am, &c.,

Alfred Varley.

Telegraph Works, 65, Roman-road, Holloway, N.,
September 4, 1872.

THE TRADE AND FISHERIES OF ICELAND.

The state of things in Iceland can hardly be compared with that of any other place, on account of the sparseness of its population, as compared with its great extent, and the insufficiency, amounting almost to a positive absence, of means of communication, locomotion, both for man and merchandise, being still only practicable on horseback. Although this island has now but few interests in common with other nations, yet, from the influence it has exercised in the mental culture of the north, it has always had a certain mysterious attraction for most people. We are indebted to Mr. Consul Crowe for information about the resources, general history, and habits of its people, given first in a report in 1867, and now again in a continued notice of the trade and fisheries. The island, which is three times the size of the kingdom of Denmark, has a population of only 69,700 souls, and so scattered are they, and so difficult their means of communication, that many of them, even of the better classes, born and living on the north and east sides, have never seen the south or west districts of the island. The country itself produces but little; it has no forests, and but little fuel, contains neither mines nor coal, neither does it grow cereals, or, indeed, any other useful plants, so that the first necessaries of life are imported. Its only wealth is its excellent wild pastures and its marvellously rich fisheries, the latter a source of prosperity which, if worked with intelligence and energy, might support a much larger population. These facts must be borne in mind in passing a judgment on the island and its trade and fisheries.

The cod and shark fisheries are carried on both with open boats and decked boats; the open ones are generally used for fishing the former, and the others for the shark fishery, but at times each kind is employed indiscriminately. The Danish merchant vessels, which in the spring bring the usual supplies of goods to the island, often, while they are waiting for cargo and clearance, increase the number of hands with natives, and fish cod. In this manner, it has often happened that one single six-oared ship's boat crew has brought home to Denmark 20,000 cod as the result of their labour while detained off the island. The census showed that somewhat more than 75 per cent. of the population were engaged in sheep-rearing and agricultural pursuits; and, notwithstanding the steady and lucrative nature of the fisheries, only about 10 per cent. were engaged in them. The stocks of domestic animals have shown a steady tendency to decrease, especially as regards the sheep flocks, in consequence of epidemics and grass failures. These visitations are bewailed by the Icelander as national calamities, but it is a question whether they may not prove to be the reverse, by opening his eyes to the necessity of devoting his energies and small capital to the better and more regular prosecution of the fisheries, which are boundless in extent, and less dependent on vicissitudes and seasons. The number of boats, in 1870, employed in the fisheries and for general purposes of local communication was 63 large-decked boats, and 3,092 open boats, with from two to twelve oars. In 1853, these numbers were 25 and 3,481 respectively; since then the larger have increased, the smaller decreased in number, and the amount of hands employed is greater than at the earlier period; therefore, the presumption is that there is no falling off in the prosecution of the fisheries, but that things in this respect are about as they were twenty years ago, perhaps rather improved than otherwise. Of the 63 decked-boats owned in the island, more than half belonged to the north side, and only one on the east coast, which fact shows that the shark fishery is chiefly carried on off the north side of the island, although these vessels often while engaged in it sail round to the west, and even to the south.

The Icelanders fish for cod and herring from open boats, and the poor results they often obtain are attributable to this circumstance, and to the indifferent character of the gear they employ. The impression is current that if these fisheries were prosecuted by means of larger decked vessels of twenty or thirty tons, the yield would be more abundant and steady. Owing, however, to the fact that the best fisheries are found close in shore, where boats are better than ships, and the eminently inhospitable character of much of the coast, large vessels would be exposed to serious dangers where small, flat-bottomed craft can now act with ease and safety. Open boats must be considered, therefore, for the native, as the chief instrument for prosecuting the fisheries, and it is surprising how little care he bestows on their fitness or improvement. The Icelander is an excellent mariner; his power of endurance, courage, and ability to keep the sea in all weathers is above all praise, but his recklessness as to the soundness of the craft he trusts his life to is equally remarkable. The number of human lives and boats which are annually lost, owing to the want of proper sails and tackle, is very great; thus, 40 per cent. of the deaths among adult males is from drowning. An improvement, therefore, in the construction of the native boats is much required, and the same remark will apply to the manipulation of the fish caught by their means. In many or most parts of the island its preparation is very faulty, and tends to diminish the market value of an excellent article of export. It is not easy to arrive at a satisfactory conclusion as to the result of an ordinary year's Iceland fishery. No account is kept of the quantities used for home consumption, which, from the nature of things, must be considerable. The returns published of the exports will, however, be a tolerable guide, as they presumably represent the larger half of the catch, certainly as far as cod and train oil is concerned. In 1869 there were 5,686,560 lbs. of dried and salt fish, 977 barrels of salt roe, and 7,744 barrels of liver oil exported. Although the cod is the only minor fish which figures in the returns as a chief article of export, the waters around the island abound in fish, among which mention may be made of the herring, haddock, halibut, and similar flounder kinds; trout, salmon, and eels are likewise plentiful in the "fjords" and fresh water lakes and rivers. Shell-fish are present in enormous quantities, especially the mussel, which is so abundant that its shell might supply the whole island with lime; at present they are only used as bait. Fully half the dry cod now prepared is shipped to Spain; the remainder is consumed by Denmark, Great Britain, and Hamburgh. The French, although great consumers, supply themselves. Neither the herring nor whale fisheries receive much attention from the Icelander, but there is little doubt that large masses of the former fish are found near the coast, and might be of great value if proper means were taken for catching them. That they periodically visit the coast in considerable quantities is plain from the presence of the numerous sea-fowl and large fish which hunt them for food, and it is surprising that, with the example of their nearest neighbours, the Norwegians, before them, no effort is made to organise and develop this source of piscatorial wealth.

Native industry, both general and domestic, is very little developed. There are but few artisans in the island, and of these the bulk are foreigners. The raw material is sent unprepared out of the country, and the manufactured article imported. Wool, the great staple of the country, is exported in its crude state, and but little cleansed, and worked either for export or home use. Domestic or home industry is carried on to some extent in the north and east districts, where, in the winter evenings, the hand-loom and spinning-wheel may be seen at work in the peasants' dwellings; and the returns show that it is in these parts that nearly all the woollen goods exported are produced. The sheep take the foremost place in the rural economy of the island. Two kinds are found there, the one small, fattening quickly, and giving a large portion of flesh; the other large, and less advantageous in the last-mentioned respect. A peculiarity of the Iceland sheep is, the smallness of the tail, and the general development of the horns. It is not at all rare to see some of these animals with four and even six horns. The Icelander never shears his sheep, but pulls the wool off with his fingers. In the spring, as the new wool grows, the old coat becomes semi-detached, and can be pulled without suffering to the animal. Should any portion of the old growth still adhere to the skin, it is left until nature has loosened it. The quantity of wool produced is very large, having in some years reached 1,750,000lbs. In 1868, as much as 625,000lbs. were shipped to Great Britain. The trading transactions of the island take place in the following manner:—There are along the coast thirty-four authorised trading places open for commercial purposes, and their position is dependent upon their capabilities as harbours, their proximity to the fishing-grounds, and their population. At these places the merchants who barter with the natives all reside, and their number does not exceed sixty-two, of whom only six are Icelanders, the others being foreigners, mostly Danes, who represent Copenhagen houses. Cash transactions between buyer and seller are very few, nearly the entire trade being one of exchange, which renders the merchant's position difficult and complicated, as, in return for the foreign goods he supplies, he has, in many cases, to take the fresh fish, liver, and other raw materials, and himself prepare them for exportation. The Icelander is almost always in debt to the merchant, and, consequently, entirely in his power, and must accept, both in buying and selling, the prices the latter chooses to put upon the articles bartered. The old monopoly system, the result of which had been the gradual ruin of the island, was abolished in 1856; but the older merchants, thanks to this vicious system of barter, from which the natives cannot free themselves, still exercise a virtual monopoly.

Education is very general, and Mr. Crowe doubts if a single Icelander could be found unable to read or write. The schools are excellent and well attended, and it is surprising to see the amount of mental culture possessed by persons in the most humble walks of life. The taste for learning and literature has been preserved among the inhabitants from the earliest ages; and their isolation has enabled them to retain and fix the rules of their original language, and transmit it to the present generation almost unchanged in all its early purity and beauty. Printing was introduced in 1530, and the numerous works that have since been published in the Icelandic language have greatly contributed to make known the richness and originality of its literature. Three ably-conducted weekly papers are now printed on the island, and several societies for the encouragement of learning, religion, and industry exist. In spite of its high latitude, the climate is scarcely colder than that of the northern part of Denmark. It can, however, be very variable from year to year, being doubtless acted on by subterranean heat, or by the greater or lesser proximity of the movable ice, which at times almost surrounds it. As an instance, in 1845, when the last eruption of Hecla took place, the temperature became so mild that the valleys were covered with an unusually abundant vegetation; while, in 1869, all the north-east portions of the island were ice-bound for months. Very severe cold was experienced, the fisheries failed, and a famine ensued, causing great suffering and loss.

THE VINEYARDS OF THE GIRONDE.

The origin, nature, and varieties of wine have been exhaustively treated by Messrs. Thudichum and Dupré, in their manual of viticulture and œnology, which reproduces the opinions of previous authorities, with the result of their own personal observation made during visits to the different vineyards of Europe. There are other countries which produce excellent wines, but nowhere has the vine attained to greater perfection than in France, and more especially the banks of the Gironde.

The department of the Gironde, through which the river flows, possesses about 140,000 hectares of vineyards, producing annually on an average 2,280,000 hectolitres of wine. It is practically divisible into five wine-producing districts—namely, the Médoc, a district on the left bank of the Garonne, extending from Blanquefort to the sea; the Graves, or high plains about the confluence of the Garonne and Dordogne; the Côtes, or inclined banks on the right side of the Garonne; the Palus, or low marshy territory on both banks of the Garonne, in the more immediate neighbourhood of Bordeaux; and the district of Entre-deux-mers, a low land between the Dordogne and Garonne. The Médoc is the tongue of land which forms the left border of the Garonne after its union with the Dordogne, called the Gironde; and it extends from Blanquefort, a little town about fifteen kilometres west of Bordeaux, to the sea. It produces the wines of Larbarde and Cantenac, Margaux, the great growths of St. Emilien and Pauillac, and in the Haut Médoc the wines of St. Estephe and St. Seurin-de-Cadourne. These are celebrated for their remarkable perfection, the low prices of their common qualities, the enormous prices of their first qualities, and by the remarkable trade to all parts of the world to which they give rise. The general feature of the country is that of a vast plain, falling somewhat towards the Gironde. The variation of the soil causes a great diversity in the products, so that the best and the most inferior sorts grow frequently side by side. The vines cultivated are not many in number; the most common is the Carbenet Sauvignone, which is also termed *Petite vidure* in the neighbourhood of Bordeaux. This produces the best and most fertile of all the fine black grapes of the Gironde, and stands to the great wines of the Médoc in the same relation as the Pineau or Morien of the Côté d'Or, or the Riessling of the Rheingau. Second in importance is the *Franc Carbenet*, which prospers best in high soils. The *Merlot* cannot bear drought, and grows best on most inclines. The *Malbec* is only planted in the low grounds, and its grape is admitted only as material for second rate wines. The *Verdot* is a vine of subordinate importance, except in the "Palus," or marshes, where it becomes the vine of first importance. As it is the latest to ripen, it is only planted in good positions. Its wine has much juiciness, fulness, and vinosity, and combines well with that of the Carbenet: it gives durability to wine with which it is mixed. The Verdot is therefore found amongst the best growths of the Médoc, in Pauillac, Saint Julien, and Margaux. The *Cruchinet* gives a remarkably agreeable bouquet, and for this cause it has for some years been multiplied at Château Lafitte. The *Carmenère* is cultivated at Margaux and Cantenac, and when mixed with Carbenet, produces wine of an excellent quality. There are other vines cultivated in mediocre situations, the only quality of which is their fertility.

The vineyards are ploughed for the first time early in March, again in April, again in May, and again according to the degree of development of the grapes. The last operation generally takes place in July, or the beginning of August. The blossoming time is very regularly the period from the 10th to the 15th June, when the superfluous shoots are cut off. This cutting (called *rognage*) is only effected once towards the approach of the vintage. Its object is to hasten the maturation of the grapes by compelling the sap to go particularly towards the fruit, and much discretion has to be used according to the different varieties. The vintage in the great growths of the Médoc is about a fortnight earlier than in any other vineyards of red wine of the Gironde, and a month earlier than in the districts of the white Sauternes. In good years it commences on the 20th September; in middling years, between September 25 and October 1. Years in which the vintage can only take place in the first fortnight of October are said to be bad. In prosperous years, great numbers of labourers flock from all the surrounding departments—the Charente, Landes, the Pyrenées, and from the Blayadais and Libournais. They are led in gangs, by agents who defray the expense of transport to the labourers, and bargain with the proprietors. The women and children cut the branches, and immediately remove all green, rotten, or otherwise spoiled grapes. The baskets when full are collected and emptied into a large pail, called *baste;* when full, this is transferred to the waggon, when the attendants stamp the grapes down into the vat fixed upon it. When this vat is full, the cart is drawn off by oxen to the *cuvier*, or place where the grapes are converted into wine. When the waggon arrives and the contents have been emptied into a large press, then begins the business of pulling the berries from the stalks. The grapes are thrown with shovels on large square wire nets, and then moved about with the hands until all the berries have fallen through the meshes into the press below. The stalks are then kept apart for awhile. When a press is sufficiently filled, a number of men step in and tread the berries with their naked feet. This they do to the sound of music of the clarionette or violin. They dance regular *contredanses* until the pulp has been trodden through. The pulp is then shovelled upon a heap in the middle of the press—the pressmen dance round it. and at each step throw with uplifted leg a little of the pulp from the heap, upon the ring in which they dance. When the heap is quite dispersed, the *contredanses* begin again, and so on until the pulp is perfect. The must is drawn off at intervals and put into the vat.

The fermentation vats, being thoroughly cleaned, and sponged with brandy, are filled with the mixture of juice, stalks, skins, and kernels; each vat, if possible, the same day, and then left at absolute rest until the wine is formed. The time required for the vinification in good years is not more than four or five days. The time for drawing the wine from the vats is determined by experienced persons; and in order to preserve the quality the filling of the wine into the *barriques* must be completed in three days at the utmost. The barriques are then closed, where it remains for four years before it is put in bottles, and may be drank when six years old. But in these respects each vintage has its own peculiarities. This is the ordinary type of the vintage and vinification of the Médoc, although variations are observed in different localities.

The Médoc has 20,000 hectares of vineyards; the yield of the whole may be about five million bottles. When these are distributed over the commerce of the whole world, it becomes apparent how small a quantity each can obtain, and how enormous must be the substitution which the trade of Bordeaux and other places makes of unclassed, and, indeed, of any kind of wine, whether from Bordeaux or other parts of France, for Médoc. The Graves, another district, occupies the heights in the immediate vicinity of Bordeaux. The wines obtained are of greater body, deeper colour, and more spirituous than those of the Médoc, and resemble much more the wines of Burgundy. The production of white prevails over reds. The first quality is that of Château Haut-Brian, distant about six kilometres from Bordeaux. The mode of cultivation followed in the Graves is peculiar, although the vinification is the same. The principal vines are the *Gros vidure* and the *Vidure Sauvignone*, together with the *Malbec* and *Crachinet*. The Sauterne district extends on the left bank of the Loire, in the neighbourhood of Langen. Its centre is Bazas, and its eastern termination Captieux. It is a series of beautiful hills, rising gradually from the Loire towards the south and west, many of them having eastern and others northern, most of them western exposures. They are interspersed with woods and a little cultivated meadow-land. The vines planted are almost exclusively of white grapes. They are particularly two in number, namely, the Sémillon and the Sauvignone, mixed here and there with a little muscatel. It is calculated that the Sémillon occupies two-thirds of the surface; the other third is occupied by the Sauvignone. The vintage is altogether different from the vintage in any other part of the world, for the grapes are allowed to hang until they are ripe and rotten, and then they are collected, berry by berry, only such berries being taken as fully answer to the description of ripe and rotten. By means of the subsequent treatment of the grape a must is obtained which is exquisitely sweet; this sweetness remains, to a great extent, throughout the whole life of the vine. The principal growths of the district are the Barsacs, Sauternes, and Bommes. From the heights of Sauterne, and from the castle of Yquem, a most splendid view of the valley of the Loire is obtained. It is one of the finest landscapes in Europe.

Those vines of the Girondes which are called wines of the hill sides, or "Vins de Côtes," are obtained on a chain of hills which extend along the right bank of the Garonne from Ambarez to St. Croiz-du-Mont. The northern part of this district produces, in general, wines of a dark colour, sometimes hard and rough at first, but ameliorating with age. In the southern part, only little red wine is made, but much white wine of a dry quality, called "wine of the little hill-sides." Under this latter denomination, the Bordeaux trade includes also the wines of the right bank of the Dordogne, from Bourg, which is about 20 kilometres north of Bordeaux, to Fronsac, which is about 24 kilometres north-east of Bordeaux. Among all these wines, the most celebrated are those which are grown in the community of St. Emilien, and generally named after that district. The surrounding districts give also wines, but less fine than those of St. Emilien. The vineyards occupy 1,041 hectares. The town was a stronghold of the Knights Templar, and of their churches and order-houses innumerable ruins exist, interspersed with inhabited houses. The varieties of grapes in this district are the *Noir de Pressac*, the *Merlot*, and the *Bouchet*, or *Cabernet*. The vine here is trained from blind canes. It is arranged so as to have several arms, and, on the whole, this mode of cultivation is very similar to the so-called basket cultivation of the Rheingau. The cutting is performed in November and December. The turning of the soil is mostly done with the hoe, but in some large properties the plough is used, as in the Médoc; the vines are tied to stakes, which here bear the peculiar name of *carassonnes*. When the shoots are well developed, the superfluous ones are cut off. The young planted vines commence bearing fruit in the fifth year; in the sixth they are supposed to be in full bearing. A hectare of the best vineyards yields about six barriques, that is, thirteen and a-half hectolitres per hectare. The common vineyards yield double that quantity. The vintage generally takes place from the 15th of September to the 10th of October. As all operations are here performed with great care, an average of good wine is produced, which is generally easily sold. Most of the St. Emilien at present goes to Belgium, Holland, Denmark, and Sweden; the second-class is largely imported to Paris.

St. Emilien is the centre of a district called the Libournais, of which Libourne is the principal town. Towards the north-west the Libournais is marked off by the river Isle. On the other side of this river is the district called Fronsadais, of which the principal town is Fronsac. To the north-east of the Fronsadais is the Blayais, which has the town of Blaye, a fortress lying on the banks of the Gironde, for its centre. The Blayais, therefore, lies opposite the Médoc, on the banks of the Gironde. In these districts considerable quantities of red and white wines are produced; none of these are classified, but many of them, especially in good years, are very useful. Large quantities are exported under various names, particularly across the Atlantic.

PORTLAND BREAKWATER.

A few facts connected with this great structure, are worth recording.

The breakwater extends for a mile and five-eighths from the east side of the island of Portland, and shelters from every wind an area of 2,100 acres of water, 1,290 of which have, at low tides, a depth ranging from five to eleven fathoms. It consists of an inner breakwater, 1,900ft. in length, divided from an outer or isolated breakwater 6,200ft. in length, by an opening 400ft. wide. The whole is built in nine to ten fathoms of water, the material used being rough blocks of Portland stone, quarried by convicts from the shore close by. This was loaded into trucks, which were run out on a scaffolding and tipped into the sea, the scaffolding being pushed forward as the reef of rocks rose above the water. The inner breakwater has been built with dressed stone into a finished sea-wall, the surface of which is two broad roadways, the outer raised above the inner on arched recesses, for the reception of Government stores.

The two sections make an obtuse angle, and the outlet occurs just before the angle of turning north, being so placed that ships going to sea in a northerly wind can pass at once through the opening, and take a fair breeze down Channel. The outer breakwater is a mere low line of rugged blocks of stone, showing above the sea just as they were tipped. At the east end of the inner breakwater there is a circular granite fort, which immediately defends the channel of passage; and at the extreme north end of the outer part of the work there is a fortress, yet to be made complete by a sheathing of heavy armour plates; besides, the breakwater is defended by most powerful batteries on shore.

The breakwater is nearly 90ft. high in places, and 300ft. wide at the base. It is made up of nearly six million tons of stone, which, if built into a solid column of 100ft. in diameter, would overtop the highest Alp. Another, and, indeed, the chief marvel and difficulty of the undertaking was the erection of the scaffolding, of which, of course, there now remains no trace. It must be described as a wooden railway viaduct of the most massive kind, built a mile and a-half out from the shore, in from 50ft. to 60ft. of rough sea water. Every timber had to be made waterproof and wormproof by the hydraulic forcing of creosote into the pores of the wood, and when this was done a huge pile was made of nine or ten timbers bolted together in one mighty spar of eight or nine tons, some 2ft. or 3ft. square. Tipped with an iron screw, this was lowered into the sea till it rested on the bottom, when it was worked round by a capstan till the screw had bitten 8ft. into the clay. Three or four of these piles were set at a time, and at once bolted together by many wrought iron tie-rods and powerful cross-timbers and under-trusses, till the mass was strong enough to carry the trucks of stone for tipping in. The top of the scaffolding was 30ft. above the water, or 90ft. above the ground. In the construction of the North Fort, these piles were set in two circles of 112ft. and 224ft. in diameter, upon which, as on a huge dial, moved a wrought-iron radial "traveller," dragging the feeding trains, each with from sixty to eighty tons of stone in tow, stopping them over the exact spot where more "tipping" was required, when the wagons rose on end, and poured their blocks into the sea. Thus, a great mound was heaped for the foundations of the North Fort, an island in the sea, of 140,000 tons of solid stone, and, with the fortifications, 100ft. high, 400ft. in diameter at the base, and 200ft. at the summit. At every tide the divers went down to level, as well as they could, the masses tipped in, and to report that a little more stone was needed here or there, as the case might be. This North Fort is in three stories, one of magazines, two of casemated batteries, and the armament will be sixty guns in all. The whole structure appears from above a ring of granite 100 ft. thick, enclosing a centre courtyard, into which look the officers' quarters and men's barrack rooms. According to the *Times*, the first idea of a breakwater at Portland appears to be due to Mr. John Harvey, portmaster at Weymouth, who urged it upon the Admiralty so far back as 1794. Its history from that time is a history of select committees, and minutes, and votes. First of all we find a select committee of the House of Commons in 1843 recommending the subject of harbours of refuge to the attention of the Government; then, in 1844, a Treasury minute, Sir Robert Peel being in office, recommending the appointment of commissioners to inquire into eligible situations; then commissioners, with Admiral Sir Byam Martin at the head of them, appointed, and delivering in their report the same year, recommending harbours of refuge being formed at Dover, Portland, and Seaford, and giving preference to the places in the order in which they are named; then, in 1846, surveys were made, and the case further and professionally reported on by Rendel; and, finally, Parliamentary powers were obtained for the purchase of land, &c., and the preliminary works were begun in August, 1847, Rendel being engineer-in-chief, and Mr. (now Sir John) Coode resident engineer. On the death of Rendel in 1856, Sir John Coode became engineer-in-chief, and has so continued, though for the last few years the work, which was at first under the Board of Trade, has been altogether in the hands of the Admiralty, and of the Director of the Works to the Board, Lieutenant-Colonel Clarke, R.E., C.B. The total cost of the breakwater and harbour works, including the coaling establishment, jetties, and waterworks, has been £1,033,600, a sum which represents money paid out of the nation's pocket to contractors and others, and has nothing whatever to do with the worth of the convict labour extensively used on the works.

NOTES ON ART.

A portion of the historical galleries in the Château at Versailles has been opened to the public since the prorogation of the Assembly.

The death is announced of M. Charles Duron, one of the ablest enamellers on gold in France. This artist passed through great difficulties during the early portion of his career, but, like Bernard Palissy, he was not only utterly devoted to his art, but confident of final success, and the Great Exhibition of 1851, by bringing his work to the knowledge of what may almost be called, without exaggeration, the whole civilised world, created for him a high reputation. In 1867 the exhibition of his works again added largely to his fame; and, lastly, those which he exhibited at the International Exhibition last year attracted great attention and were universally recognised as of very high character.

The keeper of the Luxembourg Gallery, M. de Chennevières, has just issued a new edition of the catalogue of that collection, which has been sadly wanted for years. It is surprising how slowly this museum has grown; in 1750 it comprised nearly one hundred works, and at the present it possesses but 361. During the last ten years the increase has only averaged twelve works a year. It must be remembered, however, that the collection is made up of the choicest works of living artists, and that on their death, or shortly after, the works are removed to the Louvre. M. Chennevières pleads, in his introduction to the catalogue, for the pictures and sculpture to be left in the Luxembourg galleries for five years after the death of an artist; and, when we consider the great attraction of the productions of a celebrated artist immediately after his death, this course would probably be more acceptable than removing them at once to the great gallery of the Louvre. The keeper also proposes the addition to the collection of works by eminent foreign living artists.

GENERAL NOTES.

Science Examinations.—The following minute has recently been issued by the Right Honourable the Lords of the Committee of Her Majesty's Most Honourable Privy Council on Education at South Kensington, the 19th day of July, 1872:—"My Lords consider the memorial of the Council of the Union of Lancashire and Cheshire Institutes. They direct that paragraph 42, sub-section '*d*,' of the 'Science Directory' (25th edition, November, 1871), shall be modified as follows:—For 'persons in the receipt of salaries not large enough to render them liable to the income-tax, as some descriptions of clerks, shopmen, &c., read 'persons in the receipt of less than £200 per annum from all sources.'"

The Mont Cenis Tunnel.—A great deal of indignation is expressed just now by the Italian press in consequence of the preparations now being made at Modena by the French military authorities for forming large chambers at the entrance to the tunnel, which, in case of war, would be filled with powder and fired, so that in this manner all communication would be cut off with Italy, *via* the Mont Cenis Tunnel. The *Reforma*, a liberal journal of Rome, in a leading article entitled "The Neutrality of the Mont Cenis Tunnel," declares that this work, the triumph of so many years' patient study and indefatigable labour, should be respected, and not liable to be destroyed in a few seconds at the whim of one man.

Invention Rights.—"If," says the Hon. Horace Greeley, "indestructible foundation of the right of property is labour, then the right of Elias Howe to that combination which gives practical existence and value to the sewing-machine is as perfect as any right of property. The craftsman merely fashions, adopts, or recasts materials which may be regarded in some measure the common property of mankind, while the inventor builds into void space, and adds potentially, by his own creation, to the enduring wealth of nations. I cannot perceive why his right of property is not as perfect, and even more pervading, than that of the maker of a locomotive, or the grower of grain. I have considered what has been urged in favour of a restriction of this class of property to the material being wrought, and the argument seems to me absurd. The inventor labours to perfect, not a single locomotive, but all future locomotives, and to make them less costly or more efficient. When completed, the machine may burn to ashes, yet no one would say that his labours have been in vain. As to the abolition of patent systems, which has been advocated by some eminent men, I shall be more reconciled to it when I am assured that this act will be swiftly followed by a repudiation of all rights of property, or, more strictly, of all legal guarantees and defences of such rights. Whenever the laws of my country refuse to protect the inventor and author, they should, in simple consistency, bid the land-holder, the bond-holder, and the merchant, 'Take care of yourself, and all you call your own.' The title to wild lands, granted by a European monarch who never saw, and knew not how to bound them, cannot be better than that of Whitney to the cotton gin, or that of Daguerre to photography. When these rights are successfuly denied, no rights of property will be secure. I acknowledge all property is held subordinate to the dictates of the national well-being, and I only insist that intellectual property should be recognised by law as standing on a common foundation with other property, and equally accorded the protection of the State, and the respect of all who hold property no robbery, but justly entitled to defence and upport from the wise and the good."

Beetroot Sugar in California.—The Sacramento Beet Sugar Company have expended in buildings, machinery, and 540 acres of choice land, 225,000 dollars. They have rented other lands, and have sown with beet this season 1,100 acres, from which they hope to get an average of 10 tons of beet per acre. The methods of culture can be improved in California; deep ploughing is as yet hardly understood, and thus the real wealth and producing-power of the soil is not utilised, but it is stated that the beet here yields a larger per-centage of sugar than in Europe, which, considering the favourable climate and rich soil, is not surprising. The field-work and general culture is done by Chinese. The beets are sown by a machine in rows; are thinned, weeded, and dug by hand. The Chinese, who work in gangs, receive five dollars per week; for this they feed themselves, the company paying a cook for every thirty men; they furnish also bedding and cooking utensils. The 1,100 acres planted will employ the factory about eight months, and it is hoped to turn out 10,000 barrels of sugar this year. Only the whitest sugar is made; a ton of beet ought to yield a barrel of sugar. The refuse of the beet is given to cattle, and it is found very valuable for fattening. It is also much used for this in France.

The Tradeston Explosion.—Dr. Stevenson Macadam, of Edinburgh, and Dr. W. J. Macquorn Rankine, of Glasgow University, have submitted to the insurance companies of the city the following *interim* report, dated Glasgow, 3rd August, 1872:—"We hereby certify that, in accordance with instructions received from the fire insurance companies interested in the loss and damage sustained in the explosion and fire which occurred in the Tradeston Flour Mills and Granaries on the 9th day of July, we have made a searching investigation into all the circumstances connected with this disastrous affair, and, having inspected the premises, examined all necessary witnesses, visited other mills, and inquired into the history of other explosions of a like nature, we have arrived at the following conclusions:—1st. That the primary cause of the explosion and fire was the accidental stoppage of the feed of one of the pair of stones engaged in the grinding of sharps, which led to the stones becoming highly heated and striking fire. 2nd. That the fire thus generated ignited the finely-divided dust which was diffused through the air in the exhaust conduits, and then passed on to the exhaust-box. 3rd. That the sudden combustion of the dust diffused through the air would produce a very high temperature in the gaseous products of that combustion, and this would necessarily be accompanied by a great and sudden increase of pressure and bulk—constituting, in fact, an explosion. 4th. That the first effect of this explosion would be to burst the exhaust-box, and allow the diffusion of the dust and flame throughout the atmosphere of the whole mill, as it is to be observed that all the parts of the mill were in communication, by means of elevators, hatchways, and other passages, through which flame would readily pass, and also in other parts of the mill various processes went on which produced large quantities of combustible dust. 5th. That this communication of the flame throughout the atmosphere of the whole mill was the cause of the second explosion, by which the gable walls were blown out, the mill was reduced to ruins, and all the woodwork set on fire. 6th. That the stores or granaries were set fire to partly by the flame and fire from the mill travelling along the gangways, and partly from the burning materials falling through the skylights. 7th. That no explosive or other foreign material was used in the manufacture of the flour, and we found the steam-boilers uninjured. 8th. That we have not been able to trace blame on the part of the proprietors of the mill or of any one in their employment, as every precaution known at the time was used. In a subsequent report we will state at length the information which has led us to the foregoing conclusions, and the means which we consider necessary to avert similar fires and explosions for the future."

Journal of the Society of Arts.

No. 1,035. Vol. XX.

FRIDAY, SEPTEMBER 20, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

TIN IN QUEENSLAND.

The Secretary of State for the Colonies has forwarded to the Council the following despatch from the Governor of Queensland, enclosing a Report from the Secretary of Public Lands, on the subject of the recent discoveries of tin in that Colony:—

The Marquis of Normanby to the Earl of Kimberley.

Government-house, Brisbane,
10th July 1872.

My Lord,—In compliance with the promise conveyed in my despatch No. 43, I have now the honour to forward to your Lordship a report, which I have received from the Secretary of Public Lands, on the subject of the tin discoveries in this Colony.

The report is an elaborate one, and, I believe, thoroughly to be relied upon; and as the new industry is likely to prove of great importance, I would venture to suggest to your Lordship that it might be desirable that it should in some way be brought under public notice.

I have, &c.,
(Signed) Normanby.

The Right Hon. the Earl of Kimberley, &c.

Mr. Gregory to the Secretary for Public Lands.

Mineral Lands Office, Stanthorpe,
2nd July, 1872.

Sir,—In pursuance of the instructions conveyed in your memorandum, dated 18th ult., I have the honour to furnish, for the information of His Excellency the Governor, a report on the tin fields at the head of the Severn river, in the district of Darling Downs South.

The general geographical area of the stanniferous country within the Colony of Queensland, so far as is at present known, appears to be comprised within the following limits:—Commencing on the main dividing range, between the Eastern and Western Waters at Lucky Valley goldfields, near the head of the Condamine river, the northern boundary extends in a west-south-westerly direction for about twenty-five miles, passing fifteen miles south of the town of Warwick, to the head of Pike's Creek, on the Pikedal Run; from this point it is bounded by a slightly curved line, extending south about 20 miles to the Severn river, three miles below the Ballandean Head station, where it bends south-east for 12 miles further, meeting the boundary of New South Wales at the Tenterfield Run; from thence the crest of the watershed which forms the boundary between the two colonies embraces it in a north-easterly and easterly direction back to Lucky Valley, the area comprised being in round numbers 550 square miles in extent. Of this area, however, only about 225 square miles have hitherto been found sufficiently rich in tin ore to pay for working, and, consequently, it is with reference to this latter portion that my attention has been especially directed, although there are several instances of tin being found in payable quantities beyond these limits.

The physical and geological character of nearly the whole of the area described is that of an elevated granitic table-land, intersected by ranges of abrupt hills, the highest limits of which being about 3,000 feet above the sea, its eastern escarpment forming the watershed of the Clarence river, the northern that of the Condamine, and the south-western the Severn and McIntyre rivers.

The passes and gorges whence these rivers issue from the elevated granitic country are mostly very steep and rugged, and difficult to traverse, especially to the north and eastward.

Of the rivers and watercourses which intersect this tract of country, it will be only necessary for present purposes to refer to the Severn and its tributaries, as it is on them that by far the greater portion of mineral wealth is found.

The principal head of the Severn is the stream known as Quart-pot Creek, which, with its numerous tributaries, the Funker's-gap Creek, Four-mile, Law's, Ten-mile, Sugar-loaf, and Thirteen-mile Creeks, drain the eastern portion of the district, comprising fully one-half of the country at present occupied by selections; while the northern head of the Severn, better known as the Broadwater, has for its tributaries Spring Creek, Reeves' Gully, Hardy's and Cannon Creeks.

Again, to the westward, several watercourses, known as the Ten, Thirteen, Fifteen, and Twenty mile branches of Pike's Creek, flow westerly into a metamorphic formation in about seven or eight miles, when the tin-bearing country terminates.

The majority of these watercourses rise in open sandy or rocky hollows, or shallow valleys, having at their commencement very little fall in them, and in ordinary seasons are well supplied with water, several being all but permanent streams, the main channels containing numerous large pools and sheets of water—in some instances over a quarter of a mile in length.

The fall of the country from their sources to Ballandean head station, an average distance of 20 miles, may be roughly estimated at from 400 to 600 feet, and in a few instances fully 1,000.

The portion of the district over which the principal deposits of tin-ore are distributed is that comprised by the watershed of the Severn River down to Ballandean station, with the exception of about six miles of the extreme southern head of Quart-pot Creek and Accommodation Creek, both of which hitherto have not been found to yield payable ore.

The richest deposits have been found in the stream beds and fluviatile flats on their banks, the payable ground varying from a few yards to five chains in width, occasionally broken by rocky bars; but even in these instances large deposits are frequently lodged in the pockets and crevices between the granite boulders. The aggregate length of these alluvial bands may be taken at about 140 miles on the Severn waters, with about 30 more on the tributaries to Pike's Creek.

A very careful inquiry and personal examination of a number of the various workings that have been commenced within the last few weeks, establishes a very fair data upon which to estimate the probable yield of ore. This may now with a tolerable degree of certainty be stated at an average of ten tons per linear chain of the creek beds. In some instances this has been found to extend to 30 tons per chain; but allowing for frequent interruptions by rocky bars, it will be safer to adopt the first-mentioned yield as a fair standard, upon which to base an estimate of the amount of mineral that it is probable will be raised, within the next few years, from alluvial working alone.

Of the stanniferous lodes or veins it is impossible at present to speak with any degree of certainty; the two principal ones as yet discovered are near Ballandean Head Station, and at an outlying reef of red granite, rising up in the midst of metamorphic slates and sandstone, at a spot known as the "Red Rock," and situate about six miles apart, in a north and south direction; the other crosses the Severn several times, at the point where the tin was first discovered, and the land selected by Messrs. Greenup and others.

These lodes or veins have as yet been but very partially tested; it would, therefore, be premature to give any decided opinion on them; they may, however, prove the source of an amount of wealth, the production of which would extend over many years. There are also a number of smaller lodes or veins, some of which I have not been able personally to inspect; the most promising appear to be on Law's Gully, on the claims of the Blue Mountains Mining Company, as well as on Quart-pot and Sugar-loaf Creeks; they run in parallel lines, bearing about north 50° east, commencing from near the boundary of New South Wales, opposite the Ruby Creek diggings in that colony, and again near the Broadwater, at a spot about a mile south-east from the junction of Hardy's Gully. This lode can be traced, with interruptions, all the way to the head of Spring Creek, a distance of nine or ten miles.

In describing the mineralogical character of the rocks generally, I cannot do better justice to the subject than by quoting from some valuable notes kindly furnished me by our well-known and talented geologist, Mr. D'Oyley Aplin, whose views on the subject coincides with my own observations. He says:—

"I have met with no other description of tin-ore than the peroxide (cassiterite), even in specimens from veins. The ore, so far as I have seen it, is associated with granite only, which is invariably red, *i.e.*, the felspar is a pink or red orthoclase, and the mica is generally black, but when crystals of tin-ore are found *in situ*, the mica is white.

"The granite generally is coarse-grained, and seems to disintegrate readily under atmospheric influence. There are numerous bands of loosely aggregated rock, granitoid in character, highly micaceous, and traversed by bands and veins of quartz in all directions; in these bands crystals of tin-ore are abundant, and they (the bands) seem to have constituted local feeders along the courses of drainage.

"The crystals of tin-ore are generally found embedded in and along the margin of the quartz threads or veins in those bands. In some instances they are embedded in the micaceous portions only, and the mica is invariably white in those instances in the bands referred to. The strike of the bands and the distinct quartz veins in the granite is generally north-east and south-west.

"Along the western margin of the granite a broad belt of metamorphic rocks, slates, and sandstones extend on both banks of the Severn, constituting a series of rugged, broken hills and ranges in parts difficult to traverse, except on foot. This tract of country stretches from five to six miles west of Ballandean to Maidenhead on the Severn, where the granite again appears, and also the tin ore.

"No tin floors, as at the Elsmore mine, in New South Wales, have been yet discovered."

The extent of mineral country applied for up to the present time is as follows:—Number of selections, 850; aggregate area, about 74,000 acres.

Of these, judging from those already dealt with, it is probable about one-third will be rejected as being land previously applied for or overlapping, leaving about 46,000 acres, for which permissive licenses will be issued, nearly the whole of which have been selected with frontages to the water-courses.

Although selections still continue at the rate of 50 portions per week, it cannot be maintained for more than six or eight weeks longer, without the discovery of deposits in new localities hitherto unexplored, or lodes that may be found to exist on the table-land, as nearly the entire length of the water-courses are already selected.

The population at present located on the tin fields may be set down as at the least 1,200, while it is more likely to amount to 1,500, the principal centre of occupation being the now rapidly rising private township of Stannum; the protracted delay in the sale of the government allotments in the township of Stanthorpe being the only reason why this town has not already double the number of inhabitants that are at present located on the private lands adjoining, as the majority of persons prefer purchasing government building lots to obtaining only leaseholds on the private township.

In addition to the town reserve of Stanthorpe, it will very shortly be necessary to lay out another reserve on the Severn river, about 15 miles lower down, somewhere down in the vicinity of Accommodation Creek. This will be more especially required in the event of the lodes in that locality proving equal to the anticipation of the proprietors, as the working requisite to develop them properly will give employment to a large population.

It is not easy at present to form any very accurate estimate as to the number of persons that will be required within the next twelve months to enable selections to fulfil the conditions required by the clause of the Act under which the mineral lands have been acquired, but it is scarcely possible that they can be complied with, unless at the lowest computation 5,000 persons are employed, which number, allowing a fair proportion for persons engaged in other callings, including females and children, &c., and would not give more than three persons to each 40 acres.

In reference to the probable time that will be required to work out the known beds of alluvial tin ore, it must necessarily depend upon the number of persons engaged in it, and the nature of the seasons; but under any probable conditions, it is not likely that they will be so far worked out within the next three years as to occasion any diminution of the population below from 5,000 to 8,000, and the development of workable lodes would, from necessity, permanently establish a much larger population.

The accompanying rough sketch-map* of the tin fields has been compiled, to illustrate the foregoing report, but owing to the many and urgent demands upon my time, in fulfilling the compound duties of commissioner, police magistrate, and district surveyor, I have been unable to devote sufficient time to its preparation to do it justice. I would, however, suggest that it be placed in the hands of the Surveyor-General, who, from his personal knowledge of the locality and subject, would be enabled to reduce the information it is intending to convey into a more intelligible form.

I have, &c.,
(Signed) T. F. Gregory,
Mineral Land Commissioner.

The Hon. the Secretary for Public Lands.

MONEY ORDERS FOR INDIA.

It will be remembered that last session the Council petitioned Parliament, and also memorialised the government, urging the great importance of arrangements for this purpose being made. The Council have much pleasure in announcing that the Post-office have just issued the following notice:—

On the 1st of October next, and thenceforward, money orders may be obtained at any money order office in the United Kingdom, payable at any place in British India. The commission chargeable will be uniform with that charged on money orders issued on the British colonies generally. Measures have been taken for the issue of money orders in India, payable at money order offices in this country.

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* This map, under the circumstances named in the despatch, has not been forwarded to the Society.—Ed. *S. of A.*

PROCEEDINGS OF THE SOCIETY.

THIRD COURSE OF CANTOR LECTURES.

SILICATES, SILICIDES, GLASS, AND GLASS PAINTING.

By Professor Barff.

Lecture VII.—Delivered Monday, May 27th, 1872.

Mr. Chairman, Ladies, and Gentlemen,—At our last meeting I had the pleasure of speaking to you upon different methods of glazing windows so as to produce an ornamental effect, and I mentioned a system of painting glass which is used for domestic purposes, and has, unfortunately, sometimes been introduced into churches. It is called the enamel style of painting. You will probably remember that I showed you some brown pigments mixed with flux, which are called tracing brown, and are used for giving the outline to figures in glass-painting and also for shading. Now, this is an essential and legitimate use of it. Various tints of it are employed so that we may have slightly different effects of tint in different parts, and use shadows with appropriate tints upon glass of particular colours. But when persons begin to paint with what are termed enamel colours—that is to say, with colours such as blue, yellow, green, red, and so forth; colours which are used upon porcelain, and are fit for that purpose, upon glass—then the operation becomes most objectionable, for instead of having a glass window full of brilliancy and lustre you get one which is dead, heavy, and opaque—which excludes the light, and has not that brilliancy for which stained glass is so noted, and the possession of which quality renders it so beautiful. I see with sorrow the introduction of this sort of glass-painting into churches. For instance, at St. Peter's College, Cambridge, where I was last week, there are windows which have come from Munich painted in that style, and some of the windows in St. Paul's are treated in the same way, the faces being touched with pink, and the lips made red and rosy with enamel colour. One feels a hope that now taste is changing, and is growing contrary to the introduction of this style of painting, which is wrong in principle, and therefore cannot be pleasant and satisfactory. When any one suggests that such windows as these should be put into St. Paul's Cathedral—windows, mind, which pretend to represent artistic painting—and should come in contrast with wall paintings, which must be purely artistic in such a building as that, then, I say, it is much cheaper to glaze up with the plainest glass you can get, and much better in the end; for you can yourselves well imagine what would be the effect of looking at those pictures there, and at the same time taking into your vision a stained glass window purporting to represent a painting of that class. What could be more objectionable than this? One would kill the other absolutely, whereas the proper treatment of stained glass, which I spoke of the other day, does not do this. No one imagines that those windows you see at the ends of the aisles of St. Paul's represent purely artistic work. I do not mean to say they have not artistic merit in them, but they are not intended to produce the same effect as a wall painting. The reason I introduce this subject now is because I saw a subscription list for a window in St. Paul's published in the *Journal of the Society of Arts* this last week, and I do hope and trust that those who have the management of the affair will set their faces against the introduction of anything but a work produced according to the true principles of glass-painting. The sort of glass I showed you last week is excessively beautiful; it has a very brilliant and lustrous effect. Here, again, is another kind which is very good, but not nearly so good as the other specimen. Supposing you want to put some ornamental glass in your house, why not, instead of using pink borders with white patterns, and that sort of thing, introduce glass such as this, which is exceedingly beautiful, and admits, according to its shape, of the introduction of small pieces of colour? This sort of glass was used in old times in Germany. Those of you who think of using glass at the end of passages, and in other places, will find that this will give you infinitely more satisfaction to look upon than these enamelled windows which are now mainly used for the decoration of public-houses and places of amusement.

I now pass on to another application of glass, which I have already alluded to, but which I advert to again for this reason. Mr. Lee, of Featherstone-buildings, Holborn, has sent me these specimens which are lying on the table. He has achieved what I attempted to achieve 15 or 16 years ago, but without complete success. He has found out how to print from lithographic stones on to paper, and then to transfer the pattern so printed from the paper to the glass. The ink used is of a resinous nature, and will resist the action of hydrofluoric acid, which I have already explained to you. My difficulty was this. I could never get a sufficient body of printer's ink on to the glass, but Mr. Lee has succeeded in doing so. What his process is I do not know, nor did I inquire, for he has a right to keep it secret. Here is a piece of glass which has been etched and printed as I have explained, and you see the pattern is perfectly clear and distinct. The stopping ground was printed by means of a lithographic press. Here is a smaller piece of glass, with a more elaborate pattern on it, which I am going to etch out myself, and when I have done so, I am going to rub into all the lines some silicate of potash with some dark colour. I tried this experiment, and recommended it a year and a-half or two years ago to Mr. Hawksley, a surgical instrument maker, as a method of filling in colours on thermometers to be used for medical purposes, which, being subject to friction, lose the black of the lines marked upon them. Mr. Hawksley tried the experiment according to my suggestion, and it has answered well. If this method of fixing colour upon glass will answer, there is not the least reason why it should not be employed to the exclusion of the process of firing. If we can succeed in doing it so that it will remain perfectly adherent, and stand changes of weather, then the great hindrance to the private practice of stained glass painting—namely, that it is so difficult to get the glass fired—will be removed.

There was a most ingenious plan adopted some years ago, and patented by Mr. Reece, who is at Messrs. Powell's establishment. A sheet of glass was taken and made hot in an oven or muffle, and was then pressed by means of machinery, so that the glass was embossed. That is the way those letters were made which came in fashion some years ago. They were gilt at the back, and had elaborate patterns upon them. This process is one which would admit of much more extensive application than that to which it has already been applied. However, I cannot do more now than mention this process. Glass so pressed would do well for leading up into windows, or, filled in on the embossed side with coloured cements, would make beautiful and enduring wall decorations, either for the outside or inside of buildings.

As it is mentioned in the programme of my lectures, I will say a few words in passing on the subject of enamels generally. I cannot show experiments with them, and I am sure you would not wish me to do so, for it would not be agreeable on such a hot night as this to have a furnace in the room. I will, however, mention the principle upon which enamelling is done. Many of us wear enamels on rings, brooches, watches, and so forth, and they are also used for decorating plate, and particularly for articles and utensils used in the service of religion. A plate of metal, usually gold, silver, or copper, is engraved with some pattern, which is left in the original surface of the metal; that part which is to be enamelled is cut down and the bottom left rough. For instance, here is some enamel used for enamelling watch-glass faces: the enamel is crushed to a fine powder and laid in the part cut out from the metal, and the whole is heated to a sufficiently high temperature to cause the enamel to fuse. The enamel does not run; it softens down, and sinks into the parts that have been sunk, and when it is cold it has this particularly beautiful polish—the fire polish. Some enamels are spoiled by grinding and polishing.

I cannot go into the composition of different kinds of enamels now, but probably, at same future time, I may have the opportunity of doing so.

Many years ago it was discovered that if a piece of glass was left exposed to a red heat, just sufficient to soften it, after a length of time that glass underwent a considerable change in structure. It lost its transparency and became opaque, and ceased also to be brittle. The famous French chemist, Reaumur, devoted a great deal of time to the investigation of this process of change which takes place in glass under this action of moderate and continued heat. When glass is allowed to cool suddenly from the molten state, it readily breaks, as I showed you by breaking some Prince Rupert's drops. The annealing process allowing it to cool gradually, renders it less brittle. But when glass has been treated in the way I have just explained to you, it ceases to be brittle altogether; and if the change has gone through its whole substance, you can heat a piece of glass, throw it into water and cool it suddenly, and it will not fly to pieces. This process is called *devitrification*—in what it consists I am not prepared to say. There are many theories about it. Here is a piece of common window glass which has been devitrified in the muffle you saw here the other evening. The glass has, in fact, become fibrous, and if you examine it carefully you will see that it is so. You will see a lot of little seamy fibrous forms running into one another.

Now, this devitrification is a subject of considerable interest, of interest chemically, but of greater interest as regards its applications. If vessels made in this way will not break by sudden changes of temperature, then the material would be suitable for vessels such as we chemists use; and I hope that some day or other I shall induce—probably Messrs. Powell, because they will undertake to do anything likely to be of advantage in art or manufacture—I shall probably induce them to try some experiments upon this substance. There is one peculiarity with regard to this devitrification of glass which is worthy of remark. If you take a piece of very pure glass—such as this Bohemian glass—you will have great difficulty in devitrifying it. But the more complex kinds of glass, those that contain more bases, can be easily devitrified. If anyone has at command a furnace, and will put a piece of old black bottle-glass into it, packed in a little magnesia, and let it remain for several days at a red heat, he will find when it comes out that it has lost its dark green colour, and will be like this piece here.

Now, I introduce the subject of devitrification to you because, as I have said, there are certain other applications of it which may be made; but I do it mainly for this reason, that it enables me to introduce to you a subject of very considerable interest connected with art. Here is a piece of glass which has been devitrified, and it may be broken into little tesseræ, or into any desired straight form. Here is a picture done upon this sort of glass—it is used as an opaque wall decoration, and I do not conceive that you could have a very much better system of wall decoration than this, for it is practically imperishable. It, however, requires firing, and therefore it is not within the reach of many to practice, because they cannot get these large pieces well fired. However, I think that by the use of soluble silicates the colours might be applied in such a way that they would be made to adhere sufficiently firmly to produce the same sort of effect as this. Every colour here is fired in. This figure is made in pieces, just as a stained-glass window is made. There is one piece, for instance, for the head, then the head is painted; then the drapery is cut in pieces, and so put that as little interference as possible may be made with the artist's forms. The whole is then laid together with Portland cement. It is not in a good position for inspection, for it is so heavy that there was no place to put it upon but this, and it was thought it might break down the mantelpiece if put on it. Now, I say this is useful for mural decoration. Mind, I do not for one moment class this sort of figure-drawing with what is commonly called artistic painting. Here the figures, ornaments, and all together, are used in a conventional way for decorative purposes, and are highly admissible in buildings which are so constructed as to be improved by decoration. You will also notice here that there is a great deal of gold. Now, this gold is just as imperishable as the other portions of the work. The gilding is done by a very interesting process. Here is a beautiful sample of it. This is certainly a very beautiful work, and is from Messrs. Powell's. Here is a coat-of-arms in silver, a metal that easily tarnishes, and it is on a gold background. Here is a fine pattern on the back, with the figure of a lion painted upon it. It is practically imperishable, being covered over with glass. Here, again, is a piece of glass which, if "flashed" upon transparent glass, would be ruby. This glass is gilded with thick gold leaf, and a film of fusible glass is laid upon it and then fired, not at a sufficiently high temperature to destroy the metallic state of the gold or silver, but sufficiently high to soften the glass, so that perfect adhesion takes place between it and the glass below, through the small pores which exist in the gold and silver leaf. You may very likely have seen the mosaics which have been used of late years. There are some specimens of mosaics in South Kensington Museum, and in the triangular panels under the dome of St. Paul's. Now, these are done with the small tesseræ, which are made in this way—it is a very interesting process. A piece of glass is pressed into a mould; it is then heated and drawn out, as I showed you tubes were in a former lecture, and square sticks like these are the result. These sticks are then broken into small pieces, about half an inch long, and go to form the picture. They are made of various tints, and when put together look like a piece of worsted work, but at a distance you get the appearance somewhat of a painting. These small pieces are embedded in Portland cement, so that you get a hard and an enduring work. But, then, there is great objection to its use, for where you break these sticks across you have an irregular surface reflecting lights in all directions, so that if an artist wants a high light upon the nose of a figure, for instance, the workman will probably put in a piece which will convert it into a deep shade. The gold is done in the same way. Square pieces are made, and are cut into tesseræ with a diamond. For decorative work glass mosaics do very well, but they cannot be used in high art.

I will now pass on to consider a subject which I spoke to you about when I had the pleasure of speaking to you for the first time a year ago, namely, silicious painting. I could then say but little about it in comparison with what I can say now. I mentioned to you then that I had often tried the method I recommended upon walls, and I also explained to you Professor Fuchs' process, the one commenced in Munich and used by Kaulbach in the pictures at Berlin, and by Mr. Herbert in that magnificent picture of his in the House of Lords. Anyone who looks at that picture must be struck with the wonderful luminosity it presents. You see a series of figures standing out stereoscopically from the background, which is almost the same colour as the figures. This effect depends, of course, upon the ability and talent of the artist. But look at the sky, and there you have a wonderful luminosity. If you look at the heavy sky of an oil-painting, and then compare it with the back-ground of that picture, you wil see what is meant by luminosity. The light comes through that blue to your eye. There is a back-ground in that painting of pure white; and that white has its value, producing the effect of transparency. When we look at any coloured object the colours are reflected back to our eye. For instance, a red ground sends back red rays to our eyes, and a green sends back green rays, but all the while we are seeing this by the aid of white light, and in a picture we ought to have that which represents the white light, and this you cannot get as well in oil-painting as in fresco or silicious painting. The value of a white ground for painting is now being recognised by many of the most advanced artists of this country; but they cannot properly produce the effect of luminosity, and they will never be able to do it with an oil vehicle.

Since I last spoke to you on the subject of silicious painting, I have been able to get over a difficulty which was felt to be a great one, and is alluded to by Professor Fuchs in his treatise, which was published, I believe, by the Society of Arts. It was this:—He said that some day or other some one would find out a method of applying this method to canvas, so that artists will be able to paint in their studies, and not of necessity have to climb unpleasant scaffolds to paint upon walls. I have turned my attention to preparing canvas for this method of painting, and have succeeded in meeting the requirements of every artist who wishes to undertake silicious painting. This process has been tried, on a small scale, by Mr. Newton, who I have the pleasure of seeing before me to-night. He said there were certain difficulties to be got over so as to admit of its application by the ordinary methods employed in making the ordinary oil-colour canvas; but these difficulties have now been overcome, and although he has not yet tried my later process, I am sure that when he does so he will find that they will be able, by means of trowels, to lay on canvas the proper coating materials.

Probably some of you may not know that canvasses are coated with long trowels—that the colour is not put on with a brush. The thing is to have a material which can be used for this purpose in such a way as to keep down the little fluffy threads of the canvas. I had hoped to have been able to show you one or two paintings upon canvas executed by artists of distinction; but I am disappointed, for I find I cannot exactly rely upon their punctuality, although they have had the materials for some time. I have here, however, a letter from one of them—Mr. Herbert—stating his opinion of this system of painting, and will read it to you.

"My Dear Sir,—I have not time to say all I wish respecting silicate in the way you suggest its being used. To my mind it is perfect, though certainly not the one suited to repeat the productions of a past age, but for those who paint the great now, to be known and honoured in the future, it is pre-eminently the one, for it insists upon progress; and every artist who will take the trouble to overcome some little difficulties in its use will soon find himself in the way to produce works which a thinking public will quickly appreciate. I shall wish you all success in your labour in making known the obstacles and the ruin which the use of oils occasion."

That is a letter, rather strongly expressed, from a gentleman who is a great authority in the world of art, and I am quite sure that he does not speak too strongly in its favour. If any of you here are accustomed to practise painting, and will yourselves try this material I am perfectly satisfied that if you get accustomed to it you will be delighted with it, because it will enable you to use the colours as you have them, which no oil vehicle will permit you to do. If you mix a colour with oil you know its tone goes down at once, and then, in order to heighten it, you have to mix it with white lead, or some such substance, to produce the tint you require, whereby you absolutely destroy the character of the pigment you are using. But if you treat it with this silicious vehicle, you have nothing but the colour used, together with the material binding it to the surface in an indelible manner, which material does not destroy the value of the colour you use. Now, this is matter of considerable importance. I hope before long that Messrs Newton will be able to supply this canvas to those who desire to have it, and also the materials, but, of course, it is a work of time to perfect a thing of this kind. I had hoped to show you how upon some of this white canvas, which I have myself prepared, the colours may be placed, and when they are dry they are perfectly indelible and quite firm. You can put them in water and let them float for days, and they will not come off. As I cannot do this to-night, I will do the next best thing. I have here a sheet of white paper, which has a little size in it, and I shall be able to show you an experiment or two with the colours I have here. The material used for dilution is silicate of potash—and you know all about it now—and with it is mixed aluminate of potash. The reason the aluminate is used is that silicate of potash and aluminate of potash, when they act upon one another, produce a substance which is like felspar, which is a constituent of granite. Now, here is a specimen of this material made many years ago. It is a hard substance, produced by the mixing of these two materials, which I shall use in solution presently. It will suggest itself to you that these pieces look brittle, and and so they are; but when you impregnate the canvas with them, with the admixture of another material, which I will mention presently, we find it becomes tough, and that, if you draw your fingers along the back of the canvas, it will not crack. The difficulty I experienced was this, that on drawing my thumb along the canvas it would show cracks, but when the canvas went back again the cracks closed. At all events, that difficulty is now overcome. The substance which I have used is glycerine—a small quantity is mixed with the silicate and aluminate of potash.

But you will say, you are introducing into inorganic materials an organic material, and that inorganic materials are those substances which are unchangeable in the main, and therefore the most enduring. If you introduce an organic material you introduce some substance which will in time decay.

Now, I will recal your attention to my first lecture. Probably you wondered what I could be driving at by talking to you as I did about the replacement of silicon by carbon; and I believe some of you were a little dissatisfied, and thought it did not bear upon the subject. But it does, and you will see how; and moreover it did this—it brought to me a most interesting pamphlet from a gentleman who was present on that occasion. The gentleman is Mr. Hawkins Johnson.* It was on the subject of the formation of flints in chalk; and the writer says that at the bottom of the sea he imagines there is (and he quotes Professor Huxley) a layer of organic substance called protoplasm, that in sea-water there is a small quantity of silica—small in proportion in any given measure, but large in the mass, and that the silicon in the silica and the carbon in the organic matter change places, so that we do get in this organic matrix, if I may so call it, an interchange between silicon and carbon, and instead of protoplasm you get, in the place of it, flint. I will not say any more about it except this, that Professor Morris is of the same opinion. When I talked to him about it some time ago he said he should come to this lecture, but I do not see him here. Now, there are certain organic substances, such, for instance, as glycerine, which, when used with silicates, unite with them, and form a true chemical compound. Possibly in time there may be an interchange—I believe there is—between the silicon and carbon, so that the introduction of glycerine is not a source of decay, but, on the contrary, will be the means of rendering the painting, or whatever it may be, firm, stable, and lasting. I showed you a beautiful specimen of this silicic acid and glycerine, which was lent me by Mr. Roberts, the chemist, of the Mint, and which was made by the late Professor Graham. It was a body in which the glycerine and silicic acid had now entered into chemical union. The glycerine, too, has this advantage—that it does somewhat make up for that "deliciousness," as it is termed by artists, of painting with a smooth fatty substance like oil. Now, I will mix this ultramarine blue with this solution, and put it on this piece of paper, and during the lecture the colour will dry, and by the time the lecture is over it will be pretty nearly hard and fixed. It may take a little longer to get perfectly hard, but by to-morrow it will be so firmly fixed that you may put it in water and it will not come off. Those who were present at my last course of lectures will remember that I had some specimens treated in this way, and that they were put in water some hours previous to the lecture, and were examined afterwards. I do not know that there is any occasion to try any other colour. Here you see we have not got the silicious ground, but simply common paper; but if you saturated that paper with dilute silicate, you would have an extra bond, which would hold the colour more firmly. I should recommend that process to be used if you adopt silicious painting on paper. Coat the paper with dilute silicate and aluminate, and then use this material, silicate and glycerine, and you will find that your colours will adhere firmly.

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* A paper read before the Geologists' Association, June 2nd, 1871.

On the evening of my first lecture I received a letter, without a name to it, in which I was asked to explain how it was that the famous painting by Maclise, "The Meeting of Wellington and Blucher," in the House of Lords, was coated all over with an apparent mildew. I did not notice the letter then, because that was not the time for me to speak upon the subject, but I have borne it in mind, and now I will tell you how it has happened. This particular difficulty has been experienced by most who have tried silicious painting. Silicate of potash usually contains an excess of alkali. It is acted upon by the air, and then carbonate is formed, and as this goes on a certain quantity of silicic acid is set free. You remember I showed you an experiment in which carbonic acid precipitated silicic acid; so that in the case of a quantity being contained in a vessel, there will be more silicic acid in the lower portion of the silicate and less in the upper portion. Now, Mr. Herbert, who was intimate with Mr. Maclise, has told me that Mr. Maclise was continually painting with the top of his silicate and not the bottom, and the consequence was he was using an insufficient quantity of silica in the silicate. There was also no doubt some sulphate in the silicate. When the picture was finished, this sulphate and carbonate came out. I fancy you all know that if you take a lump of common washing soda and leave it for a time, it becomes covered with white powder; this is called an efflorescence. If you destroy it with moisture, you will find it will soon show itself again as the soda dries. The soda will keep on efflorescing. That is what is going on in the picture by Mr. Maclise. In the other picture—that of "The Battle of Trafalgar"—you do not find this to be the case; there is only a little efflorescence in one or two parts. Now, that picture was differently painted. It was painted with much better silicate, and with much greater care. My authority for this statement is Mr. Herbert, and he and Mr. Maclise were perpetually together while the work was going on. In the "Battle of Trafalgar" a large quantity of zinc white was used, and that prevents efflorescence. One reason why I introduced aluminate of potash along with the slicate of potash was to prevent this efflorescence, and it does so effectually. If you will coat a wall with this material you will never get efflorescence on that wall.

There are methods, no doubt, by which this efflorence may be got rid of in existing pictures. At present my idea is that the proper thing would be to wash them over with some salts, which would convert the efflorescent salts into deliquescent ones. I hope to be allowed to try an experiment on a small part of one of the pictures some day. My idea is that some acetate, say acetate of baryta, would do, for when applied to the picture, sulphate and carbonate of baryta, which are insoluble, would be formed, and deliquescent acetate of potash. I believe some such method as that might be employed, so that we might have that beautiful picture without its present disfigurement.

I will suggest a method in which silicious painting may be used in conjunction with oil or varnish painting. It is the custom to admire an old painting, and especially the works of certain old masters, though oftentimes very little of their own work is seen. For my part, I care not whether a picture is painted by an old master or not, if it does but truly represent nature, and if the principles on which it is treated will bear the test of scientific investigation, for what is not true cannot be beautiful, and the artist's imagination and creative powers have limits set to them by nature. Some time ago I was asked by Mr. Leighton to examine a piece of a picture by Tintoretto. I did so, and analysed parts of it very carefully. I removed, little by little, all the varnish, and whatever came between me and the canvas, and I found that the whole of the picture was painted up to a high degree of perfection in distemper. It was not painted in oil at all at first. Not only was it painted in whites and greys, but painted in and shaded up to a considerable amount of finish, and all this was done in distemper. The vehicles used were size and starch, and no oil whatever; and then afterwards the painting was painted with oil or varnish, I cannot tell which at this distance of time. The glazings were put on with some resinons substance. Certainly this method of painting has wonderful advantages. When an artist puts a touch on a canvas with such materials he knows exactly what he is doing, and never depends upon chance effects. There is no running together, there is no "cessing," as in oil, in the use of this material, with which it is quite clear the old masters did produce some wonderful effects, as we see when we come to clean their works, for this Tintoretto was almost invisible before the covering of varnish was taken off, but when it was the extreme beauty of his work was manifest.

Now, the silicious method of painting may be used up to a certain point. Supposing an artist wants to glaze with lake, he cannot do it with silicious painting, because the potash will not allow of it. But there is not the slightest reason why he should not use the lake as a glaze, providing he does it with the knowledge that in years to come the lake, being fugitive, may disappear. There is nothing to prevent the use of silicate, and then of resinous vehicles upon that silicate. You can have the first painting done in silicate, which will be more enduring than distemper, and then afterwards you can glaze it with transparent colours used with resinous vehicles.

I must, however, with this hint leave this subject, ladies and gentleman. It will lead me too far. It is a subject in which I feel greatly interested, as I do in that of stained-glass, and there also I kept you too long.

I have two other matters to speak to you about, and will, therefore, pass on to them, for they are of importance in the applications of silica. I have here lying on the table some blocks of excessively hard material. You can examine them for yourselves after the lecture, and you will find that they are as hard as granite. Here is some of the same material pressed into moulds, showing that it is capable of being moulded. Now, this is used for paving; and a piece of pavement of this material has been laid down opposite the Mansion-house, and I have been informed by the patentee, the Rev. Mr. Highton, that the pavement is standing and wearing better than the Yorkshire flags. I feel interested in all applications of silicates. For the last twenty years I have been working upon them; and upon this very subject also have I been working, though not with the success with which Mr. Highton has done, for he has hit upon a plan of doing the thing in an economical way, whereas my method was rather too expensive to be generally used. You here see a lump of material which is called Farnham sand, and some of this lump is here crushed to a fine powder. This Farnham sand contains 50 or 60 per cent. of what is called soluble silica. Ordinary sand must be melted with soda of potash in order to convert it into glass prior to making it soluble. This Farnham sand requires nothing of the kind. If you put this into silicate of potash the soluble silica will be dissolved, even in the cold, by any excess of potash which may exist in the solution of silicate of potash. These blocks are made in the ordinary way. They are made of granite chippings, mixed with Portland cement, and cast into this form. The blocks are piled up, one upon another in a tank, and the whole is filled in with silicate of soda, and the silica from the silicate of soda goes into these blocks and forms silicate of lime with some of the lime which is in the Portland cement. The carbonic acid that is taken up by the silicate of soda also leaves the soda and goes to the lime, so that the caustic soda is able to dissolve the soluble silica of the Farnham sand, which is added in quantities. You remember an experiment I showed you, to the effect that lime can take carbonic acid from carbonate of soda. From the hardness of this block you will see there is penetration throughout nearly the whole of it. Now an invention of this kind is useful in various ways. There are certain wall decorations which it is perfectly admissible to repeat, and which may be cast in moulds. I should not advocate its being used in the place of carving, but it might fairly be used for certain purposes outside of buildings where cement is now used, and it would not be acted upon by damp. The use of silicate of soda and silicate of potash, together with other materials, as a protection for stone, has been before the public for a long time; but the difficulty that one has had to contend with has been this, namely, we cannot get it to penetrate the stone to any depth, and when we do get it to do so it will not hold the disintegrated particles together and bind them into a solid mass. I tried an experiment upon some old stones which were crumbling away, and I found that the decayed portions must be removed before the application of the silicate. There is a great deal yet to be done before soluble silicates can be used with much success in coating stone. At present we only get them in just skin deep; but if soluble silicates are to be used they should be used with some such substance as the alumina of potash, which causes a rapid hardening, and prevents efflorescence.

I have also had sent to me, within the last week or two, an interesting specimen of a peculiar kind of ironstone, in which there is a large per-centage of silica. Colonel Malcolm sent it to me, and explained his views about it. What he suggests is this, that it should be used as a silicious paint. Now, to use any silicate with oil paint is no advantage. The silicate destroys the body of the paint, and if you mix oil with finely powdered silica you will find you get a semi-transparent substance. It will not add body to the paint, but he says that it has been used for coating ships' bottoms, and that it is very much better than red lead for that purpose. That may or may not be the case. It is not my business to advocate anything which I do not understand myself.

I had a letter from his agent, telling me about its merits, but I believe it would be useful for silicate painting. Containing such a quantity of silica as it does, it will be a capital material to use when calcined, because any substance which contains much silica will unite readily and firmly with a soluble silicate, and with it will form a hard and an enduring mass. I speak about it because I hope it will be useful as a pigment for silicious painting, and I do hope silicious painting will not be confined to artistic work, but that before many years are over it will take the place of ordinary oil painting for the outside of houses.

There is one other point in the application of silicates which I must refer to, and it is this. We are continually having houses burnt down and destroyed by fire. How does that happen? Lucifer matches are carelessly thrown down, and the house catches fire. Any commercial man who will take up this will find it will pay him to do so. It is a wonderful desideratum. Here is a piece of ordinary firewood, and it may be held any length of time in this flame, and it will not burn. It will be a long time before it will char. In my first course of lectures, when I spoke to you about this, I could only show you a piece of paper, which did not illustrate the thing properly. Here you see this piece of wood is resisting the action of the fire. Mr. Lewis told me that he actually took a blow-pipe and burnt a hole through a piece of wood without its flaming. If the woodwork of a house—the mouldings, the doors, the window-jambs, and so forth—were to be impregnated with this material before being put in their place, they would not catch fire. The beds, curtains, and similar articles would burn out and leave the woodwork simply scorched. This impregnation of the wood is easily effected. At present railway-sleepers are impregnated with creosote. The sleepers are put into chambers from which the air has been exhausted, and the creosote is left to run in. It gets into all the pores of the wood which were formerly filled with air, but out of which the air has been drawn. If you treat the wood with silicate, instead of creosote, it will penetrate in the same manner. The silicate will go right through the substance of the wood, making it extremely tough and strong, and also, you see, rendering it uninflammable.

I have now come to the conclusion of this course of lectures, which has been one of great interest to myself, and I hope it has been of some interest, and of some use also, to you. My object all through has been to give you, as far as I could, a reasonable and scientific explanation of the various applications which may be made of silicates in arts and manufactures. My lectures have been full of imperfections; I feel it myself; and I have never left this theatre without feeling that I ought to have said a great many things that I have not said, and some things that I have said might perhaps better have been left unsaid. All I can say, in conclusion, is this: you have borne with me most patiently under these deficiencies and imperfections, and when I come to revise the proofs of my lectures I will do my best to alter them, and send them, with as few faults as possible, through the press. Any small mistakes I will correct, and also, I may add, some matters which I have been obliged to leave unsaid, and which when written will have greater effect, perhaps, than if I had given them by word of mouth. I thank you very much, ladies and gentlemen, for your kindness and attention.

The lecturer, who had been frequently applauded during the delivery of the foregoing address, was then awarded a hearty vote of thanks, which he briefly and suitably acknowledged.

ANNUAL INTERNATIONAL EXHIBITIONS.

The offices of the Commissioners are at Upper Kensington-gore, London, W., Major-General Scott, C.B., secretary.

For the general convenience of the public and of the exhibitors, it has been resolved to keep the Exhibition open till Saturday, the 19th October. During the last fortnight small portable objects in the Exhibition which have been sold may be removed by the purchasers, as was done at the International Exhibition of 1862.

EXHIBITIONS.

VIENNA EXHIBITION.—USE OF WASTE MATERIALS AND THEIR PRODUCTS.

It has already been announced that it is intended to have a special department at the Vienna Exhibition next year, illustrative of the utilisation of waste products since 1851. Mr. P. L. Simmonds, who has given much attention to the subject, by various papers read before the Society of Arts, and the publication of a special work on the subject, has undertaken for the Austrian Commissioners the formation of such a collection, to be shown in the British section, and will be glad to be favoured with any specimens illustrative of such processes, and communications and statistics from manufacturers and others, which can be addressed to him at his office, 29, Cheapside. The following circular on the subject has been issued by the Austrian Commission:—

The consumption of soap and paper, the quantity of letters exchanged, the extension of public libraries, and the use made of them, &c., are often taken as a measure of the actual degree of civilisation of a nation. An extensive and refined use made of the waste materials of industry and housekeeping might be considered with equal right as the measure of the degree of industrial development and capability. It would also scarcely be possible to find in the processes of manufacture and in agriculture an instance which shows to the same extent the really creative force of science and the characteristic tendency of a nation to economise, so well as its endeavour to keep, like nature, all within the circle of reproduction. Side by side with the increase and growth of wants, we see the quantity of useful material augment in a twofold manner. This is accomplished partly by making use of substances formerly useless, because their qualities were unknown; but still more by the use made of substances which, formerly considered as used up, appeared to be of no value, and were often incommodious, and in many cases troublesome. In order to prove, only by a few actual cases, the assertion last made, that the use of waste materials increases, and that thus difficulties are removed, and that the wealth of the nation at the same time increases, it is only necessary to take for an example the quantities of waste materials of soda factories, which were formerly a real nuisance. Now-a-days, a great part of the sulphur contained in them is extracted, and the remainder, containing chalk and gypsum, is employed as valuable material for agriculture. The acid manganese solutions of chloride of lime factories have become restored to use by means of an ingenious chemical process. The scoriæ of metals produced by blast furnaces is used now-a-days in glass-making, and becomes, by a simple physical process called basalting, a substance useful in the construction of buildings and streets. Coal and wood-tar play, in our time, an important part. It is sufficient to call to mind the beautiful aniline colours, without speaking of a host of substances which have become useful, like benzine, paraffin, creosote, carbolic acid, pyrocatechin acid, &c. Injurious and even poisonous gases, which escape during the process of smelting (sulphuric acid, arsenic, zinc vapours, &c.), have not only been rendered innocuous, by contrivances to condense and absorb them, but have even been rendered very useful. Cotton seed, which was formerly utterly useless, acquired an increased importance from the moment when the means of making oil from it was discovered. So also with soap lees from laundries, for we know how to obtain fat acids from them. Before the International Exhibition of London, in the year 1851, the glycerine in the factories of stearic acid and candle manufactures, and the ammonia in coal-gas, were lost altogether; since then they have both become important objects of manufacture. Woollen rags, which were formerly only used for the production of Prussian blue and inferior paper, but which were for the most part thrown on the waste heap, have now become raw materials, just as well as silk and cotton refuse for textile industry, and thus render very respectable clothing material accessible even to persons of very moderate means. The distillers' wash, produced in molasses distilleries, and which was formerly thrown away, has become just as useful for the reproduction of potash, which is obtained from it, and which forms the base of so many valuable alkaline salts; blood became useful for the production of albumen; cork-cutters' refuse for the manufacture of floor-cloths; old horse-shoe nails and other scrap iron for the fabrication of the soft and malleable iron for English fowling-pieces; and so on with sawdust and leather refuse, &c. How large we find the amount of the useful material and the means of satisfying our requirements by a retrospective view of the last ten or twenty years only! It suffices to single out, from the host of substances the value of which has been thus increased, one much more despised material, viz., human excrements. Without contradiction, these are considered as some of the most disgusting wastes; nevertheless, China and Japan mainly owe their flourishing agriculture to the extensive use made of them; and one of the greatest chemists of our time, Baron Liebig, has acknowledged that they contain the means of restoring to the soil of Europe its power of production, a power which will soon be exhausted otherwise. Considering this, is it not to be called one of the greatest absurdities to spend millions in getting rid of a substance which would, if we made proper use of it, make us by several millions richer? Who can deny that the increasing use of wastes, and the development thus made of new and abundant resources, and the thus facilitated removal of so much which annoyed us, proves beyond all doubt the great influence which science exercises upon life, and obliges even a superficial observer to remark the gradual development of intelligence and prosperity. Who can deny that when one observes the use made of waste material during a certain given space of time, a new picture of civilisation unfolds itself? It might, therefore, in consideration of this, appear worth while making the trial, and worthy of the assistance of men of science as well as of men of industry, to form in the Vienna Universal Exhibition of 1873 a representation of the reclamation of articles of commerce from refuse. In order to define limits to this special exhibition, the value of which lies in its instructive importance, it is, firstly, necessary to give, as exactly as possible, the meaning of the word waste. The manufacturer considers as wastes those remains of the used raw and auxiliary substances after he has obtained the principal and secondary products, and which, at the time, have little or no value in comparison with that which has been produced. But still, the whole meaning of the term waste, the circle of that which should be shown, is still to be extended, so far as to include all that remains over after anything has been made use of, and which economy considers of no further use. 1. The objects which, according to this definition, are to be considered as wastes, form the nucleus of this exhibition. 2. Concerning the period of discovery which this exhibition is to entend over, it agrees with the regulations made for other groups and other special exhibitions, and dates back to the year 1851. 3. According to the system of classification of this exhibition, there would be shown in this special department, on the one hand, the wastes which are to be found in every industrial group; on the other hand, the products which have been obtained from these wastes since the year 1851, either as quite new products or only old ones improved or cheapened. It should comprise all intermediate products between the wastes themselves and the manufactured market goods. The exhibition should consist as much as possible of the original objects themselves; only when this is not possible, or seems inadmissible, graphic data will replace them. To the objects ought to be fixed prices, statistical statements of production, the name of the person to whom the realisation of the value, or the greater profit made out of the wastes, is due, as well as all other statements relating to the history of the product reclaimed from them; finally, it is desirable that models should be exhibited, or that the machines by the use of which this increase of value has been obtained should be indicated.

Sale of Works of Art at the Milan Exhibition.—The much-admired statue, entitled "The Genius of Franklin," by Giulio Monteverde, at the Exhibition of Fine Arts at Milan, has been purchased by the Viceroy of Egypt for 20,000 francs, who has also paid 25,000 francs for a painting by Pagliano, representing "Silvestro Aldebrandi refusing to dance with Maramaldo, the murderer of Ferruccio."

Exhibition of School Apparatus.—An Exhibition is now open at Utrecht of a large collection of books, apparatus, utensils, and other materials of public school education. It is not stated whether there are any foreign contributions.

CORRESPONDENCE.

IMPROVED TELEGRAPHY, &c.

Sir,—I find occasion to explain certain propositions of mine to Mr. Richard Herring, which he has briefly, but somewhat prematurely, published in the *Times* of 11th September.

My plans comprehend the use of symbols, phonetic, alphabetic, and otherwise, to be produced, multiplied, and transmitted in various ways; developments of my main object—long known to scientific friends—a simplification of teaching at the earliest stage, and in advance of the primer with its diversity of alphabets—capital, small-case, script, &c.

The contrarieties of English orthography, instead of being postponed to a fitting period, baffle mere infants required to pronounce c a t—not *set* but *kat*—and to recognise *cough* otherwise than by the eye. I propose simple symbols for distinctive sounds (not *c* hard and *c* soft by the same symbol), until the correspondence of such symbols with their various alphabetical equivalents, may be learned with as much facility (by mere juxta-position) as is the identity of big "A" and little "a" in primers. Advantage may, moreover, be taken of the childish greed for simple tales, to clothe such in the common alphabets which have to be identified with the preparatory symbols at a later stage, as a labour of love, not an irksome task.

In other countries, and notably in Germany, reading, as generally understood, is rarely taught before six years of age, and then by the *lautirung* system (unavailable for our language), or by grouping letters, not spelling them, the method by which our ripest scholars test their own orthography.

Be it observed, that suitable symbols for sounds or letters will never need to be discarded, if adapted for use through life, as shorthand, *e.g.*, Mr. Pitman's system, that of Mr. Moon for the blind, and the like.

As developments of my original ideas may be instanced —methods for reporting spoken languages, not necessarily understood by the reporter, at least as rapidly as they can be intelligibly uttered; methods for immediate transmission of such reports telegraphically; methods of printing off such matter for transmission in circulars, say by post, without intervention of type-printers or lithographers.

I desire it to be understood that my labours in this direction have been rather to disseminate any advantages derivable therefrom as an educational help, than to acquire exclusive rights. From that point of view I have sought to ascertain what others have already achieved and are willing to see adapted to common aims, so as to spare occasion for alternative, or, possibly, competitive inventions. To Mr. Herring I owe a courteous recognition of my aims, and an illustration of how his own ingenious instrument could transmit the Morse alphabet with increased rapidity, by adaptations suggested to him; that is to say, by means of a digit board, as in a harpsichord, the keys of which may control one or more electrical currents, and produce symbols, either phonetic or alphabetical, just as musical chords are struck, simultaneously, instead of successively, as in the case of dots and dashes for the Morse alphabet, with at least fourfold expenditure of time.—I am, &c., Jacob A. Franklin.

London Institution, Finsbury-circus, E.C.,
16th September, 1872.

TELEGRAPHY WITHOUT INSULATION.

Sir,—It may interest your readers to know that the other day I had an opportunity of trying my system of telegraphy, as exhibited to the Society of Arts in May last, through 150 miles of uninsulated wire under water, and found no difficulty in working it. My experiments on this 150 miles more than confirmed the conclusions I drew in my paper from the experiments then exhibited. I hope in a few days to have an opportunity of trying through 600 or 700 miles of wire merely covered with hemp and pitch; but the ease with which 150 miles was accomplished leaves no doubt of the practicability of the system which I then proposed for any distance.—I am, &c., H. Highton.

2, The Cedars, Putney, September 16th, 1872.

COAL SUPPLY.

Sir,—The able president of the Mechanical Section, in his address at the recent meeting of the British Association at Brighton, has touched upon a subject which not only has been discussed in other sections, but is now engaging the attention of almost every person throughout the kingdom.

The high price of coal, and the increase in its consumption, force us seriously to reflect upon its use and abuse.

Without entering into the question as to where we are to get our future supply of coal from, or to predict the probable exhaustion of our coal beds, which no amount of argument can possibly settle, I shall again refer to Mr. Bramwell's address, where the question of finding sources other than coal for motive power was discussed. I am surprised to find, however, that he makes no mention of compressed air as motive power, and which has certainly not received the attention that it deserves from English engineers.

The success of the Mont Cenis tunnel has proved that compressed air may be transmitted to great distances without any considerable loss.

The vast force of the tides, as Mr. Bramwell observes, might be taken advantage of along the coast for supplying motive power; not, however, by setting turbines in motion, and distributing power by means of endless bands, as he described, but by the compression of air, which could be transmitted to inland manufacturing towns, to replace the steam-engines now consuming so large a quantity of our coal.*

A new field of enterprise is now open to engineers, and I may venture to predict that, at no very distant period from the present, motive power, in the form of compressed air, will be laid on, like gas or water, to the door of the manufactory.—I am, &c.,

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* Tomasi, in the International Exhibition last year, showed plans for effecting this compression of air by means of the tides.—Sec. Soc. of Arts.

AN ANGLO ITALIAN.

14th September, 1872.

ARTIFICIAL COAL.

SIR,—As the approaching winter appears to foreshadow "hard times" to the poor, and even to the middle-classes of this country, it behoves every one who has anything to suggest to ameliorate the condition of the people, to bring it forth at once, if at all practicable and useful. Now, I have not only thought much about, but put in practice, the making for my own household use artificial coal, which answers every purpose desired in the experiment. Artificial marble and granite are made almost as beautiful and durable as Nature's original, and I have practically proved that artificial coal can be produced which will save at least 30 per cent. of the expenses of coal in all households, works, and vessels, or engines, requiring it.

I will first enumerate a few preliminaries :—

1st. It is made much as nature makes it, and partly of the same materials, as will further be explained.

2nd. With the exception of the bituminous or oily substances used, the whole of the materials cost nothing—in fact, are objects of refuse, or nuisances, which cost both households and municipal bodies large sums of money to get rid of.

3rd. Every household can make it for itself, or companies can be formed to make it on a large scale to leave daily or weekly to purchasers.

The *modus operandi* is as follows :—It will be understood that in burning Nature's coal, it is the bituminous, or oily, substance that burns, not the gritty or earthy substance which is left in the form of coke and cinders. Now, I take these cinders, and pounding them, not too fine, but about the size of marbles ; I put to them any bituminous or oily substance that will coagulate (oils that will not set in this way will not do), and in this department it may be observed that any animal fat, suet, &c., that is often wasted in a house, will all come in useful.

Having added this in a quantity—everyone will soon find out how much is required—I add some chopped straw or hay, or any kind of weeds dried, such as straw, grass, thistles, gorse, ferns, thin branches of anything floral, in fact, anything that is combustible, and mix with the cinders, these last being to cause the composition to adhere, and the whole being saturated with the bituminous or oily subtances, as much is put on to a piece of waste paper, with a piece or two of chip of wood (such as is used for lighting firss) at the bottom and top, and to make in bulk the size of a turf or half a brick, and wrapped up and tied, laid under a moderate pressure for a few days, and then piled up for use. The householder will then find that he has all the materials for lighting a fire in one paper, which ignites immediately, and does not go out, as is the tormenting habit of many fires. One or two turf-sized mixtures will last about three hours, will give out little flame and less smoke, will soon get into a red-heat, and will leave a mixture that can be used again. We must caution that this is not to supersede the use of coal, but to materially lessen the use of it. To those who can get an unlimited supply of cinders free of expense it may supersede coal altogether. As long as Nature's ample supply is disregarded, and man does not avail himself of what is provided for him, I offer this simply as a saving to the poor.

It is said the future of coal-fields is too deep to be made available. I quite differ with this. God makes all things to be used, and the varied depths of coal is only a portion of that infinite wisdom that governs all things, whereby the coal that is given for man's use may not be all used by one or two generations, but when the science of one has used its share, the science of another will find the skill and the means to get at its lower depths.—I am, &c., W. G. HERDMAN.

Everton, Liverpool.

THE VENTILATION OF OUR HOUSES OF PARLIAMENT.

SIR,—It is by no means the first time that your correspondent, Mr. H. F. Alexander, has made appearance in this *Journal* in support of the patent laws as they now stand, and being a well-known patent agent, he is perfectly justified in so doing. I also observe that he is singularly backed up by the extravagant statement purporting to be from the Hon. Horace Greeley, who asserts that all private property, equally with the inventions of the brain, should be protected by the State.

But both these gentlemen fail to see that no invention of the brain can be valued as property until it has been accepted and adopted by the public. Now, "probabilities" having no stand-point in laws, it is utterly impossible for any man, or body of men, to decide before-hand whether a so-called invention or improvement will or will not be taken into general use; and until that fact be ascertained all rewards, premiums, or privileges are out of place, and wasted upon any such imaginary inventions. In fact, it is only necessary to run down the monthly list of registered patents, in order to see that 99 out of every 100 are of a worthless or futile nature, thus forming a lottery wherein the opulent waste their means, and the poor man meets his ruin.

Messrs. Boulton and Watt, perhaps the most successful of patentees, owing to enormous legal expenses, made no profits during the first ten years, and were compelled to make application to Parliament for an extension of their patent rights to the term of 21 years.

Under such circumstances, what can be the value of any patent law whatever—a law, be it observed, that took its rise in the iniquitous granting by the sovereign of exclusive privileges to certain merchant adventurers for trading to unknown and distant lands, to the total exclusion of all the rest of the inhabitants of this globe. Among hundreds, need I instance the Old East India or the Hudson's Bay Companies.

There can be no doubt about the propriety of rewarding meritorious inventions, but how to do so without waste or injustice is the great question so much discussed in regard to any possible improvement in the existing system of patent laws ; and I should not like to say how many thick volumes might be compiled from the disasters of patentees. To reward all inventions, or such so-called, indiscriminately, would be the height of folly, and to wait until success be proved would be equally useless, for in that case the inventors would get their own reward freely from the public.

The fact is, that the patent system is mainly upheld by those who are connected with trade and manufacture, and who usually adopt the very high sounding title of—"Her Gracious Majesty having been pleased to grant royal letters patent to Messrs. Brown, Jones, Robinson, and Company, for their valuable invention of an improved corkscrew, &c., &c."

I may here observe that really valuable inventions do not usually emanate from professionals, but from poor outsiders, who are, of course, bought up by rich capitalists. For when a patent is taken out, the first expense is but small, in order, however, to secure it many riders may have to be taken out, and all piracies and infringements to be fought and defended in the Court of Chancery; so that no patent is considered absolutely secure until it has gone through that ordeal, and has cost thousands of pounds, Brett's patent capsules, and Bovill's patent millstone ventilator, to wit.

In regard to your Edinburgh correspondent's strictures upon downward ventilation, I have nothing to say, for with a show of deep science that gentleman has condensed as much absurdity as could be compressed in the space, and all his difficulties are of an entirely imaginary character.

Yours truly,
HENRY W. REVELEY.
Reading, September 16th, 1872.

SILK AND WOOLLEN DYES OF KASHMIR.

SIR,—In the autumn of 1860 I made my first botanising tour in Kashmîr, and had my attention drawn to the dyes used in Sirînaggar—the capital of that country, near the centre of the lovely valley of that name, on the Jhelam, at 5,000 feet above the sea-level—by some notes in Mr. Vigne's book. He appears to have been a gentleman of some fortune, who travelled in that part in 1838, and in Persia and other countries.

I may as well begin with an abstract of what he states as to these dyes, and I premise that he seems to have known but little of the vernacular of India and Kashmîr, and nothing of botany.

He notes that the shawl-wool, which comes from the elevated western Tibetan tracts, is never dyed until it is made into thread, and that there are about 40 kinds of dyes, but, of course, many of these are only shades of the same colour.

1. Blues and purples are got chiefly from indigo. 2. Blacks and light brown from iron filings and wild pomegranate skins. 3. Drab from walnut skins. 4. Reds, from kermes and logwood, and a native wood called *Lin*. 5. Finest of the greens and a light-blue are extracted from English green baize. 6. Yellow from a Panjâbi flower, *Gûlîkysû*, and from a grass called *Woftûngil.*

With regard to these, I may mention that on the occasion of my first visit to Sirînaggar, two Frenchmen, one Mons. Anjeaunnet, who were there, buying Kashmîr shawls for Paris houses—strange that all those sold in England come through the former, and no English house has had pluck or sense enough to send an agent to buy for them on the spot—were very civil and hospitable to me and my chum. I mentioned that I wished to know about the dyes, and asked if they had any pull on the dyers. "Oh! yes; we can get you any information you want." So we got rowed up in their boat with them to a chief dyer, and "I speered and back-speered" him—as the Scotch phrase has it—and saw the processes going on.

With my then knowledge of plants and the vernacular, I could identify most of the plants mentioned to Vigne and myself; the most important, under No. 5, was only identified since I came home, and had the advantage of working at Kew, which I shall keep to the last.

1. Blue, for silk and woollen, is got by *Nîl*, *i.e.*, indigo, *Indigofera tinctoria*, L., and *Lâjward*, Lapis lazuli. The former is much cultivated in many parts of India, and is said to be noted in "Arrian's Periplus" as coming from the Indus, and many notices of its export by that river are recorded from the middle of the 17th century. The latter is got in quantity somewhere in the North-West Himalaya, and always for sale in Kashmîr, so that a 'cute officer often makes a bargain, and buys for a trifle a lump, most of which is not very good, but may have first-rate bits in it.

Purple is produced by dyeing blue with lapis lazuli, and then for woollen by *lâkh*, the dye excrescence or exudation caused by *Coccus lacca*, which is formed on various trees in many parts of India, Burmah, and China. The red is got for silk by *kirm* (kermes), which Mr. Moore, the officer in charge of this department in the India Museum, informs me he "presumes to be the true cochineal, produced by *Coccus cacti*, imported into the Panjâb by Bombay and Calcutta, and which is said to be found wild in the Panjâb"—very doubtful, I should think. Odd enough, he mentions that they have in the Indian Museum no specimen of the insect producing Indian *lâkh*, nor any specimen of *kirm*, which desiderata I shall see to supply when I get back to my province in October.

2. The pomegranate, *dârû*, *Punica granatum*, L., is common wild in the North-West Himalaya, 25-6,000′, from beyond the Indus to the eastern border of Kamâon, as I know from my own observations. From the specimens in Kew Herbarium, it is cultivated in Sikkim, wild in Bhotan and Belûchistân, and occurs in many other parts of Asia, South Europe, West Indies, and South America. The rind—Vigne's skin—of the fruit is very much used for tanning and dyeing in Northern India. My informants in Kashmîr said iron ash liquor, not "iron filings" is mixed with the flowers—not the "skin" of this—to make black.

3. Dust colour, *khâki*—Vigne's "drab"—is made by the outer covering of the walnut, *Akhrot*, *chârmaghz*, *i.e.*, Persian for "four brains," from the divisions of the kernels, a term used to me by an artisan in Sirînaggar and I found it was often used there. This, *Juglans regia*, L., is cultivated in the North-West Himalaya from 5-10000′, and in West Tibet to nearly 11,000′. A little black is added for dust-colour, if necessary, but no mordant.

4. There must be some error in Vigne's "log-wood," as none of that wood grows or is available in the Himalaya or North-West India, so far as I know. Also, the dyers told me that they knew of no such thing or word as *lin*, and what he meant was probably *bakkam*, *Cæsalpinia sappan*, L., the wood of which is imported into the Panjâb, where, or near which, it is not indigenous, for dyeing a fleeting red, which needs to be fixed by a mordant.

5. The fact noted by Vigne under this head is both instructive and amusing.

6. For *basantî*, a fleeting yellow, is used *gûl kesar*, Vigne's *gûlî kysû*, the flowers of *Butea frondosa*, Rox., in the Panjâb plains, in many parts of which it is a common wild tree. The bark is used for dyeing blue in the Panjâb. In Kashmîr, *phitkarî*, *i.e.*, alum, is used to make the dye from the flowers durable. In some cases, for a mordant, before the alum is used *sajjî*, *i.e.*, a salt of potash, which abounds in the soil of many parts of the Panjâb plains, called *kallar*, and effloresces thereupon.

7. Green is formed by first dyeing yellow by *wotîângil*, Vigne's *woftângil*, the root for *resham*, *i.e.*, silk, the leaves for *pashm*, *i.e.*, the inner, shorter, softer, hair or wool from the goats, I believe, for Kashmîr shawls, and then blue by indigo.

My great shot was identifying this *wotîângil* as *Carpesium abrotanoides*, L.; the second composite plant—*Carthamus tinctorius*, Rox.; grown in parts of the Panjâb, the first—used in dyeing in the world, so far as I know.

The distribution of this plant in the North-West Himalaya, as I have collected it, is thus from west to east. On the Kishengunga, a tributary of the Jhelam, the westernmost great tributary of the Indus coming from the Himalaya, west from Kashmîr 2-4,500′; abundant in and near Kashmîr, 24-6,000′ *wotîângil*; on the Chenâb, 3-6,500′; common on the Ravî, 4-6,500′; on the Sutlej, 5-7,000′; in Garhwâl, 4-7,000′; in Kamâon, 4-6,000′. In Kew Herbarium the specimens collected by others are, Kashmîr, 6-7,000′, Dr. T. Thomson, and Falconer; in Kanâwar on the Sutlej, 6-7,000′, Strachey and Winterbottom; in Bissahir on the Sutlej, 3-5,000′, Dr. Thomson; Simla, 5-7000′, Edgeworth and Fielding; common in Garhwâl, 5,000′, Strachey and Winterbottom, and Falconer; in Sikkim var. *racemosa*, 8-10,000′. Outside India, in Kew Herbarium, are specimens from Lazistan, Priuli, Lenkoran, South China, Formosa, and Japan.

Vigne goes on to say that old shawls that require cleansing, and, in some instances, new ones, are washed by means of the fresh root of a parasitical plant, called *kritz*. A pound of it is mixed with about three parts of water, and to this is added about the size of a turkey's egg of pigeons' dung, mixed and beaten up with about the same quantity of water. With this the shawl is saturated, stamped on, and washed with the hands, and then well steeped in the canal. A smaller root, also called *kritz*, is used for cleansing cotton clothes.

His *kritz* is really *kriss*, *Dioscorea deltoidea*, Wall, not a parasite, but a scandent. The smaller *kriss* is probably the smaller tubers of the same plant.

He records that in the plains the "berries" of the *raynti* fruit, stirred up with water, yet not so as to form a lather, are used for washing soiled shawls.

His *raynti* is evidently *ritha*, "soap-nut," *Sapindus acuminatus*, Wall, which is not uncommon, planted in the valleys of the outer North-West Himalaya, from the Râvi eastward, to 3,500′, and the large seed of which is used for washing various kinds of cloth, &c.

J. L. Stewart, M.D., &c.,
Conservator of Forests, Panjâb.

Kew, 30th August, 1872.

GENERAL NOTES.

The French Scientific Association.—The French Association for the Advancement of Science, formed after the model of the British Association, has just held its meetings at Bordeaux, and the attendance of French and foreign *savans* has been considerable. Amongst the papers read and subjects discussed are the following:—M. Bocca has treated the interesting question of the condition and civilisation of the Troglodytes of the Eyzies, the race whose remains were recently discovered on the banks of the Vezière, in the department of the Dordogne. These contemporaries of the mammoth lived principally, if not entirely, by hunting and fishing; they knew how to produce and employ fire, they made clothing of the skins of animals, sewing the parts together by means of needles and awls of bone. In certain districts, the Troglodytes had arms, which showed a certain amount of progress, axes of worked flint, and harpoons made of wood and bone, but no indications of any kinds of pottery have been found; in the caverns have been discovered bones with ornaments scratched, and in some cases carved, upon them. Amongst the latter objects are horns of the reindeer pierced with holes, which are conjectured to have been sceptres or batons of the chiefs. The hollow bones and skulls of animals found in the same caves are all broken, which seems to prove that these early races were fond of brains and marrow. The skulls of these Troglodytes present certain indications of ferocity, but they are not like those of the ape, the brain-case exhibiting a certain amount of superior development. The inference from all these facts is, that these men were savages, but in a state of partial civilisation, having at their disposal abundant food, and consequently leisure, applying themselves to the arts, and already exhibiting the perfectability of the race. M. Lallemand, Dean of the Faculty of Sciences at Poictiers, created great interest in the section of physics by his observations on the causes of the colouration of the atmosphere. M. Sorel, of Geneva, gave an account of his recent researches on the subject of the intensity of solar radiation. Several important papers were read in the zoological section. M. Alphonse Guérin treated of certain new processes in the transfusion of blood. Col. Laussedat, of the French engineers, read an elaborate paper on the relative condition of the French and German armies, amongst other things dwelling specially on the great value of well-organised travel, stating that in Germany at least one-fifth of the effective officers of the staff were sent annually on missions into the various countries of Europe, with a given programme, which they followed implicitly, and that General Moltke himself examined and corrected the journals and memoirs which they were bound to furnish. The Colonel proposed to the association to appoint a committee to consider the best means of aiding the development of the rising generation in France, by means of the study of languages and geography abroad, and the proposal was received with much applause. The Abbé Durand read a paper on his recent voyages in South America. Finally, M. Janssen and M. Respighi recounted the results of their researches into the constitution of the sun, and of their visit to India last year, to watch the eclipse of the sun. Scientific excursions into the environs of the city formed the concluding portion of the programme of the association.

Diorama of the Siege of Paris.—Visitors to Paris should not fail to pay a visit to the diorama in the Champs Elysées, near the Palais de l'Industrie, which is announced to open on the first of October. Even the inhabitants, from the great distance of the outer forts, had but a very imperfect idea of the *ensemble* of the operations of the besiegers, and foreigners can scarcely picture to themselves, with anything like truth, the extent of the operations on each side. This picture, taken from the top of the Panthéon, gives an admirable idea of the position of the enemy, and a sad picture of the effects of the siege. No picture can exhibit a hundredth part of the destruction, cruelty, and misery of war, but this diorama will certainly enable foreigners to form a fair conception of the extent of the operations, and the difficulties of the siege.

A Wise Endowment.—The various academies of the Institute of France have to adjudicate at intervals of one, two, three, or more years, a large number of prizes for given and unchangeable subjects. Some of these were originally ill-chosen, others have become obsolete, and generally the award of an annual prize on a given subject rarely produces a work of much importance. The Academy of Medicine, for instance, has to give every year one thousand francs for the best memoir on "Melancholy," and we believe that the result to science has been a minimum. Marshal Vaillant has left by will to the Academy of Sciences, of which he was a member, the sum of forty thousand francs, to be employed in encouraging science and scientific investigators, and he has left the bequest entirely untrammelled; the Academy is left quite at liberty to apply the money in the manner it thinks best, and it would appear that the capital as well as the interest is left to the disposition of the body. It is to be hoped that the example of the Marshal may be followed by others, whose philanthropy is not encumbered by the idea that they can foresee the wants of the future, and the progress of science.

The Sun's Parallax.—At the instance of the Minister of Public Instruction, the French Assembly voted a credit of £4,000 in the budget of the present year, for the construction of the necessary instruments for the determination of the parallax. It is now reported that a further sum of £8,000 is to be voted for the coming year. The next transit of Venus, as is well known, takes place in 1874; it will occur again in 1882, and then not again till the year 2002. Nine stations have been selected for observation; at four of these, namely, Pekin, Yokohama, the islands of St. Paul and Bourbon, both the entry and exit of the planet will be observable; at the other stations, which are Noumea, Tahiti, the Marquesan Islands, Suez, and Mascate, only one or the other of the two incidents will be visible. The set of apparatus to be used at each station includes parallactic telescopes, siderial clock, marine chronometer, meridian circle, barometers, thermometers, electric piles, &c. The French *savans* are in communication with those of England, Russia, America, and Germany, in order that each may select different stations, and thus avail themselves of all the useful points of the earth's surface for these important observations. All the apparatus prepared in France for the transit of 1874 will be afterwards distributed amongst the observatories of Marseilles, Toulouse, and Puy de Dôme, there to be carefully preserved for the next occurrence of the phenomenon.

Journal of the Society of Arts.

No. 1,036. Vol. XX.

FRIDAY, SEPTEMBER 27, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

INTERNATIONAL EXHIBITION, 1872.

The Council, having been informed that Her Majesty's Commissioners do not intend to publish reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such reports, for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following is the first of the series. The others will appear from time to time.

PAPER, PRINTING, AND STATIONERY, AT THE INTERNATIONAL EXHIBITION, 1872.

The chief impediment to the paper trade for some years past has been the limited supply of, and difficulty in obtaining, cheap and good fibre, or raw material of any kind.

Notwithstanding the subject is one of vital importance to one of our most extended branches of commerce, little more seems to have been done within the last ten years than to try various experiments with wood as a paper-making medium; but few of the experiments have been sufficiently successful to save the exhausting drain on the supply of esparto. The quantity of this grass imported into England from Spain, and to a small extent from Africa, in 1862, amounted to no more than 2,000 tons. This valuable importation has gone on increasing, until in 1871 the gross amount imported reached nearly 144,000 tons. As esparto is not an annual, but takes some fifteen years to reach its maturity, it is not difficult to understand that the supply is rapidly diminishing as the demand grows larger.

In the present exhibition many valuable additions to our paper material and raw stuff have been made. Mr. Hyde Clarke, Council of Foreign Bondholders, has furnished a fibre likely to be of some value to paper makers. It consists of a description of broom, grown largely and easily cultivated in the neighbourhood of Smyrna, and, though not equal to esparto in strength, is likely to take a considerable share in the future materials for paper-making.

The East India Museum have also added largely to the exhibition of fibres for paper-making; but few of their contributions are new, and none, as far as we can judge, abundant enough at present, or likely to become so in the future.

The most promising addition in the way of fibre for paper-making, and the one which seems likely to turn out of the greatest importance to this country and to the colony producing it, is the extraordinarily common weed called *Sida retusa;* this species of *Malvaceæ* grows in such abundance in the colony of Queensland, that it has long been considered a troublesome weed by the large proprietors of sheepwalks.

This fibre has certainly all the highest qualities that flax possesses, is very superior to esparto, is clean, and bleaches without the smallest difficulty, and the supply is said to be unbounded.

Samples of the *Sida retusa* having been submitted to the chief paper manufacturers in the country, one and all have agreed in expressing their most favourable opinion of its perfect adaptability to the purpose of paper-making, and all entertain a very high estimate of its market value. The demand for such a fibre would be enormous, and it is anticipated that the supply may be depended on.

Should the usefulness of the *Sida retusa* prove to be such as be fully expected, the introduction of this plant into the United Kingdom, through the agency of our great International Exhibitions, alone would establish abundant reason for our admiration and respect for the labours and the objects of her Majesty's Commissioners.

The specimens of fibre, or pulp, made from wood, exhibited by the Swedish Rosendahls Company, and the half-stuff made from it, are suitable for admixture with a stronger material; and the pine wood pulp, exhibited by the Djupafors Company, shows the care which Sweden and other northern countries are bestowing on the preparation of wood for the purpose of paper-making.

The raw material exhibited by W. G. Kent, and the pulp for paper-making submitted by F. B. Houghton, as well as the wood-fibre exhibited by the North of Europe Wood Fibre Company, all appeal to, and are worthy of, the attention of English paper-makers, and the materials thus afforded must become valuable aids in helping out our stronger fibres.

The strong straw millboards, made by Ullmann and Co., of Prussia, are excellent in their way, but possess no novelty.

The straw boards and pressing-boards exhibited by the Rejau manufacturers of Vienna, are valuable adjuncts to the bookbinding trade, and here at least seem to be some new descriptions of straw boards.

The Bristol-board and card-board manufacturers are well represented by Messrs. Goodall, Woolley, and Turnbull, who fully keep up to the high standard that for years they have successfully held, and they seem to have brought the various descriptions of ordinary manufacture to the highest perfection. No other makers of plain paper card-boards are represented in the present Exhibition; and probably, of the highly-finished kind of white boards, no better are made in any part of the world.

For some reason or another, really difficult to assign with any certainty, paper-manufacturers have shown something more than an indifference to comply with the invitation issued by the authorities to exhibit their wares at the International Exhibition, and the fact is, that so poorly is English paper-making here represented, that, notwithstanding there are in England over 340 mills at work, employing nearly 30,000 persons, only five paper-makers from the United Kingdom have contributed specimens of their much-demanded produce. But, fortunately, the five instances are so notable and the contributions of the five firms so liberal and so conspicuous in their importance, that commercially these five manufacturers amply support the high position that the paper trade in this country commands, although it is sincerely to be regretted that many other English makers, in several unaccountable instances, have failed to exhibit the various kinds of paper that would surely show us the improvement that must have advanced with the enormously increased demand, from the opportunity manufacturers have had since the Great Exhibition of 1851, and especially from our familiarity since then with the great paper-making countries of China and Japan.

The apathy or unconcern of many of our manufacturers to exhibit the results of their industry seems likely to lead to serious consequences. The opportunity of exhibiting their paper should certainly have been regarded by them as a means to a very much desired end—the extended sale of the product of their capital and labour; and it is to be attributed in a very great measure to the absence of their exhibits that the largest French and American houses of business have and are now making very careful inquiries as to the capabilities of the Russian and other foreign paper manufacturing establishments for supplying their enormous requirements.

The twelve frames containing specimens of water-marked papers, manufactured by T. H. Saunders, and the sheet of loan or parchment papers which is strong enough to support 5 cwt., and their well-selected specimens of materials of which papers are made, are all worthy of our highest commendation; and the roll of *The Times* paper, for printing continuously by the Walter machine, cannot be surpassed by any other exhibiting paper maker.

During the first three months of the International Exhibition, it was fondly and confidently supposed that English paper-makers were pre-eminent as manufacturers of water-marked papers; and Messrs. Wyndham S. and R. Portal, sole manufacturers of bank-note paper to the Bank of England, had contributed so splendid a show of their manufacture, that it seemed impossible that rivalry by any foreign country could for a moment be entertained. But to the surprise and utter astonishment of the whole paper-making trade, and to all experts in this particular branch, the Russian Imperial State Paper Manufactory, at St. Petersburgh, contributed, "better late than never," so extensive and varied a collection of water-marked papers, suitable for bank bill purposes and other commercial security paper, that without any reluctance the most prejudiced supporter of our home manufactures at once acknowledged the defeat of England; a defeat, however, that Russia can only half glory in, as the superintendent of the Imperial State Paper Manufactory is an Englishman.

The Russian paper is especially remarkable not only for its variety, but for its beauty; and it is a subject well worthy of the consideration of our manufacturers, that the Russian makers acquire a more perfect texture, together with a cleaner and sharper water-mark, and at the same time add a strength to the paper over and above the English makers of at least from 10 to 14 per cent.—an advantage that cannot be estimated too highly when we consider that durability and strength are the great desiderata most difficult to obtain.

Messrs. John Dickinson and Company, and Messrs. Haines and Marchant, in addition to having furnished specimens of ordinary printing and writing paper, have contributed a most interesting collection, of a highly educational character, of the materials for making and colouring paper.

Mr. W. Monckton, Basted Mills, near Sevenoaks, Kent, has one contribution only of a very good machine-made account-book paper, which in its hardness seems superior to any at present in use.

The highest terms are applicable to the Irish linen rag paper exhibited by Marcus, Ward and Co., and it is to be wished that there had been equal opportunities of speaking from experience of other fabrics exhibited in this year's exhibition.

The specimens of fancy note-paper and stamped envelopes (Papier Confection), exhibited by Theyer and Hardmouth, of Vienna, are, in style of workmanship, faultless, and put in a second place the stamped note-paper of Messrs. Macmichael and others.

For cheap, good, and sound work, Joseph Mead's account-books are not to be surpassed, but the British manufacturers of account-books, however perfectly they may finish their work, have got to learn from nearly all continental makers how to give their volumes a look—which we are almost afraid to write in this place—of picturesqueness—a look which all foreign office-books are never without, for there still lingers a traditionary artistic character about the designs of a well-made foreign ledger that reminds one of the very early days of bookkeeping.

It is satisfactory to find that nearly every branch of printing is well represented in the present year's International Exhibition, and that the great firms of printers of our own country are favourably represented by the side of our Continental co-workers.

In ordinary book-work, our most famous firms, such as Gilbert, Rivington, and Co.; Whittingham, Wilkins, and Co.; R. Clay and Taylor; Cassell, Petter, and Galpin, and others, have well supported their reputation for the style and beauty of their typography, although, when the glorious presswork of the old masters in this line is remembered, it must be lamented that our printers seem to have lost the true spirit of their noble art. Such, however, cannot be said of the contributions from Russia, Austria, Belgium, and Bavaria, and from those countries there are contributions enough to weaken seriously and effectually our confidence in English superiority in what is called book and commercial printing.

The authorities of the printing establishment of His Russian Imperial Majesty's Chancellerie have contributed most valuable material, and especially one volume exhibited by the Imperial Academy of Science, at St. Petersburgh, containing Our Lord's Prayer, printed in 356 languages; this exquisite book is a marvellous specimen of typography, and more than rivals the very important display from the British and Foreign Bible Society, who exhibit translations of the Scriptures printed in 202 of the living languages of Europe, Asia, Africa, and America, and the Islands of the Pacific. Messrs. Rivington stand alone in their new unimprovable movable types for embossing; and if these great printers had no other evidences of their skill, their types for the blind would crown them with the highest honour.

The types used in nearly all the Russian printing establishments emanate from the great foundry of J. Lehmann and Co., who seem to monopolise nearly the whole of the type foundry business in Russia.

Of what is called the commercial printing of Russia, the specimens are perfectly novel to our printers, and their methods of ornamental type printing cannot be imitated or followed in England, until the demand for such beautiful work induces our type founders and printers to entirely remodel their machinery. The Russian and Belgian mode of printing blank drafts for coupons, bonds, cheques, railway scrip, and certificate securities of all kinds, is greatly in advance of any such forms produced by English printers; our printers have certainly not exhibited, and we fear, are not yet able to furnish such commercial printing as the specimen books of Messrs. E. Guyot, of Brussels, display; and the perfectly exquisite work exhibited by the Russian Government, from the Imperial State Paper Works, seems, to our eyes, unaccustomed to such beauties, to have exhausted the means of adding preciousness to formal blank paper securities.

The Belgian method of combining lithographic and type printing together has an effect somewhat similar, but is far more costly to produce.

The specimens exhibited by M. G. A. Bonfontaine, of Bâle, appear to have been executed by a method somewhat similar to the Russian or Belgian processes, but quite unknown or unpractised by English printers, It is certainly the interest of our printers to look carefully at these foreign specimens, or they are likely to suffer greatly, not only from the loss of a very large branch of manufacture, but also from the discredit of not executing the highest order of work.

The comparison may not perhaps be exactly a just one, but the specimens of commercial engraving exhibited by Messrs. Bacon and Perkins, suffer greatly by the side of the commercial paper exhibited by the Russian manufacturers, especially as the latter possesses the commercially much desired quality of novelty, and the former represents merely the ingenious method with which we have been so long familiar, of engine-turned copper-plate printing.

The type founders have done good service to this department of the Exhibition, and no section is better represented. The specimen books of the following firms seem to contain everything in the way of type that is to desired:—Messrs. J. Lehmann, of St. Petersburg; E. Guyot, of Brussels; G. A. Bonfontaine, of Bâle; and the English firms of Stevenson, Blake and Co., A. W. Caslon and Co., V. J. Figgins, Reed and Fox, and Miller and Richards.

The printing ink manufacturers have well responded to the invitation to contribute specimens of their useful manufacture. The best English specimens are those of B. Winstone, who exhibits various descriptions of black and coloured inks, and some very beautiful specimens for lithographic purposes. The other exhibitors who well support the reputation of the printers' ink-making trade, are Messrs. Battey and Co., Messrs. Parsons and Fletcher, C. A. Springmann, of Osnabruck, Germany, and Van Loey-Nouri and E. Brasseur, from Belgium.

The art of colour printing from wood blocks and stone, is largely though imperfectly illustrated at the International Exhibition.

The exhibits of Messrs. Vincent Brooks, Leighton Brothers, Clay, Son, and Taylor, and W. Dicks and Co., all merit praise for their mechanical skill, but not one of these colour-printers appear to aim at the perfection of art arrived at by very simple means by the Japanese printers; nor can we find in the English reproduction from popular pictures anything to approach the perfectly successful efforts of the kind made by several continental chromo-lithographers; and we must despair of producing, for a long time yet, any work equal in beauty to the noble publication exhibited by Flaege and Fljin, of St. Petersburgh. It is indeed for such illustrations as the above firm exhibit that chromo-lithography is perfectly adapted, and we lose patience at the persistently ill-directed attempts of our colour printers to reproduce the endless gradations and subtle qualities of pictures and drawings like Turner's.

Of the anastatic printing Russia exhibits some highly interesting specimens of the helio-electrotype, perfected by M. Scamoni, who has very ingeniously adopted the bichromate and gelatine method, the examples of which exhibited by him show the perfect working method of this process; and although the English, Woodbury, and Heliotype processes are amply represented in the exhibition, we are unable to remark upon any novel results.

So much of the stationery, or what comes under the head of stationery, that is exhibited at the International Exhibition, has undergone the so-called embellishing aid of the pseudo-artist, that it is difficult to turn to any case of exhibits, or any frame of advertisements, without having to regard the objects from an artistic point of view; and, indeed, the pretentious manner in which many worthless designs are presented calls for condemnation, in the first place, on the score of the badly-designed frame, and, on further examination, for the ill-assortment of the objects framed.

It is impossible to regard the whole collection exhibited as anything more than a very large, and not by any means first-rate shop of miscellaneous finery; and the fatally ambitious nature of many of the objects prominently displayed says more for the exhibitor's desire to attract the injudicious many than for his wish to please or gain the praise of the thoughtful few.

The desire of pleasing everyone, or having something in stock to suit the taste of agents and purchasers, is perhaps at the root of the bad art exhibited in all directions by our manufacturers, who, having a very great regard for the remunerative patronage of the multitude, entertain at the same time a very low estimate of the taste or judgment of the public; and, having met with vast success by working down to the lowest intelligence in such matters, they seem suspicious of, and altogether antagonistic to, the opinion of those who differ from them in matters regarding the nature of supply and demand.

The demand for novelty appears to assume almost a morbid character with the modern manufacturer, and doubtless the constant directions that our art manipulators unceasingly urge on their designers are, that the more novel the designs the better the employers will be satisfied, and the more eagerly the public will purchase.

But, unfortunately, in this rage for novelty, which has taken possession of our manufacturers for the last hundred years, they have lost sight of a standard of excellence in all things, except in mere mechanical perfection, an end which, for all practical purposes, they have without doubt arrived at, although we must not be too certain or secure in our belief that our mechanical excellence has by any means reached its height; and it must be borne in mind that, admirably and faithfully as the modern machine does its work for us, nothing has yet been done by the aid of steam, in anything that relates to art decoration, that approaches the efforts of the hand directed by a thoughtful intelligence. Still, however, in the demand for novelty, there is no reason whatever why we should neglect well-established, and, to our manufacturers, almost unknown beauties. In all branches of decorative art, be it ever so trifling, or on whatever scale of importance, an endless sequence of novel designs is within our reach, without once producing an ill-shaped object, or a badly-designed or ill-covered surface.

Let us once establish in our manufactures certain acknowledged periods of history, when the art of design arrived at its highest perfection, and let us mark with equal determination the epoch of its decline, and for centuries to come our artists who work in ornamental design, and the employers of such artists, will find a golden field, ample enough for the most industrious reaper in search of the useful and the beautiful.

Whatever may be said in favour of, or in opposition to, the happily-prevailing taste with our best class of manufacturers for mediæval, or what is carelessly styled "Gothic," designs, it must be owned that the objects exhibited, adorned or disfigured, in the supposed character of middle-age art, have at least the appearance of correctness, a tendency to which they clearly indicate. In looking over the various frames exhibited by Messrs. Marcus Ward, Vincent Brooks, Leighton Brothers, and Messrs. Goodall, we cannot help regretting that the great demands upon these gentlemen for novelty oblige them to do so many inartistic things, and leave undone so many beauties that their knowledge, their skill, and their capital would enable them to give to the world.

It is scarcely fair to judge of the labours of the above-named firms by the miscellaneous subjects they have thought proper to exhibit; and it is so difficult to imagine these gentlemen incapable of forming a correct opinion of what is good in art, that we fear they have been led in selecting their exhibits, by their estimate of the low level of public taste, and by their amiable desire to please the profitable public.

Nevertheless, it is from such contributions as they have submitted that everything may be expected, and from them and to other firms working in the same direction, we may look with confidence, for a realisation of our most beautiful dreams, or, better still, the reproduction of existing beautiful realities.

Out of the many large collections of coloured playing cards, there is not one single design that would bear the severe criticism of a really well-instructed critic; and of the many Christmas cards exhibited, no single one can be selected that deserves higher praise than that it is pretty, or funny; whilst the vast majority of those displayed have alone the very questionable merit of costliness. There is no reason whatever why the manufacturers who supply the demand for this sort of amusing art, should wait until the distant period, "the time will come," to enable them to produce better things, nor need they go in search of foreign aid for their purpose; they have it in their power at home to reproduce designs as exquisite as the world has yet seen; but, in order that such designs should have the chance of gaining the popular taste, they should not be pushed and jostled into notice in company with debased companions; for one year of really fine art-work, practised by some art-loving firm, would certainly not fail to secure an ample reward of fame and funds.

The appreciation of the correct is but rarely combined with the ability for sustaining a large business, but there are now few manufacturers who are not willing to own that, in some way or other, the more art they put into their wares, the more certain they are to obtain, in the long run, credit as well as profit for their labour.

Whatever is to be said in favour of our British manufacturers, no matter what branch of trade we are called upon to consider, whenever what is called fine art is required, we must own we suffer in comparison with all other countries.

In looking at the designs of the manufactures of all eastern countries, or northern, we seldom find any object badly designed, or any surface ineffectually or ineffectively covered; whereas, we fail to find amongst our decorated objects the exception, even without which or with which, it is impossible to prove to our manufacturers that they are not always fully qualified to direct their artists, however competent the employer may have proved himself to manage the many other details of his business.

There are few cases of miscellaneous objects of stationery in this department, more perfect or more instructive than that of Messrs. Faber; and we have nothing in the International Exhibition to equal or approach their collection of slates, and especially their perfectly arranged "ship log" slate, that forms the conspicuous feature in their collection; this slate appears faultless in its arrangement and simplicity. Of Faber's other articles of stationery it is impossible to speak too highly.

The Imperial and Royal Austro-Hungarian Commission exhibit more than one case of stationery that in design is so varied, so instructive, and so novel, as to almost disturb an idea that has been long growing, and has taken a strong hold of some of our best designers, that conventional forms are the best suited for decorative purposes.

But, perhaps, of all the various branches of the stationery trade, as exhibited at the International Exhibition, literally in its most varied forms and colours, and lowest stage of degradation, is the making of paper flowers and fire-place abominations; and, considering how much is done mechanically in this way, it is sadly to be deplored that the employers and teachers of this pretty and pleasant work have not themselves been better taught.

The felted paper-curtains manufactured by Pavy, Pretto, and Co., are certainly, but oddly enough, the great novelty and feature of the stationery department, indeed, one may almost say, of the whole Exhibition, and justly have they gained their reputation; and as a cheap material for curtains, admirably adapted to afford the humbler and the middle-classes the luxury of comfortable finery at an extraordinarily cheap rate. In this respect, they cannot be spoken of too highly; in fact, it is perhaps not saying too much for this fabric to describe it as faultless in every respect but one, the one fault consisting of the badly selected designs that the manufacturers have imprinted on their papers, their best patterns having been taken from no better authority than the modern French *cretonnes*, and even the designs of these are not by any means the best calculated for the purpose; there are but a very limited number to select from. The Japanese, from whom the novelty of paper curtains has reached us, could have supplied the manufacturer at the same time with any number of appropriate and suitable designs.

The coloured tissue papers exhibited by James R. Crompton and Co. suggest the possibility of the manufacturer rivalling in time the perfect fabrics of Japan, or at least the papers of the Chinese makers; but there is a vividness, a variety, and a charm about all Oriental papers that our manufacturers do not even appear to appreciate.

On examining the four small cases of Chinese, Japanese, and Indian specimens of stationery that have been wisely contributed by the South Kensington Museum authorities, it seems impossible that our manufacturers can fail to see that they have, in these distant manufactures, a perfect school in which all that is desired connected with the making and the embellishing of paper may be learned.

In another department of the International Exhibition—the jewellery department—some Chinese paper flowers are exhibited by the Governor of Hong-Kong, which are precisely what our satin paper decorative manufacturers should place before their industrious young workpeople.

The coloured fancy papers exhibited here by English manufacturers are so far inferior to the same kind of manufacture exhibited by the Viennese makers, that whereas in the former there is scarcely any pattern or tint to approve of, in the latter there is positively so large and so well-selected an assortment, that in turning over their books of specimens, page after page of well imitated or properly designed patterns can be chosen from; and it is not until we come to what is called embossed gelatine paper that we meet with commonplace vulgarity of design, or ill-assorted colours; although, in this useful species of manufacture, the leather paper made in Vienna, or by Viennese makers, is without fault.

The step from stationery to envelopes, writing-cases, and ink-stands, is wider than it at first appears, and it scarcely seems that such objects have any appropriate places in Department II., Class 12; but here the inkstands and their accompaniments are of every conceivable material; shiny, slippery, badly-shaped affairs; overpolished, ill-gilt, painted, and bestudded with nails, but certainly strong, substantial, and useful for trade purposes of all descriptions.

One frame exhibited in this department consists of a number of perforated tissue-papers, highly gilt, or silvered at the edges, and labelled "Decorations for the table and pastry." Surely, if a false idea of luxury leads to a demand for such additions to our dinner-tables, let such expensive finery be at least good in design, for it would cost no more to make the elaborate machinery that cuts out and embosses such decorations, than to make the badly-suited patterns that are here displayed.

The circular piece of perforated tissue paper that our flower dealers put round cheap bouquets, seems to add, in many people's minds, to their beauty and preciousness, and if perforated paper be really required to support the painful regularity of the circular bouquet, it would perhaps be difficult to suggest anything very different to that with which we are all so well acquainted. The subject would scarcely be worth a moment's notice, were it not that tinted, embossed, perforated, and wire-marked paper meets our eye at every turn, from the perforated paper that is intended to enhance the charms of pastry, to the perforated bank-note, with its never too familiar dear old water-mark.

A case of Belgian bon-bon boxes is placed in crucial proximity to the small collection of Japanese stationery, and strongly suggests to the amateur in bon-bons, that a Japanese box of sweets would be a slightly more welcome present than the gift of a Belgian or English casket; but why our makers of such boxes do not try to imitate, or, if that be too mean an aim, to emulate, the beauty of the many exquisite caskets exhibited at the South Kensington Museum, is an unfathomable mystery.

The Belgian and French boxes of this kind are considered in the trade much superior to those made in England, and the demand for such luxuries is increasing so rapidly, that our English makers have vain hopes that they may soon rival our more gifted neighbours, who try seriously to do in art good things, even for bon-bon boxes; and even in England, we believe, that if Messrs. Fortnum and Mason were next Christmas to exhibit in Piccadilly a bon-bon box the size of a two-guinea tool-chest, with the sides painted by Leighton or Poynter, some devoted lover of chocolate would carry off the treasure before Twelfth Day.

At a cost very much less than is already devoted to such annuals, perfectly marvellous reproductions of the finest art could be made in paper, for the purpose of bon-bon and other delectable boxes, and we see no reason why the fond fathers of the future should not carry home to their children their presents of sugar plums in a box rivalling in beauty the caskets of the best days of any period of art that the labours of the learned have revealed to us.

The increasing demand for expensive valentines, has led to a display in this Exhibition that suggests, we may safely say, the possibility of improvement, although the floral prettiness of some of these harmless missives, exhibited by Messrs. Canton, publisher of what is called "Christmas and New Year's Stationery," is certainly not without the charm which pleases the popular taste, and they posess the merit, claimed for them by the exhibitor, of being altogether English. They most certainly employ a great many deft fingers in their manufacture; and as there scarcely seems any limit to the costliness of these February missives, there is surely as limitless a range to the possibility of adding fresh beauties to this long cherished observance.

The practice of sending Christmas cards, which has sprung up in England within the last few years, affords a much more legitimate exercise of art-manufacture; and the amount of capital that must be devoted to the production of these little paralellograms, and the cost of the gold consumed in heightening their charms, would go far towards completing the funds required for the decoration of St. Paul's.

It is quite evident that where English artists have been employed to design these cards, the only little pictures, with few exceptions, that are free from utter vulgarity, and some few evidently French rococo designs, are those that are conceived in what we call mediæval taste, and have emanated, probably, from the office of some gifted architect.

It is hoped that, ere long, we shall see the most dainty little pictorial good wishes, altogether designed and produced in England, by sincere lovers of, and workers in, correct art; but so long as frivolity leads us to admire the Dresden china and Pompadour age, we must rely on France for the pictured representations of the miserable, but not harmless, grand little airs of that artificial period.

On the fancy stationery trade generally there is much ground to report severely. Those firms which have a very extended trade should certainly be judges of their own business; but, forming an opinion of their judgment by the objects they exhibit, one might easily believe that they were unacquainted with the ordinary details of that large branch of their trade that comes under the head of taste, and indeed the most expensive objects exhibited, and those that meet with the readiest sale, are objects that could only inadvertently be placed on the tables of cultivated people. It is impossible to speak too severely in cases like these, because the interests of the great firms are not easily injured, and their means and opportunities for producing and spreading really good designs are positively enormous; and we really wonder that those great firms that must have originated the cheap stationery trade, have not shown the ambition, on such an occasion as the present, to prove that their goods, although cheap, are not necessarily ugly.

Messrs. Hyde and Co.'s interesting corner of sealing-wax making is perhaps as familiar to all who have frequented this year's Exhibition as any other that can be named; and in carelessly walking through this department, the strongest impression that is left on the mind is probably sealing-wax and paper-curtains. In the present adhesive days, however, it is difficult to produce anything new in sealing-wax; but Messrs. Hyde, of Fleet-street, thoroughly sustain their pre-eminence in this still flourishing branch of manufacture.

In concluding a very imperfect report on Department II., Class 12, it is impossible to resist the opinion that, in the most substantial objects exhibited, England has been surpassed by several Continental countries.

In paper-making and printing, there are two or three such noticeable foreign triumphs that our manufacturers and printers, however reluctantly, must admit their defeat; and Russia and Japan afford us so much instructive teaching, that we cannot do better than endeavour to emulate their motives and their methods.

Statement of the Numbers of Exhibitors from each country, Class II., Section 12, *Paper, Printing, and Stationery, International Exhibition,* 1872 :—

PAPER.

Bank-note paper	2 1	English. Russian.
Black borderers	4	English.
Bristol-board makers	4	English.
Card and cardboard makers	3	English.
Cardboard box makers	1	English.
Card cutters	1	English.
Card manufacturers (playing)	3 1	English. Belgian.
Card stampers	2	English.
Coloured paper makers	2 1	English. Austrian.
Fancy box makers	2 1	English. Belgian.
Fancy paper makers	1 1 1	Prussia. Bavaria. Germany.
Millboard makers	1	Swedish.
Paper bag makers	2	English.
Paper glossers	1 1	Prussian. Austrian.
Paper makers	5 1	English. Austria.
Paper marblers	3	English.
Passe-partout makers	1	English.
Pasteboard makers	1	English.
Pill-box makers	1	English.
Straw-board makers	1 3 1 1	Holland. Prussia. Russia. Germany.
Photographic paper manufacturers	3	English.

PRINTING.

Anastatic	1	English.
Autotype	1	,,
Graphotype	1	,,
Heliotype	1	,,
Woodbury	1	,,
Copper plate	1	,,
Gold and silver printers	1	,,
Label makers	3	,,
Lithographers	11 2	,, Russian.

Music printers	3 English.
Wood block and woodcut printing	7 English.
Printers in general	11 English. 3 Russian. 7 Austria. 2 N. & S. America. 2 Victoria. 2 Sweden. 7 Belgium. 1 Colombo and Salvadore. 1 South Australia. 1 Switzerland.
Railway ticket makers	2 English.
Rulers (machine)	1 „
Stereotypers	1 „
Wood-type cutters	1 „
Type founders	5 English. 1 Russian.

Stationery.

Black-lead pencil makers	4 English. 1 Bavarian.
Envelope makers	5 English. 1 Austrian.
Ever-pointed pencil makers	2 English. 1 Bavarian.
Fancy stationers	13 English.
Printing ink makers	3 English. 2 Belgian. 1 Austrian.
Inkstand makers, and writing case ditto	3 English.
Manifold writers	2 English.
Marking ink makers	4 English.
Penholder makers	3 English. 1 Bavarian.
Quill pen merchants	2 English.
Sealing-wax and wafer makers	4 English.
Valentine makers	4 English.
Wafer makers	4 English.

Miscellaneous.

Telegraph paper	1 English. 1 Sweden. 1 Germany.
Raw material for paper-making	8 English. 5 Sweden. 1 Hanover. 1 Queensland. 2 India.

And some 20 miscellaneous exhibitors, chiefly English.

EXHIBITIONS.

THE VIENNA EXHIBITION.

The following letter has appeared in the *Times* :—

Sir,—I am glad to see your articles and the letter of our Chairman of the Society of Arts, General Eardley-Wilmot, on the important subject of the Vienna Exhibition.

The reason I have urged it on the Council, is that I find that efforts are being made in every part of the Turkish Empire, and even in Persia, to be represented at Vienna. There is hardly a town which has a local manufacture but what each *esnaf* (or trade guild) or city company has subscribed to send specimens and representatives to Vienna. These trade guilds are still in full force in the East, and they enabled the Sultan and his ministers to understand the significance of their reception in Guildhall, where the sight of Sir Thomas Gabriel on a throne by the side of the Padishah marvellously tickled their fancies. This great co-operative action is put in full force, and also that of every functionary and gentleman who can show some ancient article of art or manufacture.

As the Turks are a travelling people, and know the name of Vech (Vienna) very well, they will make less trouble of going there than on the Hadj, and every facility will be given to visitors. Thus, there will be assembled artisans at work in their shops, and all the appliances of Turkish life will be found in Vienna, while there will be brought together the Turk, the Arab, the enterprising Armenian, the Greek, the Jew, the Syrian, and all the varied nationalities of Western Asia, and those who carry on trade with the remote interior.

These people have been asked to look upon articles of English manufacture as the choicest. Each gentleman has what he believes to be a gun, a watch, and a telescope, with an English mark; each tradesman a watch with a well-known name, and the very pedlars in the streets recommend their small wares as Inglezikas.

The question is, what these people are to see. Are they to profit solely by that opportunity which, at great expense and exertion, the Austro-Hungarian government has provided, with a view of attracting what they knew to be the great and growing trade of the East, or are they to see what they want to see—the favoured manufactures of England? Already they are largely supplied with German sham goods, woven fabrics, arms, watches, cutlery, hardware, with English trade-marks and English placards and labels; and it is very desirable that our manufacturers should profit by this rare opportunity of showing what England can really do.

Not only will the Turks be there, but Roumanians, Bulgarians, Servians, and the populations of those Eastern countries just awakening at the contact of civilisation. Mr. Ransome, who wrote to you, took part in the Ottoman General Exhibition at Constantinople, and knows the value of these markets.

Unfortunately, the season does not allow the Council of the Society of Arts to try public meetings, and it is to be hoped manufacturers will be induced, by your articles, to resort to spontaneous action; for, unfortunately, our government does not view this Exhibition in the same light as the Austrian and Ottoman governments, and is ill-disposed to encounter the necessary expenses for important national interests. At all events, let us hope the manufacturers of Manchester, Glasgow, and Belfast, will not be found less enterprising than the *esnaf* in Bagdad, Aleppo, or Diarbekir.—Your obedient servant,

Hyde Clarke.

Sir,—I notice in the Turkish papers that the Archduchess Sophia has addressed a letter to the ladies of most of the cities of Turkey, requesting they will send specimens of local work. In compliance with this desire, committees of ladies are being formed, and, among other peculiar features of this remarkable exhibition, will be found the various kinds of needlework, embroidery, lace, &c., of which each city has a peculiar style. Thus in lace there is a *point de Smyrne*, and other varieties.

It does not appear that the Austrians have had much hope of enlisting sympathy here, or that much interest has been shown. Never, perhaps, was such an opportunity presented to English manufacturers of all kinds as the Vienna Exhibition affords.—I am, &c.,

Hyde Clarke.

32, St. George's-square, S.W., September 18th.

CORRESPONDENCE.

TELEGRAPHY WITHOUT INSULATION.

Sir,—As another test of my telegraphic system, I tried the other day the following interesting experiment:—In my own house I put on a battery between the water and gas pipes, throwing them into opposite states of tension by a commutator. I got permission to place in an empty house in the same district a gold leaf instrument, also between the water and gas pipes. I took care that the gas-pipes should be metallically connected (as a mixture of tow and tallow is often used between the joints), and found that I could readily signal from one house to the other. It is scarcely possible to get less insulation than in the public water and gas pipes.—I am, &c., H. HIGHTON.

Putney, September 21, 1872.

THE VENTILATION OF THE HOUSES OF PARLIAMENT.

SIR,—The "Report on the Ventilation, Warming, and Lighting of the Houses of Parliament," which forms the basis of the following remarks, was issued in 1866, at the request of the Right Honourable the First Commissioner of Her Majesty's Works, &c., &c., and the points to which attention shall be drawn, appear to deserve particular notice.

It need hardly be premised that the object of all ventilation is to supply to the inmates of the buildings which are the subjects of its operations fresh and wholesome air, and to carry away all impure and vitiated air. If any system of ventilation fails in any of these points, its efficiency may well be doubted, but if it can be proved that it may have a tendency, instead of supplying pure and wholesome air, only to increase and intensify the foul, and if, further, it can be shown actually to do this in practice, then not only does the matter deserve special attention, but it should never be allowed to rest until perfection is attained.

This becomes a very important matter in everything connected with our Houses of Parliament. Whatever is adopted and carried out there will, very naturally, be looked upon in other quarters as perfection, and it will, therefore, be very liable to be copied by other public buildings and institutions throughout the length and breadth of the land. If what is thus copied is bad, or if it is erroneous in principle, or if it is not the best adapted for the attainment of the end in view, then what an amount of money may thus be thrown way. But, further—and this is even a more serious matter than the other—see how the onward march of improvement, slow at best, will be thrown back and retarded for years to come.

According to the report under review, the system of ventilation carried out in the case of our Houses of Parliament is one of exhaustion, or, in other words, one of suction, that is, the exhaled air is all sucked out, and then, to supply its place, the surrounding external air is sucked in, no matter how impure, or how unfit for breathing purposes it may be. We may now consider what the tendency of such a system of exhaustion is in theory, and so what the realised results may be expected to be in practice.

A system of exhaustion, such as this under consideration, is nothing more nor less than the creation of a partial vacuum, into which, for the purpose of restoring the atmospheric equilibrium, the surrounding air rushes, or is sucked in from every quarter. Were the atmosphere quiet, the process would go on in some such way as this:—Currents would gradually set in from all directions towards a common centre, that centre being the space from which the air was being constantly sucked or exhausted. These currents would set in from all quarters, and would come from distances very much greater than may be generally supposed. Were stables, cow-houses, public conveniences, or any kind of nuisance in the line of these currents, then the foul air from all or any of these would take a permanent set towards the inlets to the common centre. As they did so, their lower strata would sweep over the surface of the ground, and so bear along as well the exhalations arising from horse-dung, foul drains, and a host of other abominations; and when the inlets were reached the whole would rush in pell-mell, forming a compound of anything but pure and wholesome air. This, after being inhaled and re-inhaled, would be sucked out only to make room for fresh volumes of the delicious mixture.

Another tendency of such a system is to create draughts. Wherever there is a vacuum, or partial vacuum, the external air is pressing in on all sides in the endeavour to restore the equilibrium. At every crack or chink about a door or window it may be heard hissing in, or, if not heard, it may be felt as a cold, deleterious draught. Not only so, but at every crack about woodwork, and at every seam of the floor, is cold or damp air sucked in, giving likely toothache in the one case, but certainly cold feet in the other, together with a whole host of other resultant evils.

Another tendency of such a system of suction and exhaustion is to destroy the acoustic properties of whatever buildings in connection with which it may be in operation. It need not be pointed out that, wherever there is a partial vacuum in the same ratio as that has been reached, has the power of the air to transmit pulsations of sound been destroyed.

Apologising for taking up so much of your valuable space at this time, I must defer quotations from the report and some further remarks to a final letter.—I am, &c., H. F. ALEXANDER.

Edinburgh, September 19th, 1872.

HEADS AND HANDS.

The book by Mr. Thomas Brassey, on "Work and Wages," is valuable, not only because of the importance of its information and the breadth of its views, but because it is suggestive of remedies or compensations for strikes and lockouts. The fable of the belly and the members is too frequently exemplified, to the injury and inconvenience of the public at large, when "trading squabbles" result in sudden or general suspension of work by bakers, engine-drivers, hackney-coachmen, postmen, harvesters, colliers, and the like. Moreover, our national wealth is endangered when foreigners "send coals to Newcastle," and underbid us in the markets of the world, heretofore commanded by the superior or cheaper products of our native industry. In so far as those are consequences of want of accord between masters and workmen, in mutual dependence as heads and hands, it seems good service to promote variety in relations between capital and labour. Where all such relations are upon a like footing, neither Heads nor Hands are free to remain in concert, however so disposed, if constrained, whether by *esprit de corps* among employers or by terrorism among workmen, to abandon what else might be continuous, profitable, and satisfactory co-operation. The genius of discord can but too easily realise the ancient tyrant's wish to sever at a single neck the heads of all opponents.

One example may suffice to illustrate the expediency of distributing our resources, rather than subjecting all to a common hazard. Our national debt has of late years been wisely broken up into several distinct funds, in manner to render possible the calling in and paying off of moderate amounts without embarrassment. The familiar maxim, "not to place all our eggs in one basket," is one of many with like significance. In order, therefore, that the body politic shall not incur risk of total deprivation of any one of the necessary services indicated at the commencement of this paper, let there be provided such diversities of engagement between the instruments of those services as may secure us against desertion by all simultaneously.

The following seem to be practicable diversities of the kind required, and we invite the suggestion of others:—

1. In the case of large contracts, often lost to English firms because they are afraid to rely upon a calculable scale of wages, let the Hands be invited by the Heads to engage for the term required by the enterprise, and at a normal rate of wages, either subject to adjustment by

cost of living, as in the case of corn-rents, or otherwise, with recourse to arbitration in need, and in manner made binding in advance.

2. Modes of sub-contract, as in mining enterprise, in railway construction, &c., &c., a mode found most successful by the Postmaster-General, *vide* his last report.

3. Spontaneous or other modes of supplementing wages, by contributions to sick or superannuation funds, to life insurance or mutual guarantee funds, to building or common supply unions, to savings-banks, or other provident associations, all more or less for advantage of workers, in concert with the same employers. Instances of such inducements to employés, plus salaries or wages, abound, both in the public service, in banks, and in other first-class establishments.

4. Reversal of relations between capital and labour, so as to enable combinations of workmen to take lease of factories, hire management, and borrow capital, in security of the products of their labour, less "subsistence money."

5. Co-operation of Heads and Hands on the joint-stock principle, as it exists both at home and abroad, with improved methods of audit.

Other varieties will doubtless be suggested. Meanwhile, popular periodicals specially devoted to discussion of such subjects, and edited by first-class economists, would do good work, *i.e.*, promote accord between Heads and Hands.

It is not to be assumed that such periodicals would have a very wide circulation, but they could become the rallying ground of economists and philanthropists, able to deal with the practical as well as the theoretical, in the relation of Heads to Hands. From such periodicals readable matter would be quotable by newspapers and the like, taken in by classes desired to be reached. Perhaps further incentives to think, or to provide food for thought, on subjects of such paramount importance, might be to offer prizes to Hands, or distinctions to Heads, for original and useful contributions to the end in view.

JACOB A. FRANKLIN.

THE SOURCES OF POWER.

SIR,—The letter of "Anglo-Italian" demands the most serious attention of all those who desire the advancement of our country; it opens out a wide field for the consideration of our mechanical and civil engineers.

At this crisis of our history, when that which has materially contributed to place our nation in the van of the world's progress threatens to become so dear that our many industries must, in the future, be seriously hampered, it becomes imperatively necessary that no effort should be spared to utilize those well-known forces, air and water.

Before Watt discovered the steam-engine, these two powers were in constant use, and, where coal is scarce, are still employed with advantage; and now that coal-owners and coal-getters have materially enhanced the value of the black diamond, and the demand for home and foreign consumption is ever on the increase, air and water must again play an important part in the future demands for power.

With regard to air, there is a never-ending source of power. Living amongst the Yorkshire hills, I have often noticed the force of the air currents (the average pressure of which per square foot could easily be ascertained from our local meteorologists), most certainly capable of supplying an amount of power which would be no mean boon to our overburdened manufacturers.

Windmills have been employed in this and other lands much more extensively in the past than now. In Holland we have examples of their great use in pumping water; there, it may be said, wind and water are in continual conflict, one seeking to subdue the other.

Wind is said to be fickle one day at rest and another in a state of tempest, and that from it can never be evolved a steady and constant power, such as is required by our manufacturers. But may not this uncertain element be made into a good servant? If windmills were employed to compress air into suitable receptacles, and in number and capacity equal to the requirements of one or more users of power, we should have a steady power at the least, and probably one not soon exhausted.

By multiplying our mills, we could avail ourselves of comparatively weak currents of air, and in times of calm draw upon our reserves.

At these times the power of the compressed air could be increased by the application of heat. Thus, those great waves of air which often sweep with the force of a gale across our country, would be made to pay tribute to the demands of manufacture and commerce. Nor is it unlikely that other means besides windmills would be forthcoming for the utilization of air currents. Men of scientific culture, allied with inventive genius, would be able to add to our stores of knowledge. Not less important are our streams; the smallest stream has a certain measure of power. Stream added to stream are but the units of that power which in its onward march to the sea is often all but irresistible.

Our large towns and cities have done much towards impounding these forces, but mainly with the view of providing for domestic consumption—not the supply of power to our manufactures. More comprehensive plans for the gathering of the waters, with an economical distribution of the same, would add much to our power resources, whilst in certain positions turbines and other water-wheels could be directly employed. Yet these would doubtless be found of greater use if made to compress the air into suitable vessels, afterwards to be conveyed when and where required.

Next come our rivers. Why should they be allowed to pass our doors without contributing their share to the common stock? Is it not a disgrace to our age that such streams as the Humber, the Tyne, the Mersey, the Thames, with their many tributaries, should be allowed to waste their strength, or only be used as carriers. Let our river currents be made to do duty, as compressers of air as well as in a more direct way, but more especially command the services of all tidal streams, small or large. With regard to river currents we have an example in the Rhine. Our excursionists will not have failed to observe those floating mills, whose power is derived from the passing streams. Were these multiplied and employed to compress air, to be conveyed ashore by pipes, either laid on the bed of the river or suspended above, the power to be obtained from that stream alone could be vastly multiplied, and conveyed wherever required. As with the Rhine so with many of our rivers, none so small but may be the means of producing power, and none so large as to be beyond the grasp of the inventive genius of the age. But especially so with regard to our tidal streams, no matter which way they were flowing. It would not be more difficult to construct a tower in mid-stream, with all necessary mechanical appliances for the compression of air, and to send the power thus got ashore, than it was to build the Eddystone lighthouse or the Plymouth breakwater. Nor is it vain to hope that the immense forces of the ocean, in its ebbings and flowings, may be made the servant of man. No one can stand on the sea-shore, and watch the gathering and the breaking of the waves, without being conscious of the presence of a power which none but the Infinite can measure.

It is man's prerogative to bridle these forces. Surely it is not beyond the science of the age to grapple with this problem. In our midst we have eyes trained to observe, and minds to compare and determine. Many heads and many hands would not fail to accomplish the object. It is true the work is vast, but not too vast for a nation like ours. Its spare cash could not, I think, be more profitably invested, its army of thinkers more usefully employed. But if the work is vast, so are the advantages. Our coal measures would be spared for our locomotives, our steam-ships, ships of commerce, or of war, and for home comforts. We cannot afford to stable our locomotives or lay up in our docks our steam fleet, and yet we are threatened with this calamity. Nor can we be careless of our home comforts. Home is the garden of human life, where a weakly physical frame or a strongly developed one are in the ratio of the comforts there possessed.

As a nation, we cannot afford to have our population reduced in physical or mental power, but deterioration must take place, even if present prices of coal are to rule. Whatever checks these must be of advantage to the nation. Other nations would benefit equally with ourselves. Their demands for coal would probably decrease, having, like ourselves, a never-ending source of power in their midst.

Compressed air, compressed by air and water, is to be the means of accomplishing all this. The use of this element in the cutting of coal and in the making of tunnels is already before us. Let us take the hint, and open out a wider field for its employment. The dancing of the lid of the kettle was the clue to the steam-engine. The right use of compressed air, and the means by which this may be accomplished, especially taking note of the forces of air and water everywhere abounding, may be the key to unlock the treasures of the future, and thus out of present difficulty, and perplexity, and suffering, may come increased power and happiness to our nation and to the world at large.—I am, &c., Halifax.

Haley-hill, Halifax, September 24th, 1872.

THE COMMERCE OF DENMARK.

The series of reports furnished by the consular service and the secretaries of legation supply us with information respecting the commercial and financial condition of Denmark, and the relative share taken in the trade and shipping by Great Britain. The year 1871, according to Mr. Consul Crowe, appears to have been a very prosperous one for that country. The harvest was abundant, and exceeded an average; the prices of agricultural produce, at the same time, ranged high, and the material benefit thus conferred on the landowners and farmers was felt by all classes. The concurrent abundance of money in most of the European money markets affected the prices of all stocks, and gave an impulse to financial and industrial enterprise. The total commercial movement of the kingdom with foreign countries, according to the tables published by the Danish government for the year 1870-71, exceeded a gross weight of 3,014,000,000 Danish pounds, of which 1,976,500,000 represent the imports, and 1,037,500,000 the exports, which figures denote a considerable increase above each of the four preceding years. The increase is especially apparent in the export of native produce and of foreign transit goods, while the imports have been somewhat less than in 1868-69, and but slightly in excess of other years. The increase of this transit trade is, in a great measure, due to exceptional circumstances arising out of the war between France and Germany, which caused a considerable portion of the trade between North Germany and foreign parts to pass through Jutland. In these publications of the Danish government there are no values given for imports, and only partially so for exports, the totals must therefore be compared in weight. For 1871 there were imported 988,277 tons, and exported 518,754 tons. The share taken by Great Britain in the foreign trade was about 43 per cent. of the imports, and 41 per cent. of the exports, or 42 per cent. of the whole foreign commercial movement.

Denmark is not a manufacturing country; the amount and list of exports therefore by no means gives a clear idea of the producing powers of the country, being largely made up of articles in transit. The native exports of real importance are comparatively few in number, and are nearly all the produce of agriculture, for which there seems an inexhaustible demand in the British markets. The yearly average export of corn for British account may be calculated at about 1,319,000 imperial quarters, or nearly the whole of the surplus cereal harvest; of this quantity about half is barley, which is much liked for malting purposes. A disposition is at present apparent among the Danish farmers to decrease their cereal production, and devote their capital and energies to developing their dairy produce and cattle-rearing, which branches promise a more lucrative return, as the experience of the last twenty years show that the increase in prices of corn has not kept pace with that in butter, meat, and live stock. The potato cultivation has been pursued chiefly for home consumption and for cattle fodder; and the frequent appearance of the disease has led the Danes to depend less upon it than other agricultural produce. The great increase of facilities for communication by land and water have naturally increased the value of all Danish produce. The railway between Skanderborg and Silkebork, which is likely to be of much importance to Jutland, was opened for public traffic on the 3rd of May, 1871, and the Vensyssel line, which forms an important link in the Jutland railway net, was opened on the 15th August, and will, when the new bridge across the Lumfjord is erected, doubtless greatly feed the Jutland lines by traffic from Sweden. The Swedish trunk line, which unites Norway and Sweden, was completed and opened for through traffic on the 16th June, and the Norwegian capital is now brought within 27 hours of Copenhagen, an immense boon for those ice-bound countries which hitherto depended solely upon water-communication for the transit of their goods and passengers, and which, during the winter months, were practically cut off from all general commercial intercourse. There is now also an uninterrupted line of railway from the Scaw to Hamburgh; and when the project of running large steamers all through the winter from Fredrikshavn (Scaw) to the Norwegian coast is realised, Norway will be brought into still greater and more constant communication with her more favoured neighbours and customers. The harbour, the only available port for sea-going vessels in the north-east coast of Jutland, is difficult of access with certain winds, and is too small for the increasing traffic the newly-opened lines of railway have diverted thither. It is now proposed to form a port and harbour of refuge at the Kirsholms, a small group of rocks, or reefs, near the coast to the north of Frederikshavn. The project is to run a mole out to sea in a line with, or on, these reefs as far as the edge of the fast winter ice. The soundings recently taken have shown that there is sufficient depth and space between them and the mainland for a commodious harbour, which would be accessible in all weathers. The importance of such a harbour in these inhospitable regions cannot be over-rated when it is considered that about 50,000 vessels annually pass the Scaw, in the neighbourhood of which there is no Danish harbour large, deep, or accessible enough to accommodate the large steamers which now trade up the Cattegat and Baltic.

At the beginning of 1869 the total length of telegraph lines in Denmark was about 234 geographical miles, and of wire 616; whereas at the end of 1870 these lengths had increased respectively to 264 and 687 miles. The number of stations had likewise increased from 53 to 75, to which must be added 75 serving to 13 private lines, making the total number of stations open for correspondence at the end of last year in all 150. The number of messages were 348,690 in 1868; 409,167 in 1869; and 513,623 in 1870. A great telegraphic enterprise has been completed during the year, without Danish territory, but by Danish enterprise, and mostly with Danish capital, namely, the Great Asiatic Telegraphic Company, called the China and Japan Extension Line. Their submarine lines between Hongkong, Shanghai, Nagasaki, and Wladowstock are now laid and complete, and the land lines from this place through Siberia to Europe open for correspondence, and China and Japan are thus brought into direct communication with Europe. The Danish mercantile marine in 1871 consisted of 2,826 vessels over 4 tons, with an aggregate of 188,742 registered tons. There were besides 13,610 boats under 4 tons burden. The mercantile steam fleet consisted of 49 screws, with 9,301 tons, and 3,005 horse-power; 31 paddle, with 2,627 tons, and 2,441 horse-power; 7 open screw boats, with 51 tons and 41 horse-power. The average of the sail ships was 64 tons, and of the steamers 137 tons. The Danish shipping shared in the general prosperity, and the amount of freights earned were greater than in preceding years.

Mr. Strachey, her Majesty's secretary of legation at Copenhagen, in his report on the finances of the kingdom, observes that no manipulative tricks are practised in the public accounts of Denmark. There are no provisional budgets or transfers of credit, and instead of a a floating debt there is a large reserve. During the interval between the presentation and the passing of the estimates by the Folkething, the minister asks for any fresh votes which the exigencies of the public service may require. As almost every item of expenditure provokes a debate and a division, the discussion of the budget always takes from four to six months. He also explains the proposed tariff reforms by a short historical explanation of the tariff now in force, which derives its origin from the customs law of 1797. Before that date the import duties were pitched at the highest mark of fiscal unreasonableness, and there were the usual prohibitions, both of imports and exports. The law of 1797 was probably a greater progress for Denmark than Sir Robert Peel's tariff reform was for England. Nearly all the prohibitions were removed, the chief exceptions being those of sugar, porcelain, and cards; the duties were lowered, and numerous administrative improvements calculated to encourage commercial development were carried out. Between 1797 and 1863 the tariff went through several fluctuations, both in principle and rates. There was an occasional tendency to positive relapse, and at length, in 1838, a definite return to the system of 1797. In 1863, a complete revision was carried out. All export and transit duties were abolished, the rates were considerably lowered, and the protection to native industry was diminished. Wares received a suitable classification as raw, made up, or half made up. The primary necessaries of life, and the prime materials of industry are, as a rule, duty free. Thus, compared with the neighbouring Baltic countries, the existing tariff will be found to be a liberal one. The proposed changes do not amount to much. According to the averages of imports for the last five years, the loss to the exchequer would not exceed 8 per cent. of the entire customs revenues. The chief necessaries of life, and the prime materials of industry are free, as before. Certain raw articles of secondary importance are added to the free list; likewise reduced rates for certain manufactured articles, the whole involving a loss to the revenue which would be partly covered by raising the present duties on tobacco, wine in casks, fruits, hops, tea, cocoa, artificial flowers, and other articles of the luxury class. It might be supposed that, in an agricultural country like Denmark, public opinion would favour such proposals, but this does not appear to be the case. The yeoman, who is the determining political factor of the country, has, it is true, no wish to be fined for the manufacturer's benefit. He has, however, a strong sympathy with sumptuary taxation, or with what he regards as such. Many of the articles which would be cheapened by the adoption of the amended tariff are to the plain Danish farmer, whose habits and tastes must not be compared with those of the British farmer, mere luxuries imported to satisfy the artificial wants of the rich townsfolk. Further, the existing tariff brings in an increasing revenue, it is not found to be oppressive, and its modification might chance to derange the finances of the kingdom. These are the feelings which competent judges ascribe to the agricultural class of Denmark, and like views are attributed to many members of the "Combined Left," a majority of the Folkething.

NOTES ON COMMERCE AND TRADE.

The recent issue of the statistical abstracts for the colonial population and for British India enable an estimate to be formed of the aggregate value of the British and foreign commerce carried on by these, individually and collectively, and a digest of the figures into groups will convey an idea of the importance to which the trade has attained.

The returns for the colonies are brought down to the year 1870, but there are many omissions, owing to the returns not having been yet received, which does not speak well for official precision in the colonies.

We will take the total value of the imports first. Throwing these into groups, we find the total import trade, including bullion and specie, was as follows:—

	£
India and the Eastern colonies	53,709,824
Australasian	28,880,832
African colonies	3,663,205
North American colonies (including Bermuda and Honduras)	17,626,723
West Indian (including British Guiana)..	6,544,575
Malta	4,097,269
	114,522,428

This is exclusive of Hong Kong, the Straits Settlements, Lagos, and Gibraltar, for which no returns are given. Of the above total imports £61,567,342 was from the United Kingdom.

The total exports, thrown into similar groups, were as follows:—

	£
India and Eastern colonies	59,465,248
Australasian	28,421,352
African colonies	3,845,579
North American colonies	16,265,053
West India and Guiana	7,374,729
Malta	3,627,694
	118,999,655

Of this total, £59,537,275 was sent to the United Kingdom, or more than one-half, as the returns from several of the colonies are deficient.

These figures differ somewhat from the returns given in the last statistical abstract of the trade of the United Kingdom, when the total value of the imports from British possessions for 1870 is given at £64,832,413, and of the exports to, at £55,391,332. The explanation of this discrepancy, however, is, that the returns of the United Kingdom are made up for the year from January to December, whilst India and many of the colonies make up the returns for the year ending 31st March and 30th June.

The seventh report of the Commissioners of Customs enable the figures for the colonies to be brought down to the end of last year. Taking the value of the imports from the British possessions, the highest return of the last few years was in 1869, when it amounted to £70,416,491. The value of the imports of 1871 reached £73,447,156, showing an increase over this unusually high return of £3,030,665, or 4·3 per cent.

The rise in the value of the imports from India alone (taking the three Presidencies, the Straits settlements and Ceylon together), greatly exceeds, indeed is nearly double, this increase on the total return. It is no less than £5,788,755, more than one million and a-half of which amount is due to the article of cotton alone. There is also a very large increase in the values of silk, and a rise also in those of wool, hemp, and sugar sent from India, while the values of dry hides and of copper from Ceylon have decidedly fallen off. There is an increase of £1,116,000 in the value of the imports from the British West Indies, arising wholly from the increased quantities of sugar sent to the country in 1871, and of £707,000 in those from the dominions of Canada, principally in the value of wheat. The total value of the import, export, and transhipment trade of the kingdom, in 1871, was £695,674,901, being an increase in the total trade, as compared with 1870, of over £89,000,000, or 14·6 per cent.

The quantities of the principal imported and exciseable articles retained for home consumption, per head of the total population, in the United Kingdom, in 1871, was as follows:—Bacon and hams, 3·38 lbs.; butter, 4·69 lbs.; cheese, 4·25 lbs.; cocoa, 0·23 lbs.; coffee, 0·97 lbs.; tea, 3·92 lbs.; wheat and wheat flour, 150·63 lbs.; potatoes, 3·03 lbs.; rice, 7·47 lbs.; currants and raisins, 4·38 lbs.; eggs, 12·75; sugar, raw, 41·51 lbs.; refined sugar, 5·29 lbs.; spirits, 0·28 galls.; wine, 0·51 galls.; tobacco, 1·36 lbs.; malt, 1·72 bushels, and British spirits, 0·78 gallons.

Notwithstanding the long-protracted and sanguinary war in Cuba, the production of the two great staples, sugar and tobacco, seems to have gone on without any extensive interruption, and the exports for the present year, it is said, will fall little short of those of the past year. It is even asserted that the yield of tobacco will exceed that of last year, and be superior to it in quality. In 1870, Cuba exported over 8,000,000 lbs. to the United States, about 1,600,000 lbs. to Great Britain, about as much to France, 600,000 lbs. to Hamburgh and Bremen, and about 1,000,000 lbs. to other parts, the whole amounting to about 12,000,000 lbs. In the same year Cuba exported 165,578,000 cigars, and in 1871, 161,272,000, the aggregate value of which was very considerable; but as the cigars were of different sizes, prices and brands, no accurate estimate can be given. By far the greater part of the best Cuban tobacco and of the cigars made therefrom come to England. The choicest crop is that grown in the Viretta-Abajo district, whose soil and climate are admirably adapted to the growth of the plant, and the entire crop is sold for England, only the poorer or second quality crops going to the United States. It is estimated that the value of the present tobacco crop will amount to £5,000,000. There has been a steady decrease in the European demand for Cuban sugar, even Spain taking but a very small quantity of her colony's production. This arises from the increasing cultivation of beetroot in Europe. This, however, does not affect the production of rum and molasses, for which there is still a steady demand. Next to sugar and tobacco, coffee is one of the main products of the island, but the cultivation is not carried on to such an extent as it might be. The same may be said of other productions, which the bounteous hand of Nature has enabled this fertile and beautiful island to yield in such profusion, such as mahogany, cedar, and other valuable woods, abundant fruit crops, wax, honey, esculents of various kinds, hides, cattle, &c.

The high prices current for cotton, in 1870, stimulated production in all cotton-growing countries.

Much cotton intended for France and Germany was diverted from its direct course, in consequence of the war, during the early months of 1871, and came to this country in the first instance, even when intended to be ultimately re-exported to its original destination. There was the following increase in the imports from the four principal cotton-growing countries:—

	Cwt.
United States	2,878,865
British India	801,268
Egypt	289,878
Brazil	187,872
	4,157,883

The United States have now entirely distanced their great competitor, British India, whose contributions for ten years, from 1860 to 1869 inclusive, to the wants of the country had exceeded their own. The total quantity sent in the last two years from these countries respectively were as follows:—

	From United States. cwt.	From British India. cwt.
1870	6,395,045	3,048,819
1871	9,273,910	3,850,087
Total	15,668,955	6,898,906

The supply from the countries where cotton is only cultivated to a small extent, or from others which pass on to us their superabundant stocks, fluctuates every year.

The quantity of tobacco received last year was upwards of 73,000,000 lbs., of which 54,648,082 lbs. came from the United States, where the crop was abundant and of superior quality.

The animal food supply of the kingdom is an important subject at the present juncture, and deserves to be closely studied. The quantity of dried meat imported, both into the port of London and into the United Kingdom generally, continues to increase largely, as the following figures show:—

Into the United Kingdom.

	1869.	1870.	1871.
	cwts.	cwts.	cwts.
Beef, salted	214,955	203,713	279,179
,, fresh, or slightly salted	14,268	12,035	22,005
Pork, salted	165,944	220,533	266,967
,, fresh	24,930	36,481	30,618
Meat, fresh (chiefly mutton)	50,247	34,300	40,586
,, preserved otherwise than by salting	32,214	80,636	260,138
	502,558	587,698	899,493

Of this direct imports into London last year were—salt beef, 63,013 cwts.; fresh ditto, 20,366 cwts.; salt pork, 90,486 cwts.; fresh pork, 27,835 cwts.; fresh mutton, &c., 15,425 cwts.; preserved meats, 247,134 cwts.; or a total of 464,259 cwts.; more than half of all the imports. This year the imports of foreign animal food will show still larger figures.

GENERAL NOTES.

Italian Cavalry Horses.—From some statistics which have been lately published by the Minister of War, it appears that out of 18,930 horses and mules belonging to the Italian Army in 1871, the total loss during that year from death was 605.

Constant Water Supply.—Amongst other benefits which this confers is the facility it affords for the supply of motive power for the working of many trades where small steam engines are not available, either on the ground of expense or of nuisance to adjoining houses or premises. In Canterbury, where a constant supply exists, it is much taken advantage of for this purpose, and small water-power engines are there in daily use for a variety of purposes.

Discovery of Fresco Paintings.—The *Cologne Gazette* says that a very interesting discovery has just been made at Fribourg. In removing the whitewash from the walls of the old post-office of that town, some fresco paintings have been discovered, which seem to be the production of Holbein or of his school. The building was formerly known as the Baster Hof, or Court of Bâle, and Holbein was a native of that town. Unfortunately, the paintings have suffered serious damage.

Dog Tax.—With a view to compel all owners of dogs to pay the tax imposed by the State in France, a proposal is now under consideration to oblige all masters to place collars on the necks of their dogs, so arranged that they may be stamped, by means of a pair of nippers, each time that the tax is paid; all dogs found without collars to be seized.

To Cut and Bore India-rubber Stoppers.—In a letter to the *Chemical News*, Mr. W. F. Donkin says:—"Dip the knife, or cork-borer, in solution of caustic potash or soda. The strength is of very little consequence, but it should not be weaker than the ordinary re-agent solution. Alcohol is generally recommended, and it works well until it evaporates, which is generally long before the cork is cut or bored through, and more has to be applied; water acts just as well as alcohol, and lasts longer. When, however, a tolerably sharp knife is moistened with soda-lye, it goes through india-rubber quite as easily as common cork; and the same may be said of a cork-borer, of whatever size. I have frequently bored inch holes in large caoutchouc stoppers, pefectly smooth and cylindrical, by this method. In order to finish the hole without the usual contraction of its diameter, the stopper should be held firmly against a flat surface of common cork till the borer passes into the latter.

An Ancient Carp.—Those who have visited the Palace of Fontainebleau will remember the wonderful collection of enormous carp, many of them grey and hoary with age, and one or more of them blind, in the canal of the park; some of these creatures are declared to be more than four hundred years old. A carp was killed the other day at Chantilly by a huge pike, and the following extraordinary account concerning it is related in the *Gaulois* of Paris:—"It was the oldest carp in the world, being 475 years of age, and belonged to M. C——, the proprietor of a fine property at Chantilly. It was an historical carp, a carp which was born at the Comte de Cosse's, in the time of François I; it had passed through various fortunes, having had no less than thirty-two masters. M. G——— purchased it a year since for thirteen hundred francs. The name of the carp was Gabrielle, and it measured nearly 29¾ inches round and 38⅔ inches in length." Certainly this carp affords one of the most extraordinary instances of longevity and pugnacity combined that was ever recorded; to be killed in combat at the age of 475, is indeed rare, even in story.

Wool in the United States.—The wool interest of the United States has made satisfactory progress during the last ten years, for which the rebellion is largely responsible, woollen fabrics having been during that period largely substituted for cotton. The growth is stated as follows:—

	1860.		1870.
Sheep	22,471,275	..	28,437,051
Wool	60,264,913lbs.		100,102,387lbs.
Average per head	2·68	..	4·52

The product of wool in the twelve principal states devoted to sheep husbandry at the two decennial periods was as follows:—

	1860. lbs.		1870. lbs.
Ohio	10,608,927	....	20,539,643
New York	9,454,474	....	10,509,225
Pennsylvania ..	4,752,522	....	6,561,622
Michigan......	3,960,888	....	8,726,145
Vermont	3,118,950	....	3,102,137
California	2,683,109	....	11,391,743
Texas	1,493,738	....	1,251,328
Illinois........	1,989,567	....	5,739,249
Indiana	2,552,318	....	5,029,023
Iowa	660,858	....	2,967,043
Missouri	2,069,778	....	3,649,390
Wisconsin	1,011,953	....	4,090,670

It will be seen from the above that several states have changed positions, but the most remarkable change is that of California. That state, which ranked amongst the lowest in 1860, stood second in 1870, and promises the current year to take place by the side of Ohio. New York, although she owned fewer sheep in 1870 than in 1860, yet shows a gain of over a million pounds in her wool product. The above statistics show that the eastern states are gradually losing rank as wool growers, but the loss in that direction is much more than made up by the increase in the west. But the states in which the most rapid strides may be looked for in this branch of industry in the coming year are California and Texas, where the climate is so mild that the flocks do not require to be housed and fed, but get their own living all the year round.

Effects of Compressed Air.—M. Paul Bert has drawn the attention of the Academy of Sciences, through M. Claude Bernard, to the great danger of sudden transition from compressed air to the outer atmosphere. He states that, when the compression has been carried to the extent of eight atmospheres, sudden transition is fatal to animals, and particularly to man; and that, even in cases of lower compression, the injuries, though not necessarily mortal, are very serious. It has been found, therefore, by experience that men, having worked under a compressed atmosphere, should not be allowed to quit it except very gradually, and under full precautions as to the effects produced upon them. The autopsy of animals killed by such transition shows that the spinal marrow is reduced to nearly a fluid condition. The effect is supposed to be produced by the gases becoming absorbed in the blood under pressure; and that, when this is removed, they disengage themselves with violence, disturb the circulation, and produce a sort of general paralysis.

The Louvre.—The museum of the Louvre has received another munificent legacy, including 450 pictures, and a number of Flemish panels of the fifteenth century, late the property of M. Léirs, a rich merchant of Lyons. The panels were purchased at the sale of the collection of the Marquis D'Aresta, of Madrid. Amongst the pictures there are two by Teniers, one of which, the "Man in the Grey Cloak," is celebrated. A very fine work of Miéris, several fine pictures by Gerard Dow, and one authentic Raphael. Amongst the modern works are pictures by Paul Delaroche, Ary Sheffer, Deveria, Delacroix, Laury, Corot, Alfred de Dreux, and others. M. Léirs, like M. La Case, the last extensive donor to the museum, has stipulated that the collection shall be kept together and bear his name. In consequence of this stipulation a special gallery is being provided for the collection. A fine portrait of Eugène Delacroix, painted by himself, has also been bequeathed to the nation by Mdlle. Leguillon, and has been hung in the famous *Salon carré* in the Louvre.

Chicago.—The *Augsburg Gazette* gives the following account of the re-building of Chicago. Nine months and a-half ago there were in the city 98,500 persons without houses to live in; of these 74,500 had occupied 13,300 houses. By the latest accounts new habitations for 70,000 persons have been erected in various parts of the town. In the southern quarters, where most of the hotels, warehouses, shops, and theatres are situated, and where 3,650 habitations had been destroyed, the new houses which have been erected are very superior to the former in value, in appearance, and, which is most important of all, in solidity of construction. The total length of the streets rebuilt is equal to 26 English miles. It must be remembered that, during the first three months after the fire reconstruction was very difficult; nor could it be carried on during the winter months so rapidly as in the summer. The *Chicago Times* holds out the hope that, by the 9th of October, the anniversary of the disaster, the city will be entirely rebuilt.

Journal of the Society of Arts.

No. 1,037. Vol. XX.

FRIDAY, OCTOBER 4, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

INTERNATIONAL EXHIBITION, 1872.

The Council, having been informed that Her Majesty's Commissioners do not intend to publish reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such reports, for publication in the Society's *Journal.* The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following is the second of the series. The others will appear from time to time.

JEWELLERY AT THE INTERNATIONAL EXHIBITION, 1872.

The contributions to the present Exhibition of jewellery at this second of the international series, include examples from Germany (north and south), France, Russia, Sweden, Holland, Belgium, Switzerland, Spain, Portugal, Italy, Greece, Malta, Egypt, Turkey, China, Japan, Africa, Ceylon, India, Australia, New South Wales, and the United Kingdom of Great Britain and Ireland. Of these, it is matter of regret that only two countries, India and Great Britain, can be considered to be in any degree fully represented. France has sent very little, but private collectors have lent some beautiful specimens of French workmanship. Austria, from which much might have been expected, is but very indifferently represented. The Russian contribution is creditable, but small; and Spain, if conspicuous at all, is so only in peasant jewellery, of which character, indeed, are the exhibits of Germany, France, Switzerland, Sweden, Greece, Egypt, Malta, and Algiers, with few exceptions. The British and Italian jewellery is characteristically the reverse of this; but the Indian exhibits include jewellery and personal ornament for all grades, from prince to peasant.

There are in all 119 distinct exhibits, which include 31 collections of peasant jewellery, the property of her Majesty's Commissioners, and seven others, which are only incidentally connected with jewellery, being either mineralogical specimens or paste imitations of known and important gems.

In order that this report may be, as the Council of the Society of Arts has expressed, "of such a nature and interest as will help the public to appreciate the special and new features of the objects exhibited," I propose, as a matter of convenience, first, to draw attention to the British and Continental jewellery, commencing with the Birmingham contributions at the south of the gallery, and proceeding northwards, to consider the various exhibits in succession, avoiding only Mr. and Mrs. H. Rivett-Carnac's important loans, as belonging exclusively to the Oriental section.

In many of the individual collections, it will be observed that the names of the manufacturers of the objects have not been published, which either arises from the fact of their being unknown, or, as in the case of Birmingham, they have been suppressed, in accordance with the wishes of the manufacturers themselves.

To the credit of Birmingham, it has contributed not only much good work to the Exhibition, but skilled workers, who are daily engaged in various branches of the art of jewellery, a fact which alone merits high commendation, and which has added much to the interest of the Exhibition. In scanning the Birmingham exhibit, one is impressed with the prevalence of monograms, or such devices in the decoration of the objects as appear to be of such character, and executed with gems on gold or enamel. Many of these are exceedingly effective, and should for ever stamp out the notion, if it still exists, that Birmingham produces only cheap and bad jewellery. Some of the lockets upon which the decorations have backgrounds of black enamel are particularly happy in the contrasts thus given to the gems displayed. The valuable breast ornament, having a large diamond in its centre, cannot but claim attention, and in the general arrangement of its parts, it is a meritorious work, though not quite felicitous in respect to colour, lacking sufficient variety in hue. Near this specimen are some charming little heart-shaped studs, with turquoise centres, surrounded by small diamonds, and some excellent pendants, with carbuncle centres, bordered with pearls, which gain much in delicacy and beauty by the juxtaposition thus afforded. A gold locket, admirably varied as to its surface treatment, should not be passed unnoticed. Something of an inverted triptych in form, and of ribbed gold, covers much of its face, the points of which are emphasized with pearls, the pretty fringe of gold pendants having also pearls similarly and effectively introduced. The gold suite too is particularly good which includes the bracelet with a large pearl centre, surrounded by a star of diamonds; and the brooch with a diamond star on a jet ground, surrounded with chased gold and black enamelled scroll work, studded with pearls, is admirable. In the same group is a locket of considerable merit, on which is a stilted arch of turquoise beads on a gold ground, which includes an anthemion of diamonds, while each turquoise has a small trefoil of diamonds attached to its outer edge. Another case of Birmingham jewellery contains, with much other good work, two very happy examples of pearls on black enamel. A comparatively novel material, too, may be said to have been introduced by one of the Birmingham contributors, which has the merit of prettiness at least, and consists of tortoise-shell inlaid with gold and silver. The specimens of this class of work are unpretending as to general tone, but their geometric treatment is good, though capable of much further development and enrichment.

There is, perhaps, in many of the objects included in the Birmingham exhibit a little too strong a love evinced of strap and scroll work in bold relief to be entirely satisfactory; and, in one or two instances, propriety and good taste have been sacrificed to novelty in subject Birmingham, unfortunately, is not alone in this, and it cannot be too much insisted upon that neither horseshoes, even if diamonds, nor an ingenious hotch-potch of horse gear made up as a necklace and pendants, can ever be æsthetically right, or happy as personal ornament. The element of beauty alone is wholly sufficient in the jeweller's art, but where there is a partial absence of this, there must be much more in it than mere oddity of subject. On the whole, however, the Birmingham contribution to the present exhibition promises well for the future, but its promise would be still fairer if a little more tendency were seen in it to an appreciation of gold as a ductile and malleable material, as a formative substance, rather than one which can be made to cover large surfaces, or dazzle with its splendour of colour.

Birds and insects have been utilised and treated as personal ornaments, by A. Boucard. As specimens of beautiful colour, one could scarcely hope to see anything better than these; but, as a matter of feeling, beetles are not likely to be regarded by the many as lovable ear-pendants.

Mackay, Cunningham, and Co.'s exhibit includes a necklace of exceptional merit, designed by Sir Noel Paton, and consisting of hemispherical gems, alternating with medallions of inlaid stones and chased gold. The magnificent pear-shaped opals hanging from bows of diamonds are not equally happy in treatment, but the Holbein pendant is a delicious little ornament. The bracelet, also, with other objects similarly treated, and of pierced and chased gold overlaying silver, are well designed, and deserve careful notice.

Some carved bog-oak ornaments, exhibited by W. Gibson, have immensely gained by the introduction of small quantities of gold. Where much has been used the result is not quite so satisfactory, but the admixture of gold into the rather dismal region of mourning jewellery is certainly a step in the right direction. Surely it is not too much to hope that fashion, which is so changeful and capricious in matters of form, will soon indulge in the luxury of even so little as a small gold bead in alternation with jet or bog-oak in this class of work, without too much disturbing the orthodox piles of black with which the masses seem to think it necessary to associate the "happy dead."

Messrs. Bright and Sons contribute many objects of value and beauty. The opal cameo is very tastefully designed, and in its general form and treatment reminds one of the 16th century Cellini jewellery. The mauve enamel, however, is a little crude; and the head, which has been exquisitely cut, is injured rather than otherwise by the lovely fire of the gem itself. The fire of an opal is too uncertain as to its place to be entirely suitable for a treatment like this, but the work has been admirably done, and is in almost all respects felicitous.

In Richard A. Green's exhibit, the bracelet with a head of carved amethyst is conspicuous, and of far more than average merit. The introduction of landscape painting however, though in enamel, as a personal ornament, cannot be considered happy, but some small Wedgwood plaques have been here tastefully introduced as such, the gold settings of which are exceptionally good. Chasing upon gold, however, where the surface is liable to friction, it must be admitted, is undesirable as a rule, but, when judiciously applied, is often of great value.

The use of beads is most happily shown in one of the specimens of Bavarian peasant ornaments. The example referred to is of fine spiral metal work, of a dusky bronze hue, which covers without hiding entirely a gold-foil ground. Upon and about this, in charming variety, white beads are disposed in masses and small starry clusters, the whole effect being heightened by the introduction of large ruby paste gems, set singly and far apart, and to which the rest of the ornament tells rather as an accessory than otherwise. In close proximity to this really beautiful though peasant decoration, is a bridal crown, said to have been worn at weddings from A.D. 1600 to the present time. It is composed almost exclusively of glass balls, of every conceivable colour, and spangles, and needs, what it undoubtedly has, all the charms of happy pageant association to qualify its inherent ugliness. The silver dress ornaments included in this exhibit are, in the matter of design, of more than average merit.

Mrs. Alfred Morrison's delightful loans have been selected with such tasteful discrimination as to render it somewhat difficult to select for remark any individual object. There is nothing better in the whole exhibition than the gold work in C. Lepec's necklace included in the Spanish parure, both as to design and right use of material. The black enamel and pink topaz bracelet, though not perhaps entirely lovely as to colour, is much more harmonious than such combinations usually are where pink is dominant. Notable also is the dainty introduction of small turquoise beads in the Turkish necklace, and the exquisite interchange of gold star and bead with the pearls in the cap-pins. The damascened objects by Zuloaga are also perfect in design and delicacy of workmanship; but there is a little tendency to heaviness and monotony of tone in these ornaments, when compared with the best of enamelled and jewelled work.

Of some exquisite specimens of jewellery exhibited by A. Castellani, the most remarkable, as regards delicacy of workmanship, are the reproductions of the antique coronet and the Milo necklace, but the necklace of Etruscan cornelian scarabei, set in gold, and alternating with granulated gold beads, is very beautiful. The art of granulating gold is of antique origin, but Signor Castellani has been very successful in reviving the art, and no better example of it can be found than these beads afford. The coral and gold suite, too, is remarkably rich in character, but not quite equally happy, on the whole, in design; and the pendant mask upon the necklace is both antique in treatment, exquisitely made, and as ugly as it can well be. The enamelled plaque, too, cannot be passed unnoticed. As a specimen of modern work, of great technical difficulties successfully overcome, it is highly creditable, but the general tone of its colour is not of the happiest, and lacks both life and brilliancy.

Fitly in conjunction with Castellani's revivals of antique forms is Messrs. Phillips and Sons' exhibit, which includes another and equally perfect copy of the Milo necklace. The specimens of natural coral, too, though not "art," are of much interest, from the variety and beauty of their forms and colour; and a jewelled and enamelled pendant and earrings are alike exquisite in taste and finish.

Hancocks and Co's. exhibit includes, by permission of her Grace the Duchess of Devonshire, the suite known as the "Devonshire Gems," which is composed not only of antique, but of selected antique specimens from one of the finest collections in existence. These have been tastefully arranged as to form and colour, and set in gold and enamel, so producing ornaments of almost unmatched value and beauty. Many beautiful specimens of modern jewellery have been manufactured and exhibited by the same firm, of which the most noteworthy are several "Holbein lockets," and a necklace *en suite*, a locket or pendant of diamonds admirably arranged, with a single ruby centre of exceptional colour and size; and a pendant, which contains an unusually large, if not unique, black pearl, the grey tones in which are heightened in beauty and value by the juxtaposition of rubies. The "Prince" necklace, too, and a second of almost equal lightness and grace, are exquisite specimens of the jeweller's art, as are also some enamelled lockets—sufficiently good in colour and character to remind one of the best of Chinese work; and, lastly, a pair of fan-shaped turquoise ear-rings or pendants, with added pearls and rubies, are excellent in form and treatment.

The jewels lent by the Countess of Dudley are, as regards quality and quantity, an exhibition in themselves. Of the six magnificent parures, the ruby and diamond one is by far the loveliest in design, and the starry pendant to the necklace is graceful and rich in the extreme. Nothing can be more delicate either than the gold work in the red coral suite; and the tasteful manner in which the small diamonds in it have been introduced is very noteworthy. The chrysoberyls, too, with their diamond circlets and pendants, are as tender and lovable as any ornaments can be.

The British jewellery exhibited by White and Campbell includes a very beautiful necklace and ear-rings of lapis-lazuli and gold. The whole is extremely rich, and the colour of the stones in the ear-rings is unmatchable in its beauty and strength. A necklace, too, of ivy-leaves in green enamel, by the same firm, is very good in treatment, but, from the prevalence of *yellow* in the gold and the green enamel, the harmony is not quite perfect. The introduction of the enamel in the onyx brooch is in exquisite taste, as is also a bracelet, characterised by a geometric treatment of white enamel and small rubies.

Howell and James exhibit many choice objects, of which none deserve more attention than a pair of diamond ear-rings, in nowise pretentious as to the size of the individual gems in them, but entirely right and beautiful as to their distribution, both in the masses and the delicate pendants in which they are attached to mere threads of gold. The juxtaposition of these to an aigrette, invites comparison as to treatment which is not favourable to the latter. The introduction of bows or knots, as in a textile fabric, though composed of closely set diamonds, is not in good taste. The bracelet having a row of pink, lozenge-shaped coral, dotted with small diamonds through its centre, and bordered with pearls and plain gold, is admirable.

The suite designed by Sir M. D. Wyatt, and composed of pearls and diamonds on gold, is of considerable beauty in design, and exquisite in its surface variety, whilst the little bridesmaid's locket, too, designed by Lewis F. Day, is admirable in the distribution of its quantities of enamel, both as to colour and tone. The surrounding gold is right also in its general form, but the drilling of holes, with a few scratches of the graver, does not make the most of interlacing bands of gold.

J. Ward and Co. exhibit small birds' heads and beetle-like insects of exquisite colour set in gold; and G. V. Wisedil contributes two pins, with a label containing a moral about gambling. The pins are sufficiently good to have been allowed to speak for themselves, the coil of the serpent round the dice being particularly good; but the jewellers' art should be on the side of beauty, not morals, and it entirely mistakes its proper function when the latter supersedes the former.

The specimens of Roman shell camei exhibited by Francati and Santamaria are of much more than average merit, and Mrs. G. Blenkins lends a delightful suite, consisting of brooch, ear-rings, and necklace, set with Oriental garnets. The gold work in this instance is as beautiful in treatment as can be wished. Well worthy of notice, too, in this respect especially, are the Roman mosaics lent by Sir Daniel Cooper.

The miniature copies of saints' heads, from pictures by Fra Angelico, painted and exhibited by Elizabeth M. Allen, and not very tastefully mounted as brooches, are full of sweetness, and, as regards subject, contrast favourably with the more perfectly executed specimens of enamel by W. B. Ford, which are of the naturalistic school.

The Florentine and Byzantine mosaic jewellery, exhibited by P. Bazzanti and Son, and the Venice and Murano Glass and Mosaic Company, includes no very striking examples of either the mosaicist's or the jeweller's art. The treatment of flowers in perspective cannot be productive of the best art of this kind, for the infinite variety of colour and tone in stones gives opportunity for another and far richer treatment. The glass beads too, exhibited by the Mosaic Company, are rather overloaded with crystalline forms suggestive of scratchiness. The white beads, however, which alternate with the coloured ones, in several instances are exquisite in texture and hue.

Some pendant gold crosses and brooches of simplest form, exhibited by E. Culver, have in one or two instances a very tasteful introduction of enamel upon them.

A Moorish necklace, with pendant coins and filagree crescent dotted with turquoise, included in the succeeding peasant jewellery, is richly strung together, and there is much quaintness in the Armenian portion of the exhibit.

The peasant jewellery from Ceylon contains many specimens of great beauty and tastefulness, in which open-worked or skeleton gold beads alternate with others differing in treatment.

The little Belgian exhibit, composed of specimens of jewellery by B. de Bruyne, C. Devos, and A. Seldenslagh, is of high importance. The gold work is exquisite, both in design and workmanship, geometric in treatment, and composed for the most part of twisted strands of gold, in some instances contrasting most agreeably with burnished surfaces—it is one of the contributions to the exhibition which merits all praise.

The metal work of the sporran purse, by Millidge and Sons, is excellent in design, and the cairngorm brooches, in which the stones are of unusual size and beauty, are well treated.

C. and M. Crichton's exhibit contains some very good specimens of chased silver work, and the blue and white enamel brooches are well designed. A bracelet with foliated pierced gold over silver, and studded with pearls, is of special merit.

Dr. Ivor Murray's loan is—as almost all Japanese and Indian art is sure to be—delightful. The Japanese portion is full of quaint little conceits, tenderest devices, teeming with humour and rich fancy, and of most delicate workmanship. Heartily may we wish that European taste and influence may never reach this wonderful people to affect their art, in which head, hand, and heart are felt to be in especially happy union. In another branch of art indeed, that of pottery, in the so-called Lowestoft ware, the effect of European influence is too painfully manifest ever to be regarded as other than a warning in the direction pointed out.

Some of the specimens of Spanish peasant jewellery are remarkably good; more especially a pendant and earrings of a somewhat antique type; and some silver gilt filagree crosses, and pendants from Salamanca, are very suggestive, and novel in treatment, the open work being well relieved in them by the shade in the concave surfaces at the back of it.

John Neale's exhibit is very varied in character. It includes several very beautiful and valuable jewels, as the diamond earrings, and a gold suite, which is excellent in design; but many of the objects are unimportant, if not commonplace. Mr. Neale has, however, successfully introduced the standard hollow gold chains, a specimen of which is included in this exhibit.

The reproduction of old Russian types, exhibited by John Chichileff, are uniformly rich and good, though, perhaps, a little crude, as are also the otherwise highly creditable specimens of French jewellery from Bourg en Bresse, some of which are in excellent taste.

Some specimens of carved amber, exhibited by Franz Hiess, are good; and one of the brooches included in the North-German peasant jewellery, and worn by the Vierländer women, is very tastefully designed.

Mrs. Maberley has lent some beautiful specimens of Chinese workmanship, composed of portions of blue feathers, jade, and gold, as quaint and grotesque in form as they are exquisite in colour. Other specimens, equal in beauty, and of similar material and treatment, have been contributed by Miss R. Cole, Miss F. Redgrave, and also the Governor of Hong Kong.

The Swiss peasant jewellery is not remarkable, but that from Sweden is very effective, concave burnished pendants, or spangles, having been used to great advantage. The filagree work is excellent in design, and the inexpensive and tasteful silver ornaments, by Tostrup, and exhibited by A. Borgen and Co., deserve very special notice. The treatment of the frosted ivy leaves in the necklaces is both conventional and beautiful, and burnished spots have in places been introduced with much effect.

Jeremiah Goggin's carved bog-oak ornaments, with their gold tips and paste or crystal, are not striking in design, and the "Coldstream star set" is even a little disappointing.

H.R.H. the Princess of Wales lends a magnificent corsage, one side of which is composed of diamonds, the other of ruby and white enamel, with pendant emeralds. This is an exquisite work on the whole, and of the bangles of Lasque diamonds and enamel it is enough to say in their praise that they are of the finest Indian workmanship. The Highland brooch also is admirably designed, the cairngorms being contrasted most agreeably with the blue enamel and white interlaced bands which form their background.

The "old French peasant jewellery" includes a lovely pendant and ear-drops of ruby pearls and black and white enamel; and a collection lent by Madame A. Jubinal is well worthy of notice, more especially the filagree suite, dotted with black and white enamel.

James Robertson exhibits, amongst many admirable objects composed of stones and rock crystal set in silver, a noble cairngorm brooch and an Iona cross of crystal, with a circlet of small rubies connecting the arms, both of which are of special merit.

W. Marshall and Co.'s specimens of chased and pierced silver, with delicately-introduced black and white enamel, are admirable, some of the crosses being charming in design, and avowedly copied from antique ecclesiastical examples.

W. Whiteley exhibits a highly creditable case of black cut-glass personal ornaments, every small portion of which is backed with metal. The general effect of these objects is very good, the polish being much brighter than jet is capable of receiving, and every care has evidently been taken in the manufacture. An onyx necklace, in another group by the same exhibitor, is of considerable merit, both as to the form of the units and the general treatment of the whole.

Saunders and Shepherd have contributed some tenderly-executed specimens of carved jet, with added ivy leaves in gold, which cannot but be generally and justly admired.

John Ward's exhibit of ear-pendants includes one with a star of pearls upon blue enamel, of special merit in design and execution. A contrivance is also to be noted here for more effectually securing the ornament to the ear than the ordinary form admits of, unless such an appliance is added, which, as a label informs, can be readily done.

Some excellent personal ornaments of a geometric character are exhibited by J. A. Wheatley, in which shap granite and silver are conspicuous as materials; and some of J. W. Singer's enamelled brooches and pendants are exceptionally good in form, though crude in colour.

Conspicuous as to merit in M. L. Spiegel and Co.'s exhibit are the triple elliptical earrings, with added cinq-foils in blue and green enamel; and of the objects contributed by C. Bryan the mourning crosses are far the most meritorious.

Thus, with some unimportant exceptions, the east gallery has been reviewed, and it remains, as far as the prescribed limits of this report will allow, very broadly to consider the oriental work exhibited, in which division Mr. and Mrs. Rivett Carnac's extensive loan in the east gallery forms an important auxiliary to the magnificent collection of objects in the Indian Court. Dr. Burdwood could not done better than he has in preluding this gorgeous Indian exhibition with the specimens he has collected of natural growths, including grass, berries, seeds, and seed-pods, which have evidently furnished the Hindoos with materials for their simplest or most primitive personal ornaments, as instanced in the armlets worn by the Thakoors of Matheran.

It is to be observed that the indentical forms which occur here in plaited or twisted straw and grass are found, in some instances in metal too, clearly indicating their origin, and the probable adoption of the latter for the sake of increased durability, and, with added colour or gems, increased splendour. It should be remembered, too, that these primitive ornaments of plaited straw, though very ineffective, possibly, if worn by fair-skinned Europeans, may be extremely effective and tasteful upon the bronzed Hindoos.

It is obvious that the remarks to be made upon this Indian collection must be of a very general character, a detailed consideration of which would suffice for a volume. One broad and important principle, an observance of which characterises all Hindoo work, must be specially insisted on, for it is of *supreme* practical import. It is this, that *considerations of material, in relation to monied value, are systematically set aside, except in so far as they subserve the higher qualification of general harmony of colour.*

Diamonds and rubies, if at hand, say these people, by all means; if not, diamonds and ruby paste; or foil and paste, or sealing wax, if need be, but, whatever the *material*, the effect must be harmonious—splendid—and the keenly sensitive Hindoos in the broad field of labour thus open to them, produce ornaments of almost incomparable splendour, and which seem rather to have blossomed as flowers under their hands than to have been put together piece by piece. There is clearly no apprehension in the mind of the Indian jeweller that one may come to him, and, with ill-natured suspicion, say, "That *may* be a diamond; I suppose it is, but if it is, it's off colour; and *that* I am sure is common paste;" or, as though it were a question of morals, possibly involving a charge of deceit, "I'd buy that, but it is so very like coral, and I know it isn't." There can be no hope for anyone in art whose only faculty, after much exercise of it, is merely to detect the presence of stones, paste, or metals wherever they may occur, entirely missing the all-important element of beauty, which is the spirit and purpose of the whole matter. Who sells a paste gem and declares it to be emerald or ruby is a deceiver; but he who uses it in harmonious combinations is, and just in the measure he does so, an artist. As an example in which much has been made out of wholly common material, a little pendant ornament in the Indian collection is well worth considering. It consists of five pieces of ruby paste, crescent, from the lower and convex edges of which hang, equidistant from each other, seven small imitation pearls. Within the upper edge, and included in the line of its curve if produced, is a quatrefoil, the crowning-leaf red, the two next below green, spreading laterally to the extremities of the arc of ruby paste, and limiting it; and last and very important, is the fourth petal, of white foil, in form a hollow cone. Now the beauty of this little trinket is very great, and much of it depends upon the difference in tone of the dull white pearls and the white foil central leaf, which is the focal-point of the whole ornament, and as bright, by happiest contrast, almost, as a dewdrop in sunlight.

Notable, also, as expressing the carefulness of these people about the little things in art, even the stringing of beads, is a necklace composed of them. A few of these beads in the order given are of gold, wood, red-paste, pearl, red-paste, wood, amethyst, and so on. It is to be observed that the gold beads are left, as it were, very much to take care of themselves, occurring as they do sometimes between two red beads, or a red and a wooden one, or between two wooden ones. These, then, in any combination, according to the instinct of the person who strung these beads together, could not get far wrong or be misplaced. But pearls are delicate things, and their particular beauty of hue and tone is easily marred. These must be taken care of, so they are placed, without an exception, between two dull red beads, that their sweet grey tones may be strengthened. Does any one suppose this to have been accidental? Impossible. Such attention in the arrangement of intrinsically almost worthless material could only have been paid, when to do the right thing, however, small, was almost a necessity, and evidently a pleasure, whilst the converse would have been annoying, if not painful.

So these semi-barbarous people prove to us that there can be no monopoly of art on the side of wealth. Art is universal, and its highest development is ever where delight in it is purest and strongest. Those whose privilege it has been or will be to see the magnificent gems which the present exhibition includes, will have seen almost as much of priceless and peerless stones as will even be good for them to see for some time to come, but they will not have seen all that Art can do, or the best that Art can do in relation to them. We have not yet learnt to make the most of gems, and the Hindoos have proved this to us. The stringing together of precious stones, though facetted never so perfectly, is no more Art, necessarily, than the stringing together of shells or beads. The wealth of beauty is there assuredly, individually, but it may have been lavishly—even savagely applied. The world has seen an art which, in its application to jewellery, was at least equal, as to harmony of colour, to the best of Indian art, and immeasurably superior to it in refinement and elegance. The Italian art of the sixteenth century, examples of which are happily seen from time to time in our Museums, is as distinct in its matchless beauty from all European art of the present day as it is possible to be; but the costliness of such work in enamel, and gold, and gems, even were it possible to revive the genius and skill of Cellini and his compeers, would exclude all but the comparatively rich from the possession or enjoyment of it. Thanks to the Hindoos, and the crowning novelty of the present Exhibition, indeed, is the light they have given us in relation to the universality of art and its application; they have taught us this lesson—that *materials* only, however costly or costless they may be, are but the *strings* and *horse-hair*—not the *music*—of art, which can only be enjoyed where and in whatsoever combinations true beauty exists.

Indian art, however, though, perhaps, supremely splendid, is not without important rivals at the present time as in the past, in this realm of colour. The beauty of Chinese ornaments and general decorative art, especially in cloisonné enamel, is quite comparable to that of the Hindoos in this respect; and Japanese art, whilst equal in this also, is immeasurably superior to it in some much higher qualities than harmony of colour alone. Indian art is comparatively inanimate, and its greatest beauties are as those of the floral kingdom, but Japanese work teems with quaint and beautiful life, and is as distinctly in advance of all other art in this element of vitality as it is superior in the dainty finish which characterises it.

Numbers of Exhibitors and Lenders.

EXHIBITORS.

England	70
(Of this number 47 are from Birmingham.)	
Scotland	5
Ireland	2
Italy	5
Belgium	4
Bavaria	2
Russia	2
Algiers (French province)	1
Sweden	1
Armenia	1

LENDERS.

Great Britain	26

Her Majesty's Commissioners, to whom almost without exception the whole of the peasant jewellery exhibited belongs, are included as one in this number.

EXHIBITIONS.

Exhibition of Useful Insects.—An exhibition of useful insects and their products, and also of noxious insects, with samples of the injuries caused by them, organised by the Central Society of Agriculture, and under the patronage of the Minister of Agriculture and Commerce, will be held during this month in the Luxembourg Gardens in Paris. It will comprise silkworms and the cocoons of every species, with samples of thrown and raw silk; apparatus for silk culture; with the manufacture and raw product of bees, and apparatus for bee culture; a collection of noxious insects, and apparatus suited for their destruction; other useful insects; collections of mammifers, insectivorous birds and reptiles, &c. The programme of the exhibition may be obtained of the Secretary of the Society of Agriculture, 59, Rue Monge, Paris.

ON SOME RECENT IMPROVEMENTS IN THE MANUFACTURE OF ARTIFICIAL STONE.

By Frederick Ransome, A.I.C.E.[*]

The progressive development of the natural world, through periods which occurred long before the dawn of the most remote traditions of antiquity, have placed at the disposal of man materials which for the most part eminently subserve the varied purposes of construction and decoration. These materials, however, such as the granites, marbles, sandstones, limestones, &c., occur in isolated groups, in some instances so remote from the centres of civilisation as to render the employment of them prohibitable for general use, excepting in local situations. The requirements of man, at an early period of his history, demanded a material which should approximately fulfil the conditions of stone, and this necessity was in the earlier ages supplied by the manufacture of bricks, concrete, &c. The advantages afforded by these substances were readily recognised by the ancients, and have been fully appreciated in modern times; but great as these advantages are in a constructive point of view, they fall very far short of the requirements of the present age.

It is therefore no matter for surprise that numerous attempts have been made, from time to time, to supersede the productions of nature by the imitations of art, and the importance of producing a material combining all the advantages, without having the defects, of the most useful building stones, and possibly possessing attributes peculiarly and specifically its own, was recognised many years since by the author, who set himself the task of solving the problem of manufacturing an artificial stone which should economically answer the varied purposes of the productions of nature.

His investigations into the nature and properties of stone commenced nearly thirty years since, and he found that, with few exceptions, the hardest and most durable stones were those which contained the largest proportion of silica. After numerous attempts at combining crystals of sand with powdered glass under hydraulic pressure, and uniting the mass by partial fusion, and after having exhausted the combinations of these substances with the various cements, it occurred to the author to substitute a concentrated solution of silicate of soda or potash for the other cementing materials he had previously employed.

This solution of silicate of soda or potash being mixed with sand, and pressed into a mould, formed when dried a very hard stone, having a close and uniform texture, but which, however, disintegrated upon being exposed to moisture. The next step was to submit the compound to the action of heat, when the free alkali of the cementing silicate combined with an additional quantity of the silex of the sand, and produced an insoluble silicate unaffected by moisture. In the course of time, however, the efflorescence of a salt was observed to form on the surface of the stone in buildings where it had been used. This, for the most part, proved to be sulphate of soda, which existed originally in the soda ash used in the manufacture of the silicate. This objection was removed by treating the solution of soda with caustic baryta before using it in the preparation of the silicate.

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[*] A paper communicated to the Mechanical Section of the British Association, at Brighton.

Such in general were the results the author had obtained by the year 1859, when he had the honour of placing them in detail, together with his experience in the preservation of stone by soluble silicates, &c., before the Chemical Section of the British Association at Aberdeen. At the invitation of the President of the Mechanical Section of this meeting he again appears before the association, in order to place before its members a description of such alterations and improvements as he has introduced in the process of manufacture since his previous paper was read, and which have led to its increased usefulness, both in the constructive and decorative arts.

The process of the manufacture of the solution of silicate of soda has been so fully and frequently described in various scientific journals that the author considers it unnecessary to do more than simply allude to it here. Ordinary flint stones are subjected to the action of a strong solution of caustic soda in cylindrical boilers or digesters under steam pressure of from 60lbs. to 80lbs. to the square inch. Under these conditions the flint is rapidly dissolved by the solution of caustic soda, and the silicate of soda in solution is produced, which, after being discharged from the boiler, is concentrated by evaporation to a sp. gr. of 1,700°, and contains about 66 per cent. of silicate, 33 per cent. of soda.

In manufacturing the stone, the silicate is thoroughly incorporated with clean, dry sand and other suitable siliceous or earthy ingredients, in a mixing mill specially constructed for the purpose, when the compound assumes a stiff, pasty consistency, is readily pressed into moulds of any required form or pattern, and is capable of receiving and retaining the most delicate impressions. If now the mass be allowed to dry gradually at an ordinary temperature, it will become hard, and to all appearance a perfect sandstone; but inasmuch as the several particles of sand, &c., are combined together by a soluble silicate, if exposed to the action of water, the silicate will soon become re-dissolved, the sand and other ingredients will be set free, and the mass entirely disintegrated.

The next problem to determine was how to convert the soluble silicate of soda into some insoluble silicate, which should possess the properties requisite for the formation of a good, hard, compact, and durable stone, without the action of fire heat, which had been found so inconvenient and expensive in its application in former methods.

In the year 1861, in consequence of the premature decay of the stone of the Houses of Parliament, a committee was appointed by the government, to examine and report on the causes of such decay, and the best means of preserving the stone from further injury. The author, in common with others, was summoned to give evidenee on the subject, having, for some years previously, been engaged in working a process, patented by himself, for preserving stone by first saturating it with a solution of silicate of soda, and afterwards applying a solution of chloride of calcium, which immediately decomposed the former, and produced an insoluble silicate of lime in the stone so operated upon. In order to demonstrate conclusively the efficiency of such application, he proposed to reduce a piece of stone to powder, and then, by the aid of these two solutions, to re-convert the powder back into a solid stone.

The experiment was tried, and the result was so completely successful, that a patent for the manufacture of artificial stone, by the employment of these ingredients, was at once obtained, and arrangements were made for carrying out the same upon an extended and practical scale. In doing so, the mixture of sand, silicate, &c., when moulded as previously described, was immediately removed to benches placed over open tanks, or immersed therein, and completely saturated with a solution of chloride of calcium. This operation, in cases of large masses, is materially assisted and accelerated by aid of air-pumps, &c. Double decomposition of the two solutions of silicate of soda and chloride of calcium immediately takes place, resulting in the production of an insoluble silicate of lime, firmly uniting and enveloping all the particles of which the object under treatment is composed, and a solution of chloride of sodium, or common salt, which is subsequently removed by the free application of water.

The foregoing is a brief history of the material manufactured by the author down to the year 1870, when he developed another process, as distinct from the last described as that is from the process explained to the Association in 1859.

It was found, in practice, that the process of washing, so as to completely remove all trace of the chloride of sodium from large masses of the stone, was open to objection—it was both tedious and expensive, especially in localities where there was a difficulty in obtaining a good supply of tolerably pure water at a reasonable cost.

The author then conceived the idea of obviating this washing process, by producing the insoluble silicate of lime, without the formation of chloride of sodium, or other soluble salt, which would require subsequent removal. Step by step, this result has at length been arrived at, and the process of manufacture thereby materially simplified, the cost of production reduced, and the application of the material considerably extended. Many gentlemen present will, doubtless, recollect that some years since a silicious mineral was discovered at the base of the chalk hills in Surrey—especially in the neighbourhood of Farnham, possessing some very peculiar properties, amongst others that of being readily soluble in a solution of caustic soda, at a moderately low temperature. Taking advantage of this peculiarity, the author commenced a series of experiments, in order to determine if it were not possible, without the use of chloride of calcium, to produce a stone in all respects equal in quality to what had hitherto been done, and in this he has now succeeded.

By this latter process he combines a portion of the Farnham stone, or soluble silica, with a solution of silicate of soda or potash, lime (or substances containing lime), sand alumina, chalk, or other convenient and suitable materials, which, when intimately mixed, are moulded into the required form as heretofore, and allowed to harden gradually, as silicate of lime is formed by the combination of the ingredients present. The mass then becomes thoroughly indurated and converted into a compact stone, capable of sustaining extraordinary pressure, and increasing in hardness with age.

The chemical actions which effect these results appear to be as under. When the materials are mixed together the silicate of soda is decomposed, the silicic acid being liberated combines with the lime, and forms a compound silicate of lime and alumina, while a portion of soda in a caustic condition is set free. This caustic soda immediately seizes upon the soluble silica (from Farnham), which constitutes one of the ingredients, and thus forms a fresh supply of silicate of soda, which is in its turn decomposed by a further quantity of lime, and so on.

If each decomposition of silicate of soda resulted in the setting free of the whole of the caustic soda, these decomposing processes would go on as long as there was any soluble silica present with which the caustic soda could combine, or until there ceased to be any uncombined lime to decompose the silicate of soda produced, the termination of the action being marked by the presence in the pores of the stone of the excess of caustic soda in the one case, or of silicate of soda in the other. In reality, however, the whole of the caustic soda does not appear to be set free each time the silicate of soda is decomposed by the lime, there appearing to be formed a compound silicate of lime and soda, whereby a small portion of the latter is fixed at each decomposition. The result is, that the caustic soda is gradually fixed, and none remains to be removed by washing or the other process.

Having explained the manufacture and chemical composition of the several descriptions of artificial stone herein alluded to, it will be as well in the next place to point out some of the varied purposes for which they are peculiarly adapted. The primary conditions of materials for construction are, unquestionably, strength and durability—those of a secondary nature being appearance, facility of application to the intended purpose, and economy in use. As regards strength, the value of the artificial stone herein described increases with age. By some experiments, which were made for the purpose of testing their possession of this quality, numerous samples were proved, within a month of their manufacture, to be superior to Portland stone. At the age of ten weeks, in stones made by the last-described process, the strength, as compared with Portland stone, was found to be as 7,145 lbs. to 2,630 lbs. per square inch ; and as compared with Bramley Fall, 7,145 lbs. to 5,120 lbs. ; and as regards granite, 7,145 lbs. to 1,200 lbs. per square inch. With reference to durability, the artificial stone has been found practically to withstand the atmospheric changes of various climates, having been exposed to the cold of Russia and the heat and rains of India. In general appearance, the stone manufactured by these processes bears such a perfect resemblance to the best description of natural stones as to mislead the most critical observers, whilst the facility of application and its economy in use will have been apparent from the foregoing description.

By means of the last-mentioned process, the field has been widely extended for the application of the stone produced thereby, and which, for convenience, as distinguishing it from all others, has been termed "Apœnite." It is now no difficult task to produce blocks of this material of any form and of any size, the only limit being the means available for handling them upon the spot where they are employed. Moreover, the materials which form the bulk of apœnite are, as a rule, generally to be found in abundance where hydraulic or other important works are being carried on, and for which purposes the new stone is eminently suited.

The want of such a material for such a purpose has long been felt, although that want, until recently, has only been partially supplied. In 1870, Mr. J. W. Butler applied for and obtained a patent for improvements in the application of concrete to structures and foundations, also to cofferdams and similar constructions. Mr. Butler's obvious desire was, in the first place, to provide a cheap and efficient substitute for stone for hydraulic operations, and in the second, to render unnecessary the construction of false works, &c., and thus to avoid the expense connected with the employment of iron cylinders, hitherto so extensively used. The idea was certainly an excellent one, but its realisation appeared to Mr. Butler very remote, until it occurred to him that the material then introduced under the name of "apœnite" would answer the purposes of his proposed methods of construction. He accordingly communicated with the author upon the subject ; and with the sanction of the engineer a set of hollow cylinders 8ft. in diameter and 9in. thick were made to form part of a retaining wall to protect the foreshore of the Thames at Hermitage Wharf, where they were accordingly sunk, and the result was satisfactory.

The arrangement proposed for economically carrying out this class of work is as follows :—A timber staging is erected, upon which the materials may be mixed and moulded, the moulds consisting of an inner and outer framing, the space between the two forming the mould for each ring of a cylinder or hollow block, as the case may be. The courses are joined by means of a cement formed of similar materials to that of which the rings or blocks are composed. These are lifted from the staging on which they have been made, and lowered into position by an overhead traveller or crane, as may be most convenient. The lowest course is chamfered, as shown in the diagram, and when necessary from the nature of the soil, may be shod with iron. The operation of sinking is carried out generally in a precisely similar manner to that adopted with iron cylinders. The horizontal joints are made with alternate projections and depressions, and the several courses are connected vertically by dowel piles, which also serve as guides in sinking the work.

The application of this principle is capable of modification to suit almost every variety of construction, and it would be found especially applicable in structures requiring heavy foundations, particularly where the ground is uncertain.

For forming a face-wall in building quays or docks, instead of cylinders, rectangular hollow blocks or caissons may be used. By employing hollow blocks of hexagonal form, no interstices are left, a thin layer of the cementing material rendering the structure practically homogeneous. Cylinders constructed upon this principle are also adapted for deep wells, apertures being formed in the sides for the admission of water.

Turning to works of greater magnitude, it will be seen that apœnite forms a suitable substance for the construction of bridges, sea-walls, piers, and similar undertakings. The structure could be carried up to the underside of bridge girders, or built with ordinary masonry above high-water level. For sea-walls or piers, the arrangement given in the previous paragraph could be adopted. Here two rows of caissons are employed, separated from each other longitudinally, the intermediate space being filled in with dry rubble hearting, and the blocks themselves with a similar material, or, if necessary, with concrete.

In the case of an embankment for a reservoir, the heart of the bank, which is usually made with a puddle-wall, is proposed to be substituted by two rows of cylinders, the contained spaces being filled in with puddle, and the cylinders themselves with material similar to that of which the bank is made. In sinking the cylinders, they would be carried some distance below the natural surface, so as to obviate any chance of leakage below. Should a leak occur above, it could be only to a very small extent, as it would be prevented from extending by the proposed structural arrangement. It is obvious that this plan could, without much difficulty, be applied to embankments already constructed where there was reason to apprehend that any settlement had occurred. By sinking the cylinders from the top through the puddle-bank, but without removing any of the slope on either side, they would be carried down to sound ground, rendering the embankment safe, and removing all fear of danger in the future.

It would not be difficult to multiply the instances in which this material can be practically applied ; but sufficient has been said on this point. An artificial stone combining the advantages of apœnite—one, moreover which can be so readily moulded into any form and size with but small expense and little or no delay, is necessarily applicable to a great variety of uses. The author will, therefore, only briefly remark upon its applicability for ornamental and decorative purposes.

Besides possessing the several properties which have been described, the apœnite, when prepared with suitable materials, is capable of receiving the most delicate impressions, and, by the incorporation of various metallic oxides, any variety of colour can be imparted to it.

By the use of the native red oxide of iron maganese and other mineral substances, artificial marbles or granite of almost every description can be produced. These artificial stones, like their originals, are capable of taking an excellent polish, are extremely hard, and can be readily moulded into the most elaborate forms at a very small cost.

In conclusion, the author submits that, both constructively and ornamentally, apœnite is eminently fitted to meet the numerous requirements of the engineer and architect, and to subserve many useful and important purposes in the industrial arts.

The paper was illustrated by diagrams, showing in detail the special application of the material for the purposes named by the author.

A discussion ensued, which was summed up by the president of the section, Mr. F. J. Bramwell, as follows:—

I am sure that the members of this section will give their most hearty thanks to Mr. Ransome for his very interesting and valuable paper. After the discussion you have heard from the able and distinguished men who have spoken on the subject, it would ill become me to take up the time of the section by any lengthened remarks. I cannot, however, refrain from saying that I believe the process of making artificial stone, which Mr. Ransome has invented and perfected, is of very high importance indeed, and that it has given to the world a new material which will be of great service, as well for the structural works of the engineer and architect as for purposes of mere ornamentation. Mr. Ransome has not alluded to one large use of this artificial product, and that is, the manufacture of grindstones. This, judging from report, and also from that which I saw when I had the pleasure of visiting Mr. Ransome's works, appears to be a very considerable business. The stones have been most carefully tried by some of our best mechanical engineers, and have been reported on as far better than the natural stones for the purposes of grinding. This superiority would seem to be due to the fact that they are much more uniform than the ordinary stone, and have a sharper cut. The process of manufacture of one of these grindstones, considered in relation to its ultimate use, is very striking. At one moment one sees the shape of a grindstone, it is true, but on touching it with a stick, or even with a finger, one can make holes in it at will. In a few minutes, this same mass, on being struck with a trowel, can scarcely be chipped by it, and very shortly it will be fit to grind the trowel to pieces. Mr. Hawkshaw feared the cost might preclude the use of this artificial stone in cases where nothing but plain blocks were required, and where natural stone was within easy distance; but it must always be remembered that the stones delivered by Mr. Ransome are complete and ready to set, and that, therefore, in considering their price in relation to natural stone, the cost of the latter must not be taken per cube foot in the rough state, but per cube foot after all the labour and waste of dressing, preparatory to setting, have been incurred; and, moreover, as Mr. Hawkshaw has pointed out, there are countries, like Holland, where stone is not, but where sand is in abundance, and where, therefore, the conditions of relative cost are most favourable for the artificial stone. With respect to the fact of the artificial stone being complete, I will refer to that which Mr. Ransome has said about stones for engine beds. We all know the cost and delay in "jumping," holding down bolt holes through large blocks of natural stone. By the use of Mr. Ransome's stone, all this is avoided,—the stone is formed with the holes in it. This is a matter well worthy the attention of those wanting large stones for such purposes, but I cannot help expressing a hope that engineers will abandon the class of "house engines," and will construct really self-contained steam-engines, which will not depend on their foundations to take the strains produced in working, and will, therefore, demand nothing more than a sufficient base to carry their weight. So long, however, as "house engines," with their massive foundations, continue to be used, engineers selecting stones for such foundations will, I think, do well in most instances to resort to Mr. Ransome. Mr. Ransome has pointed out the very interesting use of his stone for "cylinder foundations." Mr. Hawkshaw has called attention to the curious fact that, in abandoning cast-iron cylinders for artificial stone, we are on the way back towards the brick cylinders that have from time immemorial been used in India for such foundations; but manifestly Mr. Ransome's material possesses great advantages over a mere shell compounded of separate bricks. In Mr. Ransome's case the cylinders are made complete, in suitable lengths, and are united at their joints by some of the very material from which they were themselves manufactured, and thus, when in their places, must be practically one continuous stone cylindrical shell. I have just made a calculation of the comparative cost of 8 ft. cylinders 9in. thick, such as those Mr. Ransome has described as used at Hermitage Wharf, and of cast-iron cylinders of the same diameter and 1¼in. thick, and I find that if the cast-iron be taken as low as 6d. per ton, and the artificial stone at as much as 2s. per cubic foot, the stone cylinder per foot run is considerably less than half the cost of the cast-iron, even without allowing for the flanches and bolts necessary to unite the portions of the cast-iron cylinder; if these be taken into account, I believe the cast-iron would be nearly three times as dear as the stone per foot run. Mr. Dines and nearly all the speakers have borne testimony to the value of the artificial stone for decorative purposes. I believe if you go to the Aquarium and examine the ornamental capitals made in this stone, and compare them with those cut out of the natural stone, you will be much struck with the excellent manner in which the artificial stone will bear the contrast. I doubt if Mr. Ransome told you that when ornamental work was required, the stone, in its soft state as it comes from the mould, is as easy to carve as cheese, and thus very delicate work and undercut work, that could not be got out of a mould, may be readily made. Mr. Vignoles has forcibly put forward a most important point in relation to this material, and that is its rendering buildings to a considerable extent independent of the all but prohibitory demands of the masons. We all know how much more pleasing to the eye in every way a town of stone houses is than one where brick prevails, and yet one sees in places where stone is plentiful, but where brick-earth also is plentiful, the modern houses, unless of the very best class, are built of brick, and so built for the reason that, although the stone is to be had for the quarrying, it is, when got out, in rough blocks, that require high-priced labour to shape them, while the brick when made is made to shape. It seems to me that Mr. Ransome's invention may redeem us from this reign of brick, without submitting us to the penalty of high-priced labour, because, as I have already said, Mr. Ransome's material, like brick, is formed at once to the finished shape, and requires no further labour than the setting. I began by saying that I would offer but a few remarks. I find, however, I have been betrayed into a far greater length than I had intended, but I have been led on by the importance of the subject. It now only remains for me to ask you to give your cordial thanks to Mr. Ransome.

THE COMMERCE OF POLAND.

The extraordinary development of commercial enterprise that has taken place of late years in Germany, has begun to bear fruits, even in a country so unfavourably circumstanced as Poland. The establishment of numerous banks, of a Credit Foncier for urban property, the increased demand for agricultural implements, the development of various industries, and the enormous rise in the price of every article of daily consumption, and especially the great increase of shops in Warsaw for articles of luxury and comfort, corroborate this statement. According to the report of Consul-General Mansfield, the external trade of Poland, in the year 1869, amounted to 20,946,307 roubles exports, and 31,918,573 roubles imports, showing an increase over the year 1868 in the exports of 1,679,803 roubles, and a decrease in the imports of 1,479,401 roubles. The principal articles of export were rye, wheat, timber, wine, wool, flax, bristles, hides, &c. The principal imports consisted of vegetables, seeds, &c., cotton, raw, wool and cotton twist, coals, woollen fabrics, machinery, groceries, petroleum, herrings, &c. British commerce with Poland fully maintained the very marked progress of former years. The value of exports to the United Kingdom exhibits an increase over the previous year of £122,307, and an estimated total of £1,416,437, the principal articles consisting of cereals, oil, seeds, timber, rags, turpentine, hides, hemp, tallow, wool, &c. The value of imports of British produce, &c., for the same year is estimated at £2,004,157, and shows an increase over the previous year of £364,487, and over the year 1859 of £1,369,629. The principal articles consisted of cotton, raw and manufactured metals and machinery, groceries, coals and coke, salt, Australian wool, woollen fabrics, woollen twist, carpets, petroleum, linen, salt fish, cement, dyes, colours and varnish, stationery, earthenware, &c. The arrangements respecting trade-marks, recently entered into between the English and Russian governments, cannot fail to have a favourable influence on British commerce in Poland, which has hitherto suffered immense detriment from fraudulent marks affixed to German produce of an inferior quality.

The Agricultural Exhibition at Warsaw in 1870 was opened on the 15th and closed on the 20th September, and was visited by upwards of 20,000 persons. It much surpassed that of 1867, both in the number of exhibiters and produce—and a much larger number of peasants exhibited their produce at this show than at the preceding one. The number of peasant exhibitors amounted to 72. The show was subdivided into five sections—viz., agricultural, horticultural, and forest produce, live stock and animal produce, agricultural and forest industrial produce, agricultural implements, and architectural.

To 400 exhibitors who figured in upwards of 4,000 heads the prizes distributed were—in the agricultural section, two gold, twenty-six silver, twenty-eight bronze medals, nine favourably mentioned, and eleven money prizes; in the live stock section—six gold, thirty silver, twenty-six bronze medals, twenty-one favourably mentioned, and twenty-one money prizes; in the industrial section—one gold, five silver, six bronze medals, eleven favourably mentioned, and three money prizes; in the architectural section — five silver medals, two favourably mentioned, and thirty-seven money prizes. The total number of exhibitors who gained prizes amounted to 275, of whom 146 received medals, forty-six were favourably mentioned, and eighty-three money prizes, amounting to 79 per cent. of the whole number of exhibitors. Besides the prizes, six exhibitors received thanks from the committee. Among these last, Count Berg, Nannistrick of the kingdom of Poland, obtained thanks for a system of covering roofs, in use in Finland; and Count Stanislas Zamojski, for encouraging peasants to industry suitable to their wants. In general the show excited a keen interest, and was visited by farmers and agriculturists from the most remote parts of the country. As regards the harvest of 1870, the cereals were not equal to an average. On the other hand, beetroot and root crops in general gave a very favourable yield. The agricultural movement in Poland has not undergone any check. The use of agricultural machines is very considerably on the increase, and even the peasants purchase largely the less costly instruments, and for the more expensive club together, when out of the reach of one individual.

The industries, more especially as regards sugar, textile fabrics, and iron works, are in a most flourishing condition. The demand for iron works comes from Russia, where Polish goods find a ready market, as being superior to what is produced in the rest of the Empire, and cheaper than what is imported from abroad. The number of exhibitors from the kingdom of Poland taking part at the St. Petersburgh Exhibition of 1870 was in excess of the former. At Moscow, in 1865, the number of Polish exhibitors amounted only to 70; at the exhibition at St. Petersburgh in 1861 there were but 50; at the London Exhibition in 1862 only 48; and at the International at Paris 100; while at the last Exhibition at St. Petersburgh the number amounted to 240; and the number of exhibitors who obtained distinction was 145. The mining movement alone in Poland exhibits a decrease in produce and general activity. As, however, this is in a transitive condition, it is not to be expected that the present state of things will be for a continuance. The government has already disposed of a portion of the mines, and is anxious to part with what remains. The coal deposits are, if anything, richer than those of Silesia, and the iron workings would also give a good remuneration; but, owing to the political state of the country, and defective communications, foreign capital hesitates to embark in enterprises in Poland.

CORRESPONDENCE.

THE VENTILATION OF OUR HOUSES OF PARLIAMENT.

Sir,—In my last letter, it was taken for granted that our Houses of Parliament were ventilated on a system of exhaustion, and it was shown what the results would likely be found to be in practice. It now remains for us to prove, from the "report" mentioned in that letter, first, that the system is really such as we took it to be; and secondly, that such faults as the tendency of the system would lead us to expect have really been experienced in the case of our Houses of Parliament.

First, at page 4 of the report, under the head "System of Ventilation at the Houses of Parliament," we read in the 4th and 5th sentences of the first paragraph as follows:—"There are two great up-cast shafts, namely, one of the turrets of the Victoria-tower and the clock-tower. There are also the following additional up-cast shafts, namely, the Peers' shaft, the Commons' shaft, the Speakers' shaft, the river front shaft, the north end shaft, the west front shaft, and the Black Rod shaft." The object of all these shafts is to suck the air out, and the effect to produce a vacuum more or less perfect. Then, finally, at the beginning of the second paragraph, there occurs this:—"The two systems of ventilation by mechanical propulsion and *exhaustion* have been actively discussed, and each has its supporters. Both Houses of Parliament have condemned the former system and sanctioned the *latter*." Please mark the words "exhaustion" and "latter," which we have thrown into italics, as they prove the point contended for. It would have been interesting to have known the grounds upon which mechanical propulsion was condemned, but these are not mentioned.

Secondly, at page five of the report, under the head "Source of the Air Supply," we find, in the second sentence of the third paragraph, the following:—"If horse-dung happen to fall near any of the inlets, the air entering will instantly be thereby more or less infected. This is particularly liable to occur in the Commons court, where carriages sometimes wait for a considerable time near the entrance to the ladies' gallery, which is close to the inlet for the air on that side of the House. In order to keep the air of the House from being thus contaminated with the not very agreeable emanations from horse-dung, carriages should be forbidden to wait at the door above-mentioned, and should be stationed in the Speaker's court, whence they may be called as soon as required." Again, in the fifth paragraph—"A strong smell of the kitchen was several times perceived in the House of

Commons during the last session of Parliament, and this was due to the opening of the tops of the windows in the kitchen of the House. On account of this smell it was necessary, more than once, entirely to prevent the entrance of the air from the Commons court." Again, in the sixth paragraph we read—"The smell of gas-tar was several times perceived during last session in the House of Commons and elsewhere in the Houses of Parliament, and, on investigation, it was found that the tar from the Chartered Gas Company was transferred from carts, through open gutters, into barges moored just under the south wall."

It is plain, therefore, from the foregoing, that the objections to a system of exhaustion exist, not in theory only, but in practice as well. Of course, in the case of the Houses of Parliament, steps were taken (as the report informs us) to remedy these, and down-cast shafts might help to lessen the evil still further. But even this could never entirely prevent the evil, for the foul air would still rush in at the doors whenever opened. According to the report, this actually occurs. At paragraph four, still under the head "Source of the Air Supply," we read—"Annoyance has occasionally been experienced in the House from the odour of tobacco smoke. If a person while smoking *merely* walks through the Commons court, in a few *seconds* a distinct odour of tobacco smoke will be perceived, especially near the Speaker's chair." The words "merely" and "seconds," which we put in italics, deserve notice.

It may be quite true that these faults may be remedied so far, but they are in the principle of the system notwithstanding, and to that extent, therefore, the system is bad. This remedying is nothing more than the patching up of a faulty system. An opposite system, what might be called one of repletion, would certainly be free from all these objections. Instead of a vacuum, and the surrounding air forcing its way in from all sides, there would be the reverse. From a given centre, the air would be pressing in all directions outwards. There would then be no cold draughts coming in from doors, windows, or seams of floors; no foul air could come rushing in from doors, or any other openings. If any such existed near at hand, the tendency would be to drive it away from the building, and not to suck it in; and to the same extent as a vacuum was avoided would the acoustic properties of any building be improved.

Attention is called to these points, because not only does the report not refer to such as faults, but it appears to view the system as perfection. In the third paragraph of the fourth page, notwithstanding the practical effects which it records elsewhere, it says:—"When properly carried out and attended to, it is all that can be desired, both in regard to simplicity and efficiency." And further on, in the same paragraph, and as a further illustration of its efficiency, it again says:—"It is capable of ventilating the largest collieries, with all their intricate workings and roads, often extending many miles in the aggregate."

So much for our Houses of Parliament; but, as for the ventilation of our coal mines by such a system of exhaustion, the effects must undoubtedly be, in many cases, most disastrous; but, with your kind permission, Mr. Editor, a consideration of this had better be delayed to another opportunity.—I am, &c.,

H. F. ALEXANDER.

Edinburgh, September 28th, 1872.

LIEBIG'S EXTRACT OF MEAT.

SIR,—In a paper read by Dr. Edward Smith, in Brighton, before Section F of the British Association, respecting the alimentation of the population of Great Britain, on "Preserved Food and Extract of Meat," of which an abstract appeared in the *Times* of the 20th of August, Dr. Smith expresses opinions which are incompatible with the present state of science.

Having directed my special attention to this subject, and the leading ideas upon nutrition and food being the same which have been made known by me 25 years ago, I trust I may be considered entitled to elucidate and correct in your *Journal* the injurious and erroneous inference of Dr. Edward Smith.

Dr. Edward Smith attaches great importance to the preparation of food; the economy of nutrition, however, depends essentially on the right proportion in the nourishment consumed of the nitrogenous substances (meat, fish, eggs, &c.), and those free from nitrogen (starch, butter, sugar, &c.).

An excess of meat in the diet is waste, and the exclusive consumption of potatoes is likewise waste. The chemical composition of meat and of potatoes (as well as of all other articles of food) is perfectly well-known, and it is therefore easy to calculate the proportion in which they must be mixed, in order to obtain the maximum of nutritive value for every individual at every stage of life.

The alimentation of a population can only be judged by means of a knowledge of their wants, and of the above-mentioned proportions. The great economical successes in the production of meat and milk, by agriculturists who are acquainted with the relative nutritive value of the various sorts of food, are well-known, and as long as Dr. Edward Smith does not specify what weight per head "the small morsel of meat" and the potatoes or rice should have, in order "to form a highly nutritious diet," and as long as he does not explain why the small morsel of meat should be fat meat and not lean, which "the poor, in their fastidiousness, prefer," so long Dr. Edward Smith must allow us to consider his assertions that the English were worse fed than the Irish or Scotch as a mere fancy.

In the selection of food, which is influenced by necessity or want, the instinct and the experience of the million are infallible, and a far better guide than the theoretic speculations of men who have remained ignorant of the composition of food, as well as of even the simplest laws of nutrition.

"Fish," says Dr. Edward Smith, "is sometimes suggested as a substitute for meat; but fish is rather a relish than food, and contains little more nutriment than water."

From Payen's investigation it is well-known, however, that the flesh of fish, on the average, does not contain more water than fresh beef, and as much solid substance as the latter. For instance, the flesh of salmon contains 75·70 per cent. water and 24·296 per cent. solid substances, while beef (muscle) contains 75.88 per cent. water and 24·12 per cent. solid substances. The flesh of herring contains still less water than salmon, and even flat fish, such as soles, are as rich in nitrogenous substances as the best wheaten flour, weight for weight.

The assertion of Dr. Edward Smith that the flesh of fish contains little more nutriment than water is, as may easily be perceived, in direct opposition to well-ascertained facts.

Truly comical are Dr. Edward Smith's views respecting tea and extract of meat. "He laments the amount of money which is, as he holds, wasted, and worse than wasted, upon tea, the amount of nutriment contained in an ounce of tea being infinitesimal."

Dr. Edward Smith cannot seriously imagine that tea is taken by certain ignorant and stupid people because they believe it to be a nutriment, which tea indeed is not. The capability of swallowing, not one single camel, but an entire troop is, however, required, in order to believe that if an individual, a short time after having retired from a well-supplied table, satisfies the longing for a cup of tea, he does so for no other reason than to add to the food and wine consumed in abundance an infinitesimal fraction of carbon and nitrogen, the two chief elements of nutrition.

Tea is no nutriment in the ordinary sense. The individual who takes tea after his meal feels, without being able to define it, that tea has a favourable effect upon certain highly important functions in his body, that digestion is accelerated and facilitated, and that his brain-work is benefited thereby; and if a poor factory workman imposes on himself privations in his food and other necessaries of life in order to spare a few pence for tea, there must be a deeper cause for this than mere custom.

Neither tea nor extract of meat are nutriment in the ordinary sense; they possess a far higher importance by certain medical properties of a peculiar kind. The physician does not employ them as specific remedies. They serve the healthy man for the preservation of his health. Taken in proper proportion, they strengthen the internal resistance of the body to the most various external injurious influences which combine to disturb the general vital processes, and they adjust these latter.

Health is nothing but resistance to injurious influences, and its degree in different individuals depends upon the force of this resistance. The object of every intelligent physician will be directed, in the cure of an illness, towards strengthening the internal resistance to local disturbances, and to restore the normal functions by his remedies, which in this case are called medicines; and he knows therefore how to assign the proper place to the beef tea or meat juice which he prescribes to his patients and convalescents.

It is surely a grave offence against all laws of physiology to compare tea, coffee, and extract of meat to the more common articles of food, and because they are not that, to draw the inference, as Dr. Edward Smith has done, that they are nothing at all. This is certainly not scientific reasoning.

As regards coffee, Julius Froebel, in his work "Seven Years in Central America," says:—"For the men accompanying the great mercantile caravans in Central America coffee is an indispensable necessity. Brandy is taken as medicine, but coffee is quite a necessary article, and is drunk twice a day. The refreshing effects of this beverage in heat and cold, in rain and dry weather, are extraordinary."

Of the composition and the value of the extract of meat Dr. Edward Smith holds the most singular opinions. He says, "This is sold as a very thick liquid, in jars, and 1lb. is said to represent 32lbs. of flesh."

It has, however, never been asserted that 1lb. extract of meat represents 32lbs. of flesh; this is simply an invention of Dr. Edward Smith. The truth is that 1lb. extract contains the substances soluble in hot water of 32lbs. of flesh.

Dr. Edward Smith proceeds to say:—"The composition is water (if you will completely dry a pot of the extract you will see how large is the proportion of water), the salts of meat, and the phosphates, extractive matters of a soluble kind, the peculiar flavour of roasted meat, and common salt, which are added to it." It is utterly impossible to suppose that Dr. Edward Smith intends to make us believe by this sentence that extract of meat is water, to which are added common salt, the phosphates of meat, the flavour of roasted meat, and soluble extractive matters. It is rather to be assumed that Dr. Edward Smith would have expressed himself quite differently and more correctly respecting the composition of extract of meat if he were possessed of even a faint notion of the science of chemistry.

As regards the proportion of water contained in extract of meat, it is well known, through innumerable analyses, that it amounts on an average to 19 per cent. (*maximum* 22 per cent., *minimum* 16 per cent.) Extract of meat is beef-tea made from fresh beef—not roasted—in the purest state, condensed to the consistency of a thick honey, to which nothing whatever is added by the manufacturer. The assertion that common salt is added to the extract is an unjustifiable invention. The juice of the muscles contains, as a never absent component part, a small quantity of chloride of potassium, but no chloride of sodium (common salt.)

The eminent African traveller, Dr. Schweinfurth, dwells on the extract of meat as follows:—"Those only are probably fully able to appreciate the value of extract of meat who, like myself, were compelled, for weeks together, to live upon purely vegetable food. Such a diet engenders a peculiar state of weakness, and lowers the mental and bodily energy, which is raised again through the use of meat. I can state from my own experience that, in the absence of meat, the addition of extract of meat to vegetable food produces the same good effect on the body as fresh meat, and that, under such circumstances, it is the only means of supplying the lack of meat. When my American extract of meat was consumed I prepared some myself from the flesh of antelopes, which did excellent service."

With regard to the considerable saving effected by the use of extract of meat, we are indebted to Dr. von Schneider (Chief of the Chemical Department of the Imperial Mint in St. Petersburg) for the following highly interesting communications (*Norddeutsche Allgemeine Zeitung*, No. 12, 1872, Sonntagsblatt):—"In order to ascertain the economical value of extract of meat, all soups consumed during the months of November and December, 1871, and January, 1872, in my small household, consisting of three persons, were prepared from remnants of bone, fat, and vegetables, with addition of extract of meat, and all the meat (mutton, pork, beef, veal, poultry, and game) was roasted. In the month of October, 1871, on the other hand, the beef was used for the preparation of the *pot au feu* (with the addition of rice, semolina, maccaroni, potatoes, &c., exactly as in the other three months), consequently without any extract of meat, and all the meat was consumed as boiled meat. It was proved at the end of these experiments that in the month of October 40 per cent. more money was spent for meat than on the average in any of the other three months—viz., the consumption in the month of October of boiled meat amounted to 120lb., in any of the other three months, on the average, 80lb.; of roast meat, therefore, 40lb. less. We use daily 6 grammes extract of meat, in 83 days 1lb."

These facts prove incontrovertibly, in my opinion, the physiological effect of extract of meat. The necessity for the consumption of meat is considerably lessened when extract of meat is added to the vegetable food; in addition to the nutritive value which vegetables possess in themselves, they acquire, in the soluble component parts of meat, those substances which give to a meat diet its peculiar effect. In view of the present high price of meat, Dr. von Schneider's observations are deserving the most careful attention. The trial is easily made, and it is in everybody's power to make it.—I am, &c.,

Justus Von Liebig,
President of the Royal Academy of Science
in Munich.

GENERAL NOTES.

Constant Water Supply.—Referring to the paragraph in last week's *Journal* under this head, it appears that there are in Canterbury fifteen water-power engines at work, namely, two soda-water machines, four printing machines, four sawing machines, two drilling machines and circular saw, one for pumping, one for hair-brushing, and one for a lathe. In reply to inquiries which have been made, it may be stated that these water-power engines have been erected by Mr. John Ramsbottom, hydraulic engineer, Leeds.

Commerce and Commercial Law.—The students of commerce and commercial law in King's College are this year encouraged by the offer of two prizes of ten pounds each, by two leading merchants in the City, for proficiency in commercial science; and one of ten pounds is also offered by the new Lord Chancellor (Sir Roundell Palmer) to the students of commercial law. Professor Leone Levi's introductory lecture will be delivered on Monday evening next, "On a New Treaty of Commerce with France."

The Chiffonniers of Paris.—A census of that curious portion of the Paris population, the rag and bone collectors, has recently been made by order of the Prefect of Police, and the results are, that there are, at the present moment, 22,500 individuals who live by collecting the refuse of the rest of the population. These 22,500 persons, who mostly make two long journeys per day, from one of the outskirts of the city to its centre and back, collect on the average about 50,000 basketfuls of rags. paper, bones, &c.; the value of the contents of the basket, or *hotte*, being fifteen pence, or, on the whole, about £3,000 per diem. A strict watch is just now kept over the chiffonniers, as it is believed a number of dangerous Communists, having obtained possession of chiffonniers' badges, without which it is illegal to follow the calling, are hiding amongst their ranks.

A Workman's Library.—A popular library has just been opened at Clichy, a suburb of Paris, by the efforts of several private individuals, whose names are not made public, to place within the reach of working men the best technical, historical, literary, and moral works. The library is established in a large room capable of containing from four to five thousand volumes, and about a hundred readers; good tables, pens, and ink are placed at the disposal of all comers. The number of books at present on the shelves is not quite five hundred, but they include some of the best historical works, those of Victor Hugo, Lamartine, Cousin, Michelet, scientific works recommended by the Faculty, a number of workmen's guides, and other technical books, atlases, &c. It is but a commencement, but in a neighbourhood situated far from any library, and almost exclusively inhabited by artisans, it becomes an important institution.

The French Academy of Sciences.—The patriarch of the Academy, M. Chevreul, the "Father of Fatty Acids," as his colleagues amusingly style him, has reached his eighty-seventh year, and the Academy seized the occasion to present its ancient member with a commemorative medal, by the hands of M. Dumas, who made a remarkable discourse on the occasion. Sixty-six years ago, M. Chevreul presented his first memoir to the society, on the fossil bones of Anjou. M. Chevreul's investigations of fatty bodies culminated in the discovery of the fixed acids which they contain, and especially stearic acid, thus giving birth to the production of stearine candles, one of the most useful inventions of the period; and, secondly, in the separation of the volatile fatty acids and the production of artificial essences. In the same work in which these discoveries were announced, M. Chevreul showed that those natural substances must be considered as salts furnished by these various acids, united to an organic base, glycerine, thus opening, said M. Dumas, the road by which the present system of organic chemistry was attained. The speaker then alluded to M. Chevreul's study of colouring matters, the discovery of the principles to which many of them owe their characteristic qualities, thus establishing from absolute experiment the theory of dyeing. M. Dumas concluded his long eulogy by referring to the service of M. Chevreul to the Jardin des Plantes, the manufacture of the Gobelins, the Central Society of Agriculture, the Ecole Polytechnic, and to the devotion exhibited towards France during the difficulties and positive dangers of the two sieges of Paris. It may be mentioned in connection with the above that, in 1857, the Royal Society of England bestowed the Copley medal on M. Chevreul, when the President, Lord Wrottesley, said:—"The discoveries of M. Chevreul are of very much higher value, in a scientific point of view, than the simple establishment of facts, or the discovery of new substances of value to industry; the methods of research which he introduced laid the foundations of new researches, and it may be said that he endowed organic chemistry with the power of becoming what it is at present." These are glorious tributes to the recipient, and highly honourable to his contemporaries.

The Consumption of Food at Vienna in 1871.—The following statistics will give some idea of the quantity of food consumed in Vienna, which, in 1871, according to the returns published by the octroi was 1,141,624 chickens and pigeons, 115,317 hares, 434,312 fowls, ducks, or geese, 155,913 pigs, 136,681 calves, 93,293 bullocks; 18 million litres of wine, and 72 million *mass* of beer.

French Postage and Postage Stamps.—The stamps employed in France are produced at the Mint, in Paris, under a special director. A cabinet, closed with three different locks, contains the plates and the original dies of the stamps, while another large piece of furniture contains the printed sheets. Spoiled sheets are destroyed in the presence of the sub-director of the Mint itself, who draws up a report on each occasion. The production of the stamps is contracted for by one person, who supplies all the necessary assistants, and receives 60 centimes per 1,000 by way of remuneration; the quantity at present produced is 400,000,000; when the production reaches 500,000,000 the rate of payment is to be reduced to 50 centimes per thousand.—Great complaints are made by the French and the English merchants and others in France, of the number of letters which arrive from England insufficiently paid, and the slightest turn of the scale costs the recipient of the letter 90 centimes, or three times the amount of the stamp affixed in error. This difficulty was foreseen when the initial weight of 30 centimes was fixed for such letters, but the positive refusal of the French authorities to accept half-an-ounce as the weight of a single letter, induced the English Post-office to accept the awkward third of an ounce. Now that such is the case, it is really the duty of everyone to provide himself with the proper weight, as the frequency of the demand for a further nine-pence is a source of considerable annoyance, and tends to diminish the correspondence between the two countries.

Destruction of Private Property during the Siege of Paris and the Commune.—The Prefect of the Seine has recently published the report of the commission appointed to assess the damages done during the siege of Paris, the reign of the Commune, and the taking of the city by the government troops, and to relieve necessitous sufferers. The number of persons whose claims have been received amounts to more than twenty thousand, of whom 2,305 are of Paris itself, and the rest in the outlying communes of the Department of the Seine, Sceaux and Villejuif having suffered most. The value of the property destroyed, ascertained to the 1st of July in the present year, amounts to £2,786,835, three-fourths of the total belonging to persons in poor circumstances. A sum equal to £453,999 has been distributed amongst the latter class of claimants. The above totals do not, however, represent half the damage actually done; many establishments were situated on the military zone, and were liable, by the terms of their tenure, to destruction at a moment's notice, at the cost of the proprietors who have no remedy, but the commissioners put in a plea for them also. "However," says the report, "utter ruin to many resulted from the measures taken for the defence of the city. Large industrial establishments were utterly razed to the ground, and numbers of men employed in them are still without work. Small proprietors and tradesmen were compelled to evacuate the ground within twenty-four hours, losing the result of years of labour. Nothing whatever has been done for them, and the military authorities hold out no hope of assistance. I cannot too warmly call the attention of the government to these losses, which amount to more than four millions sterling." With respect to the other classes of sufferers, the sums distributed do not amount to more than 17 or 18 per cent. on the total losses; but the account is not closed, and the prefect expresses the hope that eventually the compensation will be raised to 50 per cent., with which he believes the sufferers would be well satisfied.

Journal of the Society of Arts.

No. 1,038. Vol. XX.

FRIDAY, OCTOBER 11, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following books have been presented to the Library:—

Minutes of Proceedings of the Institution of Civil Engineers, Vols. 33 and 34. Presented by the Institution.

Magnetical and Meteorological Observations made at the Government Observatory, Bombay, 1865 to 1870. Presented by the Secretary of State for India.

French: Practice and Theory. By G. C. Mast. Presented by the author.

Une Excursion Scolaire à Londres; par C. H. Bulo. Presented by the author.

Proceedings of the Academy of Natural Sciences of Philadelphia for 1871. Presented by the Academy.

The Spelling Hindrance in Elementary Education. By George Withers. Presented by the author.

INTERNATIONAL EXHIBITION, 1872

The Council, having been informed that Her Majesty's Commissioners do not intend to publish reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such reports, for publication in the Society's *Journal*. The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following is the third of the series. The others will appear from time to time.

MUSICAL INSTRUMENTS AT THE INTERNATIONAL EXHIBITION.

Compared with the previous International Exhibitions of 1855, 1862, and 1867, the present one, so far as the class of musical instruments is concerned, is inferior, both in variety and quality of the objects contributed. Great Britain is naturally the largest contributor. The foreign contributions are proportionately insignificant.

The present report will be divided into sections of instruments, in the following order:—Pianos, harmoniums, organs, wind instruments (brass and reeds), bowed stringed instruments, and miscellaneous instruments.

Pianofortes.

1. In the production of pianofortes Great Britain may, without prejudice to other nations, be said to be foremost. And as the pianoforte section is more fully represented than any other, one can but deeply regret that the most important English pianoforte-maker is conspicuous by his absence.

2. The following is the list of exhibitors from Great Britain—Messrs. Augener, Ennever, and Son, T. Jackson and Son, Chappell and Company, Mornington and Weston, Keith, Prowse, and Company, J. B. Cramer and Company, W. Walter, Metzler and Company, H. Ward, Moore, and Moore, P. I. Smith and Son, Kirkman, J. and J. Hopkinson, Challen and Hodgson, R. Wornum and Son, John Brinsmead and Sons, Lamis, Darney, and Company, Major Gleig, Messrs. T. Molineux, Rust, and Company, H. Justin Browne, H. Brinsmead, W. G. Eavestaff, C. Jackson, Parker and Smith, S. Brewer and Company, H. A. Ivory and Company, the Mendelssohn Pianoforte Company, W. Creber, J. C. Holman, J. Windus, Venables, Tolkien, and Strohmenyer and Sons, numbering in all thirty-five firms.

3. France, according to the catalogue, is not represented at all. In her annexe, however, there are pianos from Messrs. Erard, Pleyel, Wolff and Company, H. Herz, and A. Bord.

4. The other foreign exhibitors are—From Belgium, Messrs. Günther, Lamb, Hoeberechts and Son. From Germany, Messrs. Biese, of Berlin; Messrs. Hagspiel, of Dresden; Messrs. Kaps, of Dresden. From Norway, there are Messrs. Hals Brothers. From Sweden, Messrs. Norberg. From Russia, Messrs. C. M. Schröder. From Austria, Messrs. Zinke and Wintersburger.

5. The majority of the pianofortes shown partakes of the class of instruments styled by M. Fétis "*pianos d'etude et de fatigue*;" and it does not come within the scope of this report to discuss the good or bad points of these instruments, which present no suggestions for improvements upon the long-established and satisfactory mode of construction adopted by the foremost makers. The demand for cheap instruments is constant and increasing. Hence the number of makers of such instruments is large. It would seem desirable, however, that more attention should be paid by these makers to the production of good and wearing mechanism than to the carving and gilding of cases of instruments.

6. The instruments which may be classed as the best ones in the Exhibition are those of Messrs. Erard, Kirkman, Hopkinson, Pleyel Wolff, and Schröder. Messrs Erard's most remarkable instrument is a fine grand pianoforte, placed in the French Fine Arts Gallery. The tone is brilliant, and the touch is irreproachable. The decoration of the case is gorgeous, and was carried out under the direction of Monsieur E. Guichard, of the Union Centrale of Paris. Other pianos by this celebrated firm are shown in the annexe. They are cottage pianos, of an expensive character, but present no novelties in construction. The marqueterie work of one of the cases is intricate and beautifully executed. In Room No. 13 are three instruments by Messrs. Kirkman. One is a full-sized concert grand, one a boudoir grand, and one a semi-grand. It appears that Messrs. Kirkman have made great advancement in the manufacture of piano-

fortes. Metal frame-works have been generally adopted by the trade; they are of cast and wrought-iron. The cast-iron frames are made in one or two pieces. Uncertainties surround the operation of casting, as the iron, when cooling, is apt to shrink unevenly or to curl, all of which incidents are inimical to the true fitting of the action and strings afterwards. Messrs. Kirkman, appreciating the importance of these facts, have adopted steel as the material for the frames of their best and most expressive pianos. As may be well known, steel is much lighter, harder, and more capable of precise mechanical manipulation than cast or wrought iron. The advantages arising from employing this material are therefore apparent. The tone of this instrument is powerful, round, and even, while the action is well balanced, and enables the performer to obtain (as perfectly as any interposed mechanism will allow) nuances of expression as varied as the violinist produces out of his violin. And here may be interposed that a greater perfection of mechanical fitting and of strength could be obtained if Messrs. Kirkman were to employ some new kind of steel invented by Sir Joseph Whitworth, who has entirely got rid of the air-holes which occur in steel castings. The semi-grand piano is made upon a similar mode of construction as the grand. The boudoir grand is less expensive. The frame-work is of cast-iron. All the internal mechanism is thoroughly well executed. Resembling the arrangement adopted on the Continent, the bass strings, to obtain the greatest length of string, are strung obliquely above the strings of the alto and treble clefs of the piano. This arrangement is not satisfactory, since it generally affects the tone of the tenor clef, and unless some compensation is effected in the disposition of the sounding board, by which a kind of reaction may be created, a twangyness of tone is noticeable. Messrs. Kirkman are to be congratulated on having surmounted this difficulty, since the tone of their boudoir grand piano is throughout even and pleasant. The action of each of these three instruments is a "repetition" one, though, for the matter of that, a well-constructed action with a medium escapement and good check, provides, to an average pianist, the means of producing that repetition, which the *soi-disant* "repetition" action professes to do for the beginner or indolent performer.

7. Messrs. Hopkinson's grand pianoforte is fitted with a new action, termed "Hopkinson's patent grand pianoforte action." It is considerably less elaborate than that of Messrs. Erards, and, in the present instance, the touch is well balanced, and secures an instantaneous response.

8. One of the first necessities for obtaining an evenly toned piano, seems to be that the frame-work shall be of such construction and strength that the various degrees of the strings' tensions shall not unequally affect it. Perhaps the next necessity is that there shall be a firmness at the point whence the vibrating portion of the string starts. To obtain this, makers fit the brass studs over which the strings pass on to the iron frame-work. This operation requires much care, and makers—particularly German and American makers—are liable to permit the strings to be too closely connected with the unyielding and comparatively non-communicative iron framing. Hence the tone of the strings becomes hard and metallic. Some may consider such tone a desideratum. In Messrs. Hopkinson's iron bijou grand the higher notes have rather a quality of tone similar to that above referred to. Messrs. Hopkinson show other instruments; one, an upright piano, made for tropical climates. The weight of this instrument is inconvenient, and the price (200 guineas) unnecessarily made high by ornament, which is called the style of Louis XVI. The framework seems well adapted to insure an inappreciable affection by rapid variations of temperature. The bijou pianoforte, £25, by Messrs. Hopkinson, is fitted with an unchecked action, and the hammers are apt to rattle. The tone of this instrument is somewhat weak and uneven.

9. The four pianos shown by the firm of Pleyel cannot be be too highly praised. The mechanism in all of them is well carried out. The tone is pleasant, singing, and powerful, and devoid of the "metallicism," if one may say so, of foreign pianos, wherein much iron is introduced. Messrs. Pleyel use wrought iron now, instead of cast-iron, as formerly. In their semi-grand instrument they meet with the difficulty of the tone influenced by the superposing of the lower strings over the middle ones, and the variation of tone is perceptible to some extent. In their concert grand, although a precisely similar arrangement is resorted to, the tone is even, full, and "singing" throughout. In this instrument Messrs. Pleyel introduce their recently-perfected repetition action, which seems to be capable of easy regulation, so that the repetition may be obtained by the movement of the hammers a half, a quarter, or an eighth the usual striking distance. The tuning-pin block in all Messrs. Pleyel's instruments is of wood; the strings pass, through brass studs fixed into the wooden block, to the wrought iron string plate or *sommier*. The lid to protect the tuning pegs is a useful addition.

10. M. Bord has a grand pianoforte, fitted with Erard's complicated but perfect action.

11. Although Russia is represented by a single instrument, she is to be congratulated that that instrument is unquestionably a fine one. It is made by Messrs. Schröder, of St. Petersburg. The touch is, if one may say so, thick and heavy, but the tone is round and full. Sweden, as represented by M. Norberg's instrument, cannot boast of much. This piano is a square one, with its ends S shaped. The arrangement of strings is certainly picturesque; one set radiates from the curved wooden bridge on the sounding-board to the frame, while the others radiate in a different direction above them. By this means, M. Norberg, in the smallest compass, secures as long strings as possible. The damping action is an adaptation of the early form of dampers, and is somewhat cumbersome. The price of the instrument is about fifty pounds, and considering this, as well as a fairly easy touch, one should not criticise the distinguishable variation of tone which is produced by the superposing of some of the strings in the manner to which allusion has been made.

12. Messrs. Wornum have conserved their original form of construction of pianos, and use no iron whatever. The tone of each of the instruments shown by them is sweet, but hardly full or forcible enough.

13. Messrs. Chappell's students' pianoforte, with a compass of five octaves and a check action, at the price of 15 guineas, is a very useful and low-priced instrument. It seems to have good lasting qualities, whilst the workmanship throughout, though not refined, is good. Their upright pianos for warm climates are well constructed for wear, and have a pleasant tone—some metallic perhaps, and a well-regulated touch.

14. As respects novelties in the pianoforte section, it has been a work of some difficulty to select those which appeared to be worthy of mention.

15. Major Gleig claims for his upright pianos the following principal features, which are new:—1. The plan of construction of the framing or body of the instrument, which has to take the pull of the strings. 2. The sounding-board. 3. The string-plate. Without entering into the details, which would take too much space, one may be permitted to say that the construction of the piano has been carried out in accordance with scientific theories. Those parts which Major Gleig conceives it necessary to make strong are so massive, that, compared with the works of old-established firms, they appear to have been overdone. There can be no doubt that Major Gleig's sounding-board possesses vibrating qualities superior to those in ordinary instruments, and the increased length obtained in the vibrating section of the string conduces to fuller and richer tone than heretofore. The coating of the hammers is of one piece of felt, and in this respect resembles the coating adopted some time since, and occasionally used by Messrs. Broadwood. In future pianos Major Gleig will

probably be able to reduce some of the lavishness of his construction, and being now sure of obtaining a richly-toned instrument, he may diminish, by producing at the same time a number of instruments, the present price of £84. The touch is heavy, and the response is not quick enough.

16. Near Major Gleig's piano is the violin piano of M. Maitre, of Paris. A similar instrument, by M. Baudet, was shown at Paris in 1867. The present piano-quatuor appears to be identical with that there shown, and professes to secure the same results. The tone of the instrument is grating, and so closely resembles at times the unpleasant sound of the hurdy-gurdy, that one's prejudice for the last-named instrument may possibly affect an opinion upon M. Maitre's piano-quatuor. In any circumstance, the producing, by mechanical means, of sounds which are supposed to take the place of those produced by the touch of an artistic performer, seems much at variance with the tenets of art faith.

17. Mr. Venables shows a piano with four pedals. The advantage to be obtained by using the four pedals of Mr. Venables, appears to be very similar to those which musicians, at the end of the last century, were able to have when playing upon one of Zümpe and Meyer's pianos. Performers on these instruments were obliged, in order to obtain variety of expressions, to make the best use they could of the unmatured system of damping and undamping by sections the strings of the piano. The so-called *basso sostenuto* of Mr. Venables exists more in theory than in fact.

18. Mr. Holman is a maker who has evidenly received a suggestion from early instruments. His octavo piano reminds one of the quality in tone of that of the harpsichord, excepting that, in the latter instrument, the strings were set in vibration by the catch of a quill, and in Mr. Holman's piano they are struck by a hammer. The action of the pedals enables a performer to procure the ordinary tones of the piano, or to add the octave throughout *à voluntâte*. Some years since, Messrs. Kirkman made a few octave pianofortes.

19. Messrs. Parker and Smith, of Plymouth, exhibit a pianoforte fitted with their patent "transverse laminated sounding-board," which Mr. Brinley Richards and Mr. Lindsay Sloper commend.

20. In concluding the notice of the piano section, it should be stated that the foreign pianos are remarkable for their cheapness; and further, that no foreign countries besides France and Russia have sent in pianofortes which can be admitted to the category of contributors of first-rate instruments or novelties.

Harmoniums.

21. Harmoniums are shown by the following:—Messrs. Breavington, Chappell and Co., J. B. Cramer, Metzler and Co., Arthur Allison, J. and J. Hopkinson, R. F. Stevens, Gilbert and Bauer, Charles Kelly, Claude and Son, S. Rolfe, from Great Britain. From Wurtemburg, Messrs. Karcher and Kraus; from Germany, Messrs. Rutheimer; from France, harmoniums by Mustel and Alexandre are shown by Messrs. Cramer and Chappell.

22. To Messrs. Cramer, commendation should be paid for their ready appreciation of and desire to circulate what is excellent. Probably M. Mustel may be considered to be one of the best harmonium makers. His instruments are difficult to obtain, since he employs no labour or assistance save that of two of his sons. In this respect he is not unlike the old makers of musical instruments. Messrs. Cramer are successful in bringing over to England a few of Mustel's harmoniums yearly, but few, indeed, they are; the number of them can be more frequently represented by one than two figures. All judges of harmoniums have unanimously accorded to the house of Mustel the highest praise for their instruments. In the instruments exhibited, the chief feature is a stop, called the "forte expression." There are two knee pedals, which act independently, one upon the upper and one on the lower reeds of the instruments, so that a performer desiring to emphasis the treble notes and to retain a similar quality, but smaller quantity, of tone in the bass is here enabled to do so. Heretofore a single stop "expression," acting simultaneously upon all the reeds, has been in use.

23. In M. Alexandre's harmoniums here shown, there are, one on each side of the row of stops, two stops called "double enforcement," which can be used separately. These stops bring into operation an additional set of reeds, which, however, do not speak unless the key is entirely pressed down. If the key is half pressed down, only the ordinary stops which may happen to be out speak. In M. Mustel's harmoniums a similar effect may be obtained. But here there is no provision of special contrivance. The perfection of the mechanism for raising the pallets, which permit the passage of air to the reeds, is such, that when a combination of stops is in use, a slight pressure of the key will allow the air to pass to only the reeds which are first in order of arrangement, and the others produce no sound until the key is entirely pressed down, and thus the pallets become opened for the passage of air to all the reeds in use. For the performance of passages in which the melody should predominate and the accompaniment made subservient, this double touch is a useful accessory. Both in Messrs. Mustel's and in Messrs. Alexandre's instruments the tone is sweet and organ-like, and the articulation rapid and distinct. The other harmoniums which call for special mention are those by M. Trayser, of Stuttgart, imported by Messrs. Hopkinson, and the American organs, which are in reality harmoniums.

24. It will be found, in the instruments made by M. Trayser, that the mechanism is thoroughly well done. His reeds are made of a metal, the composition of which is known to the maker only. It is flexible, and withstands almost any amount of bending, thus the voicing of the tongue can be easily effected, and an injury to the tone from an extra pressure of wind or concussion can quickly be rectified. The mechanism connected with the keys and the reeds is fitted by a hinge over the bellows, and opens with the greatest ease, and in a simple manner. This is a manifest superiority over those harmoniums in which the works are so fitted and screwed down, that it may be a labour of a quarter of an hour or more to accomplish what in Messrs. Trayser's instruments takes half a minute. As respects finish of workmanship, these harmoniums are like M. Mustel's, and this is to be accounted for by the fact that Mustel and Trayser were fellow-workmen in the same factory, prior to each of them starting a business of his own. Messrs. Hopkinson are the importers of Trayser's harmoniums for the United Kingdom, and it is due to their suggestions that improvements have been made by Messrs. Trayser in the manufacture of harmoniums, especially in those destined for England. The quality of tone in these harmoniums, which are low-priced considering the results obtained, is rich and organ-like.

25. The tone of the American organs is generally round, and fuller than that of the usual harmoniums. They are calculated to last longer than the usual harmoniums. The price of the instrument, by comparison, is therefore high. The air is sucked in through the reeds from above, while in the ordinary harmonium the wind is forced through them from beneath. Messrs. Cramer, Breavington, Metzler, Lucas, and Collins show this class of instrument, which is imported from America. The stop "vox humana" is an effective one when introduced. It is a fan which, rotating above the reeds, renders the quantity and supply of the oir to be sucked in, irregular, hence the tone produced partakes of a tremolo quality. Messrs. Cramer, besides showing imported instruments, exhibit some made at their own factory by American workmen. In one of their home-made American organs they have introduced a stop called the "basso prolongo," which is a mechanical contrivance acting only upon the lowest notes in the bass, for sustaining a note, or any number of notes, within the compass effected. By striking some other

note also with the compass those which were held down are at once released, and the note last struck becomes the sustained one. This is useful in the performance of pedal passages.

26. To their harmoniums, made upon the usual principle, Messrs. Cramer have added a stop called the "petite expression." In the case of the ordinary "expression" stop the air from the bellows is diverted from the wind reservoirs, and made to act directly upon the reeds. This, in some instances, produces a detrimental effect upon the vibrating tongues, which may be of such metal or strength, that an undue pressure quickly puts them out of order. By the "petite expression" the effect of tone by the wind acting direct on to the reeds is obtained, but the risk of injury is lessened, as half the wind only is allowed to act upon the reeds, whilst the other half is made to go into the wind reservoir.

27. Messrs. Chappell have instigated M. Alexandre to make, particularly for the English market, a new organ harmonium, with a compass of five octaves, for six guineas. This is a decided improvement upon the former small harmonium. The tone is full, and is unaffected by the kind of "buzz" which is not unfrequently to be heard issuing from cheap instruments. The reeds are fitted with a broader tongue, and voiced upon a new system. The articulation is fairly rapid.

28. Mr. S. Rolfe's harmonium is an instrument intended for four pairs of hands. Opposite the ordinary fingerboard is a set of keys of two octaves with a flute stop, and at each end are respectively two octaves of keys with a clarionet stop and a bassoon stop. The instrument sent to the Exhibition was apparently out of order.

29. Mr. Gilbert L. Bauer's harmonium has a pleasing tone.

30. Mr. C. Kelly claims to have produced a novel and improved swell action. The usual swell action in harmoniums is like a Venetian blind, with flaps of wood fitting closely together over the reed box. A pressure of the swell pedal raises the flaps much or little, according to the strength of the pressure; thus the sound either has a comparatively large or small space to emerge from. In Mr. Kelly's harmonium, the swell action is obtained by two slabs of wood, which slide one above the other. Both are perforated with holes of an oviform shape. The pedal connected with these two slabs of wood moves them, so that the orifices of the under one may correspond precisely with those of the upper one, thus giving to the sound the larger means of exit, or they may form a small aperture, and so reduce the quantity of the sound. This is a more complicated action than the usual swell action, already described, but possesses qualities peculiar to itself, useful in producing certain effects. By an improved arrangement of the wind reservoirs and the reeds, a quick articulation is obtained. Mr. Kelly's instruments are not expensive. The quality of their tone is fairly good.

31. Mr. Claude's harmonium is a handsome instrument, well made, and with a quick articulation.

Organs.

32. From Great Britain there are nine makers and importers who exhibit, as follows:—Messrs. Cramer, Alfred Monk, Richard Brown, Bryceson Brothers, Speechly and Ingram, Bishop and Starr, Henry Jones, Bevington, Chappell.

33. From Germany:—Messrs. E. F. Waelcken, whose agents in England are Messrs. Imhof and Mukle.

34. Mr. Jones's organ is the largest and most important instrument of this class. Unfortunately, it was placed in the south gallery, and a fair opinion of its power could not be formed. It has three complete manuals and an independent pedal organ. The mechanical movements are made of mahogany and wrought iron, polished or burnished in every working part, to ensure freedom and lightness of action, while leather and cloth are introduced to prevent rattlings, &c., which might arise in certain parts. The great organ has nine stops, the swell organ seven, choir organ five, and the pedal organ five. There are five couplers, a tremulant acting upon the swell, three composition pedals to great organ, and two to the swell. The selection of the stops is such that the organ is admirably adapted for all classes of music. The front is of varnished deal, and bright metal pipes, the mottled appearance of which bears testimony to the careful mixture of the metals used in their production.

35. Next in size and importance is the organ by Messrs. Imhof and Mukle. In this instrument there are two manuals, with seven stops to one and five to the other. The pedal organ has three stops. There are three combination pedals, and a pedal for the general swell, which incloses the whole organ except the pedal stops.

36. The key-boards are placed away from the instrument, so that a performer accompanying a choir has the advantage of seeing his singers. The system of blowing is somewhat unusual. It is thus described by the manufacturers:—They have done away with bellows, and have introduced a wooden case with two divisions, which contain two lids, made air-tight in the borders, so that when either of the two divisions is nearly empty the weighted lid is pulled up, and the wind rushes in from below; but while the process of filling is going on, that division is entirely disconnected from the supply of wind to the organ. Thus the manufacturers claim that this gets rid of the irregularities of supply of wind which, occurring at times from bellows worked in the ordinary way, have a detrimental effect upon the tones from the pipes which are speaking.

37. Messrs. Bishop and Starr's organ is shown to exemplify how space may be economised in the arrangement of the pipes and manuals. The actual ground-space occupied is small in proportion to the wall space.

38. The electric organ, by Messrs. Bryceson, is notable, as the general public, for the first time, may inform themselves of the way in which the communication between the key-board and the organ is effected. By their application of electricity for musical purposes, Messrs. Byceson are enabled to construct instruments so that the pipes, &c., of an organ may be at the west end of a church while the organist plays upon manuals which may be placed at the east end. With securely insulated wires, carefully-adjusted connections, and a continuous strength of battery, certainty of response from the organ is obtained.

39. Other organs which are shown call for no special remark. They are chiefly small and low-priced instruments.

Wind Instruments (Brass and Wooden).

40. This section of the Exhibition is but smally represented. The exhibitors are—Messrs. Rudall, Carte, and Co., S. Arthur Chappell, Distin and Co., Kenny, Potter, and Co., Keith Prowse, Boosey and Co., J. and R. Glen, from the United Kingdom. Messrs. Ahlberg and Ohlston, from Sweden.

41. Messrs. Rudall, Carte, and Co. make an excellent display of instruments. The collection includes specimens of the best workmanship in military brass instruments, clarionets, hautboys, flutes, &c. Since M. Bochin sold his patent to Messrs. Rudall and Carte, they have made many additions and improvements to this species of flute. Mr. D'Oyly Carte, a member of this firm, has given much attention to this branch of musical instrument making, and has had made gold and silver flutes. It appears that the gold flute produces the best tones. This is accounted for by the closeness of the metal and its malleability, both of which aid the precision of the delicate work required in forming the head-joint. Mr. D'Oyly Carte has described the features of M. Bochin's flute in the following terms:—"The new cylinder flute is the reverse in its construction of the German or conical flute. In this instrument the main part, or body, upon which the finger-holes are placed,

is a cylinder, while the head-joint, on which is the mouth-hole, is conical, tapering towards the top end of the flute. But the curious and essential condition of this head-joint, and upon which the beauty, volume, and mellowness of its tone depend, is that, although conical, it is not a direct cone or straight taper, but must assume the shape described by a stone thrown from a sling or the hand as it nears the ground, and is known as a section of a parabolic curve. Unless the head-joint is made of a tube formed of this curve in a certain degree, and if it be more or less curved, the sounds will be more or less harsh, or hollow and unmusical." The flute shown by Messrs. Boosey and Co., which is constructed on "Radcliffe's model," has the merit of combining, to a great extent, the advantages of tone and intonation of the new order of flutes with the smallest change from the old system of fingering. Amongst the clarionets is one called by Mr. Carte the "Clarionet of the Future." This appellation is presumably given to it, as the fingering is very different to that in use. It will, therefore, require some years before its adoption can be general. The mechanism for stopping the holes at first sight, seems intricate. Besides finely-finished silver bugles and cornets, Messrs. Rudall and Carte exhibit some military-band brass instruments. In the construction of brass piston instruments it has been a matter of some difficulty by some makers, not sufficiently considered, to remedy the weak and incorrect tones which issue from the piston-tubes when in operation. This imperfection is almost entirely done away with in Messrs. Rudall and Carte's new instruments to which pistons are attached, invented by Mr. Oates, of Birmingham. The passage for the air in these pistons is said to be as clear and free as in the main tube of the instrument, and the testimony of well-known performers to the excellent tone produceable from these instruments confirms the correctness of the assertion.

42. The show of wind instruments by Messrs. S. Arthur Chappell and Co. is confined solely to military band brass instruments. All of them are made by Messrs. Antoine Courtois, and are notable for their careful workmanship, and for the excellent quality of the metal employed. This metal has the advantage over ordinary metal used for wind instruments, of being reparable when parts of the instrument may be too much worn, and it is not liable to flaws or cracks. M. Courtois, working to overcome the defective intonation so common in piston instruments, has added to some of his tenor horns and euphoniums a fourth piston. A cornet, with the "echo attachment," is exhibited. By means of a valve, the sound can be diverted from the ordinary bell into this echo attachment, which confines the sound, reducing its penetrating power very considerably. A student by this means can practise in a house without annoying other inhabitants of it. The echo attachment is also useful in producing in orchestral music subdued tones.

43. Messrs. Distin and Co., in their collection of instruments, have shown the various portions of pistons and tubes in process of manufacture. The "patent light valve" is a feature in Messrs. Distin's instruments. It conduces to a uniformly true intonation of the notes of the two classes termed "fingered" and "open." For the performance of vocal music, Messrs. Distin have recently made a ballad horn, which is highly spoken of, both by amateurs and professionals. Instruments such as the slide trombone and ordinary French horn are being superseded in military bands by pistoned instruments of a similar character. In the slide trombone, as is well known, the accuracy of intonation depends upon the correct ear of the performer, who, by moving the slide, sharpens or flattens a note, in the same way that a violinist produces a similar effect by the slightest movement of his finger on the strings. Hence it is necessary that a performer of the slide trombone should be a fair musician. Of the French horn the same is the case. The correctness of the "shut" notes depends upon the proper adjustment of the hand in the bell of the instrument. Messrs. Distin state that their "tenor cor" combines the mellow tone of the French horn with the fulness of the "tenor," and the fingering is the same as that of the cornet. A want is here said to be supplied to military bands in which the difficulty of obtaining performers on the French horn has been felt. The low-priced instruments shown by this firm are well made, and useful for schools, factory bands, students, &c.

44. The instruments sent by Messrs. Boosey are merely a small collection of the usual military brass-band instruments which they supply to the army and navy, &c. There are also a few flutes, made upon M. Bochin's model, and after the model of a flute played upon by the late Mr. Pratten.

45. Messrs. J. R. Glen show a case full of melody chanters and bagpipes of three or four sizes.

46. The foreign instruments are low-priced, especially those of Messrs. Mahillon, of Brussels, whose workmanship is good. They exhibit a trumpet in wood, to show that the material has no influence on the sound. The tone of this instrument is more briliant than might be expected, but it can hardly be said to possess that ring or stradency of tone which are the features of metal trumpets. Messrs. Ahlberg and Ohlston's instruments are of gillow brass. There are one or two specimens of the now somewhat *passe* "cylinder" instruments. The instruments in the French section call for no special remark. The smallness of the collection is not worthy of so musical a nation as the French, nor of the Exhibition.

47. There are a few military drums, such as the *grandes caisses* and side drum; also a few kettle drums. Those sent by English firms are the best manufactured. The skin employed by Messrs. Potter seems thick, and the sound obtained from the kettle drums is perhaps too toneless, although powerful. Hanson's patent metal-headed drum is struck with sticks, the tops of which are of hard vulcanised india-rubber. It is exhibited by Chas. Atkins and Co. The novelty claimed is the use of "metal," instead of "parchment" or "vellum," for the head of the drum, and a simple mechanism in the place of the hoops, cords, and screws hitherto used. If proof against damage from exposure in rain, &c., it is not unlikely to become an economical instrument for adoption in military bands.

Bowed Stringed Instruments.

48. Dr. Stone, Mr. Philip Richards, Mr. John Day, Messrs. Keith, Prowse, Mr. Georges Chanot, and M. Charles Boulangier, exhibit stringed instruments, under the denomination of British exhibitors.

49. Messrs. Heidegger send one or two specimens from Bavaria, and Messrs. Anton Lutz from Austria.

50. France, which owns celebrated makers, such as Messrs. Gaud and Bernardel, Miremont, and Vuillaume, is not represented at all.

51. Mr. John Day's violins are made after the models of A. Stradivarius and J. Guarnerius. The wood is of excellent quality, and the varnish closely resembles in appearance that of the old varnish. The imitation of years of wear is clever. The price of these instruments is somewhat high. M. Chanot's copy of an old six-string viol by Jean Karlino is faithfully carried out, though instead of six, M. Chanot puts four strings, and calls the instrument a viola. For a viola it is of large size, but the tone of it is said to be sonorous, and superior to what is generally obtained from the ordinary viola. The instruments by M. Charles Boulangier, a French maker resident in England, are carefully made. The wood is well selected, and the contour of his model (a Stradivarius) closely copied. His violoncello is somewhat fiery in varnish; when the instrument was used at one of the recitals on musical instruments in the Albert-hall, the tone of it was pronounced highly satisfactory.

52. Dr. Stone's double-bass has, like the double-basses

used in military bands abroad, an additional C C C string.

53. The instruments shown by Messrs. Keith, Prowse, are apparently of French manufacture, possibly from Mirecourt.

54. M. Auton Lutz's instruments are good-looking and moderately priced. No opportunity presented itself for forming an opinion of their tone.

55. Mr. Philip Richards shows three violins, two after Guarnerius (it is not stated which member of the family), and one after A. Stradivarius in his "Amatisé" period. The varnish of these instruments is not good, when compared with the ancient precedents they profess to be reproductions of; it is unevenly put on the surface, and has an unpleasant gaudy orange colour.

56. One class of musical appurtenances of importance is altogether unrepresented at the Exhibition, viz., that of fiddle-strings. The great importance which they possess as musical mediums should surely have entitled them to some consideration. It appears that modern violin-makers content themselves with strings made in a kind of hap-hazard way from the necessary materials obtained from well-fed sheep. The Neapolitan sheep undoubtedly provide the best materials, their diet being less fat-creative than that of their northern brethren. Hence it is that strings from Naples are the most highly esteemed. But even these are constructed without much consideration. The irregularities of the materials are rubbed away only to obtain an even surface. No provision is calculated for to compensate for the variations which naturally occur in the various lengths of material which compose an entire string; and as regards the wire-covered string, little if any attention is paid to the proper width that the covering wire should be, or to the careful adjustment of the wire, so that it may not be twined round too closely or too broadly. It may be satisfactory to know that M. Vuillaume, of Paris, whose refined workmanship in violins seems likely to rival Stradivarius, of whom he is a sincere disciple, is paying great attention to the construction of strings.

Miscellaneous Instruments.

57. Under the classification of miscellaneous instruments may be placed musical-boxes, shown by Messrs. Paillard-Vaucher, Fils; Nichole, Freres, imported by Messrs. Keith, Prowse, and Co.; some concertinas, by Sir Charles Wheatstone, E. Chidley; an accordion, by C. F. Zimmerman; cithers, by M. Anton Lutz and Anton Kiendt; pigeon whistles, to scare away vultures, lent by Lady Dorothy Nevill; and an instrument called the diapason. This last-named consists of a series of lactal tongues, similar to those used in musical-boxes, and is designed to assist a tuner in tuning a piano. The specimen shown appeared to be somewhat out of tune, and the tone of the bass tongues uncertain. Until this class of instrument can be so regulated that the truth of its tones may be depended upon, it seems to be a question if in its present state it justifies the title given to it.

58. In concluding these notes, it should be stated that the collection of information has been a work of some difficulty. The insignificance of most of the instruments as *musical* instruments added to the difficulty. It was hard to draw the line in such a collection between instruments made for the promotion of art and those made for the promotion of commerce. As respects the French section, it is beyond comprehension why so musical a nation should be so ill-represented. Even the limited number of instruments from France proves that her best pianoforte makers do not, like ours, object to contributing to exhibitions. Surely makers of other instruments could have been induced to come to the fore.

59. One lesson is undoubtedly to be learnt from the present collection. It is that there still remains the opportunity for presenting to the public as complete an exhibition of first-rate modern instruments as that of ancient musical instruments which were shown at the South Kensington Museum.

ON THE PREVENTION OF AND MEANS OF ARRESTING PUTREFACTION.

The following is an abstract of a series of papers read before the Royal Society, by Dr. F. Crace Calvert, F.R.S., and which give the results of a very important series of experiments:—

On Putrefaction.

This paper is intimately connected with those I have already published on protoplasmic life and the influence it exerts on putrefaction.

I have already shown that when albumen from a new-laid egg is introduced into pure distilled water, and communication with the atmosphere prevented, protoplasmic life does not appear. If the same solution, however, be exposed to the atmosphere for from fifteen to forty-five minutes, minute globular bodies appear, having an independent motion, which I denominate monads. The time required varies according to the time of the year, the amount of moisture present in the atmosphere, and the temperature.

Although M. Pasteur has already noticed the meteorological conditions which influence that life, he has not noticed the extraordinary rapidity with which the fluids are impregnated, and that this impregnation is proportional to the surface exposed.

On the 18th of May, 1871, two portions of albumen, measuring 400 grains, were placed, the one in a test-tube having a diameter of ¾ inch, the other in a test-glass which at the surface of the liquid had a diameter of 2 inches. In the tube vibrios appeared after twelve days, whilst in the glass only five days were required for their development. If in place of pure distilled water the water supplied by the Manchester Corporation (which is one of the purest waters in England) was used, the time required for the development of vibrios in a test-tube was only twenty-four hours.

These experiments prove that the rate of development of vibrio-life is influenced by the extent of surface exposed.

M. Pasteur has already demonstrated that oxygen is essential to the life of the Mucedines, but I am not aware that it has been proved that this gas is necessary to the existence of vibrio-life.

In the hope of throwing some light on this subject, the following experiments were made:—

Into each of five glass bulbs equal volumes of a solution of albumen in Manchester water were placed, and the first left in contact with the atmosphere for twenty-four hours, after which the ends of the tube were hermetically sealed about 2 inches on each side of the bulb. After passing oxygen, hydrogen, nitrogen, and carbonic acid over the other four solutions, the tubes were also hermetically sealed. These tubes were kept closed for twenty-seven days, during which it was observed that the albumen in the bulb containing oxygen speedily became turbid, then the one containing air, while the other three remained clear. After this period the tubes were broken and the contents examined. A large quantity of vibrio-life was found in those containing oxygen and common air, whilst those containing nitrogen, carbonic acid, and hydrogen contained very small quantities, that with hydrogen the least,—thus proving that oxygen is an essential element to the production of putrefactive vibrios.

In further support of this view, I may state that, under certain conditions, these animalcules produce such an amount of carbonic acid and other gases, as to exclude oxygen to such an extent that their own development and life are impaired.

This is easily proved by taking albumen full of animalcules, but not emitting any putrid odour, and placing it in test-tubes, closing some and leaving others open. If these tubes are examined after a few weeks, it will be observed that in those left in the air life has much increased, and they emit a very putrid odour;

whilst the life in the closed tubes not only has not increased, but appears to be in a dormant condition; for if the corks are removed, and the fluid again comes in contact with the oxygen of the air, its activity returns. The albumen also in the closed tubes does not emit any putrid odour.

M. Pasteur has also found that oxygen was necessary to the vibrios of putrefaction, although the same gas destroyed those produced in butyric fermentation; but he has not made any experiments to show that the products emitted by such vibrios are prejudical to their development, and even to their power of locomotion.

Having stated above that liquids exposed to the atmosphere become impregnated with monads, I will try to describe their gradual development into vibrios, and their ultimate transformation into microzyma.

A few hours after the albuminous fluid becomes impregnated, the monads, which have a diameter of about $\frac{1}{128000}$ of an inch, appear to form masses. Then some of the monads become elongated into vibrios, which, though attached to the mass, have an independent motion; so that, as the force exerted by the vibrios predominates towards one or another direction, so is the mass moved over the field of the microscope. As the development proceeds, the mass is broken up, and ultimately each vibrio has an independent existence, and may be seen swimming or rolling about in the fluid. Their size at this stage is about $\frac{1}{20000}$ of an inch. These, which I call ordinary vibrios, gradually grow into long vibrios, which attain a length of $\frac{1}{6400}$ of an inch.

These long vibrios gradually become changed into cells, which I have called microzyms. The first process in the transformation is its division into two independent bodies. One extremely faint line appears across the centre of the animalcule, and increases in distinctness until the vibrio appears like two smaller vibrios joined together. The separation takes place, and each part acquires an independent existence. These parts again divide, and the process of subdivision is carried on until they appear to be nothing more than cells, which have a swimming power so great as to pass over the field of the microscope with rapidity.

After twelve or eighteen months all the vibrios disappear and are replaced by microzyms, either in motion or at rest. If these microzyms are placed in a solution of fresh albumen, vibrios are abundantly developed. The apparent explanation of this fact is, that in the fresh albumen they have all the circumstances favourable to their growth and reproduction, while the putrid albumen has become so completely modified as to be incapable of affording them the requisite conditions for reproduction.

I may also notice that at the same time a deposit has taken place which, under the microscope, appears to consist of shoals of small particles of matter which have no life. The solution has now become perfectly clear, possesses considerable refractive power, and has lost the property of becoming coagulated by heat.

The albumen solution does not emit a putrid odour until after the formation of the above-mentioned deposit, and the amount of odour is in direct ratio to the number of vibrios present.

I remarked during the investigation, the presence of several other forms of animalcules which contribute to the decomposition and putrefaction of proteine substances, the description of which will be found in the original memoir.

On the Relative Power of Various Substances in Preventing Putrefaction and the Development of Protoplasmic and Fungus Life.

To carry out this series of experiments, small test-tubes were thoroughly cleansed, and heated to dull redness. Into each was placed 26 grammes of a solution of albumen, containing one part of white of egg to four parts of pure distilled water, prepared as described in my paper on protoplasmic life. To this was added one thousandth, or ·026 gramme, of each of the substances the action of which I desired to study.

The reason why I employed one part in a thousand are two-fold. First, the employment of larger proportions would, in some instances, have coagulated the albumen. Secondly, it would have increased the difficulty of observing the relative powers of the most efficacious antiseptics in preventing the development of the germs of putrefaction or decay.

A drop was taken from each of the tubes and examined under a microscope having a magnifying power of 800 diameters. This operation was repeated daily with the contents of each tube for thirty-nine days, and from time to time for eighty days. During this time the tubes were kept in a room, the temperature of which did not vary more than three degrees, namely, from 12·5° C. to 15·5° C.

In order the better to show the influence of the antiseptics used, I examined two specimens of the same solution at the same time, one of which was kept in the laboratory, the other in the open air.

A marked difference was observed in the result; the one kept outside becoming impregnated with animal life in less than half the time required by the other, while as many vibrios were developed in six days in the tube kept outside as were developed in thirty days in the tube in the laboratory.

A summary of the results of the experiments is given in the following table, in which the substances are grouped according to their chemical nature:—

	Days required for development of	
	Fungi.	Vibrios.
1. *Standard Solutions.*		
Albumen kept in laboratory for comparison	18	12
Albumen exposed outside laboratory	None	5
2. *Acids.*		
Sulphurous acid	21	11
Sulphuric acid	9	9
Nitric acid	10	10
Arsenious acid	18	22
Acetic acid	9	30
Prussic acid	None	9
3. *Alkalies.*		
Caustic soda	18	24
Caustic potash	16	26
Caustic ammonia	20	24
Caustic lime	None	13
4. *Chlorine Compounds.*		
Solution of chlorine	22	7
Chloride of sodium	19	14
Chloride of calcium	18	7
Chloride of aluminium	21	10
Chloride of zinc	53	None
Bichloride of mercury	81	None
Chloride of lime	16	9
Chlorate of potash	19	17
5. *Sulphur Compounds.*		
Sulphate of lime	19	9
Protosulphate of iron	15	7
Bisulphite of lime	18	11
Hyposulphite of soda	18	11
6. *Phosphates.*		
Phosphate of soda	17	13
Phosphate of lime	22	7
7.		
Permanganate of potash	22	9
8. *Tar Series.*		
Carbolic acid	None	None
Cresylic acid	None	None

9. *Sulphocarbolates.*

Sulphocarbolate of potash	17	18
Sulphocarbolate of soda	19	18
Sulphocarbolate of zinc	17	None

10.

Sulphate of quinine	None	25
Picric acid	19	17
Pepper	None	8
Turpentine	42	14

11.

Charcoal	21	9

In comparing the results stated in the above table, the substances can be classed under four distinct heads, viz. those which prevent the development of protoplasmic and fungus life; those which prevent the production of vibrio life, but do not prevent the appearance of fungus life; those which permit the production of vibrio life, but prevent the appearance of fungus life; and those which do not prevent the appearance of either protoplasmic or fungus life.

The first class contains only two substances, carbolic and cresylic acids.

In the second class also there are only two compounds, chloride of zinc and bichloride of mercury.

In the third class there are five substances, lime, sulphate of quinine, pepper, turpentine, and prussic acid.

In the fourth class is included the remaining twenty-five substances.

The acids, while not preventing the production of vibrio-life, have a marked tendency to promote the growth of fungus-life. This is especially noticeable in the case of sulphuric and acetic acids.

Alkalies, on the contrary, are not favourable to the production of fungus-life, but promote the development of vibrios.

The chlorides of zinc and mercury, while completely preventing the development of animalcules, do not entirely prevent fungus-life; but I would call special attention to the interesting and unexpected results obtained in the cases of chlorine and bleaching-powder. When used in the proportion above stated they do not prevent the production of vibrio-life. In order to do so they must be employed in excess; and I have ascertained, by a distinct series of experiments, that large quantities of bleaching-powder are necessary. I found that part of the carbon was converted into carbonic acid, and part of the nitrogen was liberated.

If, however, the bleaching-powder be not in excess, the animal matter will still readily enter into putrefaction. The assumption on which its employment as a disinfectant has been based, namely, that the affinity of the chlorine of hydrogen is so great as to destroy the germs, is erroneous.

The next class to which I would call your attention is the tar series, where neither the carbolic nor the cresylic acid fluids gave any signs of vibrionic or fungus life during the whole eighty days during which the experiments were conducted.

The results obtained with sulphate of quinine, pepper, and turpentine deserves notice. None of them prevent the development of vibrio-life; but sulphate of quinine and pepper entirely prevent the appearance of fungi. This fact, together with the remarkable efficacy of sulphate of quinine in intermittent fever, would lead to the supposition that this form of disease is due to the introduction into the system of fungus germs; and this is rendered the more probable if we bear in mind that these fevers are prevalent only in low, marshy situations, where vegetable decay abounds, and never appears to any extent in dry climates, even in the midst of dense populations, where ventilation is bad and putrefaction is rife.

The results obtained in the case of charcoal show that it possesses no antiseptic properties, but that it prevents the emanation of putrid gases, owing to its extraordinary porosity, which condenses the gases, thus bringing them into contact with the oxygen of the atmosphere, which is simultaneously condensed.

The above results have been confirmed by a second series.

A series of experiments was also undertaken, substituting gelatine for albumen, and was continued for forty-seven days.

Vibrios appeared in two days in the standard gelatine solution, and bacteria after four or five; and during the whole time of the experiment, life was far more abundant than in the albumen solution. A distinct putrid smell was emitted after twenty-six days.

With bleaching-powder it took twenty days for life to appear instead of seven, as in the case of albumen; while at no time during the twenty-seven days which remained was life abundant. No putrid odour was emitted, but a mouldy one could be detected on the thirteenth day.

With chlorine solution vibrio life was observed only after forty days; no putrid nor mouldy smell was given off at any time.

The protosulphate of iron gave, with this solution, results quite different from those with albumen, in which, it will be remembered, vibrios appeared in seven days, and fungi after fifteen; whilst with gelatine neither protoplasmic nor fungus life appeared during the time the experiments were continued.

Another substance, arsenious acid, also presented a marked difference in its action in the two solutions; for although with albumen twenty-two days elapsed before vibrios were present, and eighteen before fungi, with gelatine animal life appeared after two days, and at no time did any fungi exist. The effects of the other substances with gelatine were so similar to those with albumen, that it is unnecessary to state them here.

On the Relative Power of Various Substances in arresting Putrefaction and the Development of Protoplasmic and Fungus-life.

This series of experiments was undertaken as being complementary to those described in my last paper, and consisted in adding to a solution of albumen, swarming with microscopic life, one-thousandth part of the substances already enumerated in that paper, and examining the results produced immediately after the addition of the substances, and after one, six, and sixteen days; but in this abstract only the results obtained in the first and last cases will be noticed.

The solutions were placed in test-tubes similar to those described in my last paper.

The experiments were begun on the 30th September, 1871, the solutions being kept to a temperature of 15°—18° C.

In the standard solution the amount of life and putrescence increased during the whole of the time.

The first class includes those substances which completely destroyed the locomotive power of the vibrios immediately, and completely prevented their regaining it during the time experiments were conducted:—

Cresylic acid.

The second class contains those compounds which nearly destroyed the locomotive power of all the vibrios present when added, and afterwards only one or two could be seen swimming about in each field:—

Carbolic acid, sulphate of quinine, chloride of zinc, and sulphuric acid.

The third class are those which acted injuriously on the vibrios on their addition, leaving only a small number retaining the power of swimming, but which allowed the vibrios gradually to increase in number, the fluid, nevertheless, containing less life after sixteen days than the standard putrid albumen-solution:—

Picric acid and sulpho-carbolate of zinc.

The fourth class includes those substances which acted injuriously at first, but permitted the vibrios to regain their former locomotive power, so that the fluid after sixteen days continued as much vibrio-life as the standard putrid albumen:—

Chloride of aluminium, sulphrous acid, and prussic acid.

The fifth class contains those compounds which acted injuriously at first, destroying the locomotive power of most of the vibrios, but which afterwards permitted the vibrios to increase more rapidly than in the standard albumen-solution:—

Bleaching-powder, bichloride of mercury, chlorine-solution, caustic-soda, acetic and nitric acids, sulphate of iron, and the sulpho-carbolates of potash and soda.

The sixth class contains those compounds which exercised no action on the animalcules, either at first or after sixteen days:—

Arsenious acid, common salt, chloride of calcium, chlorate of potash, sulphate of lime, bisulphite of lime, hyposulphite of soda, phosphate of lime, turpentine, and pepper.

The seventh class includes those substances which favour the production of animalcules and promote putrefaction:—

Lime, charcoal, permanganate of potash, phosphate of soda, and ammonia.

TRANSPORT OF MEAT FROM AUSTRALIA.

Mr. William Shand, of Portobello, says in a letter to the *Standard* of the 7th inst.:—

I am asked what would be the cost of transporting a cargo of fresh meat from Australia to London, in a vessel prepared for the purpose with refrigerating machinery.

Taking the published statistics of the Melbourne Meat Preserving Company, I find the average price of 590 oxen to be £5 11s. 9d. each, and that of 160,752 sheep to be 7s. 3·04d. each. Presuming, for I am not specifically informed on this point, that an ox without offal will weigh 6 cwt., then we have beef in the carcase at 2d. per lb. Allowing 48 to 60 pounds for the weight of each sheep without offal, then we have mutton at 1½d. to 2d. per lb. in Australia.

Here, in Edinburgh, the offal of an average sheep is worth at least as much as the average Australian sheep entire. It seems fair to suppose that the offal of an Australian sheep will at least pay for the expense of shipping the carcase, including the cost of cooling it down to nearly 32 deg. Fahrenheit. In Australia it has hitherto been the offal that gave the sheep its value for killing. The offal must, therefore, constitute a very large proportion of the value of the average sheep costing 7s. 3d.

Freight from Australia to London per steamer is to be had, I am told, for 70s. per 40 cubic feet, allowing one-third additional space for impermeable linings and bulkheads, machinery interspace and air channels, and so taking 53 1·3 cubic feet for each ton weight of meat, we arrive at a freight of £4 13s. 4d., or exactly one half penny per pound.

The outlay in fitting up 5,334 cubic feet with duplicate refrigerators, air fans, linings, and donkey engine, might cost £3,000. Allowing that a steamer can make very little more than two voyages a year between London and Melbourne, and taking 25 per cent. per annum for interest, wear and tear, replacement of capital, &c., we arrive at another halfpenny per pound on the cost price of our Australian meat. In fact, a halfpenny per pound on 200 tons per annum only would give more than 31 per cent. on £3,000, or would pay 25 per cent. on £3,733. But we must reckon liberally in a speculation of this sort.

Then the working of the machinery has to be considered. With coals at famine prices, it is simply impossible to make any estimate of what it might cost to keep up a temperature of 30 deg. to 40 deg. Fahrenheit, during nine or ten weeks, in a ship's hold, where 100 tons of meat are stowed. No one has ever dealt with such a problem. No data exist. All I can say is that in 100 tons of meat every penny added to the price per lb. gives £933 6s. 8d. on the whole. Allow, for the sake of argument, one penny per pound as the cost of keeping up the the necessary degree of cold on the voyage between Australia and London, the cost price of our mutton landed from the docks in London is still only 3½d. to 4d. per pound. Now, the wholesale price of meat in the Edinburgh market during the current year is 7d. to 9d. per pound. In London it is just so much more as is equivalent to the profit and charges of our speculating butchers, who consign large quantities of meat from hence to Smithfield by rail.

The question is now narrowed to this. Besides the general risks of the venture, for which some allowance has been made in the progress of my calculations, there is the risk that £933 6s. 8d. will not be sufficient for the expenses of keeping 100 tons of meat down to, say, 35 deg. Fahrenheit, on the voyage from Melbourne to London.

Per Contra—Cent. per cent. Profit at least.

COST.

100 tons of finest Australian mutton, at 4d. per lb.				£3,733	6	8
Insurance, landing, delivery, brokerage, and dock dues, 10 per cent...				373	6	8
				£4,106	13	4
PROCEEDS.						
100 tons sold at 9d. per lb. ..	£8,400	0	0			
Profit..				4,293	6	8
				£8,400	0	0

I ask your mercantile readers whether a profit like this is not sufficient to cover a great deal of risk.

NOTES ON SCIENCE.

Since the Hon. J. W. Strutt brought before the Royal Society, in last June, the subject of diffraction gratings, this topic has received much attention from scientific men. A diffraction grating consists merely of a number of parallel lines, ruled by means of a diamond point, upon glass, these lines being so close together that six thousand of them occupy but the space of an inch. A plate of glass thus ruled possesses the property of showing several spectra of any luminous body which may be examined through it. A diffraction grating thus, to all intents and purposes, forms a compact and elegant little piece of apparatus, capable of serving for spectrum analysis. But, from the method of construction, it of necessity is very expensive; and the communication of the Hon. Mr. Strutt to the Royal Society, to which reference has been made, consisted in his describing the means by which such gratings could be made by photography, at a price so low as would place them within the reach of every person. The method proposed is to apply the diamond-ruled grating to the surface of a sensitive dry photographic plate, and expose them to light for a few seconds. On developing the image thus formed, the lines are found re-produced with a degree of force and distinctness sufficient to enable the spectra of luminous bodies to be seen with great beauty. As these photographs may be produced very cheaply, there seems no reason to doubt that they will soon be sold as scientific toys at a shilling each, for from one original may be obtained an unlimited number of photographic copies.

Active preparations are being made in the Royal Observatory, on the Carlton-hill, Edinburgh, for the reception of a new telescope, for which government last year gave a grant of £2,300. To Mr. Howard Grubb, of Dublin, has been entrusted the construction of this instrument, which is to be a reflector upon Foucault's principle, of having the large mirror composed of glass faced with a thin deposit of silver. The mirror is to be 24 inches in diameter, with a focus of ten feet. This is a much shorter focus than it is customary to give to a mirror of such an aperture; but the height of the dome has been restricted owing to architectural considerations. The new instrument will, of course, be equatorially mounted, and will be largely employed for spectroscopy and photography. It is expected to be completed in December next.

Modelled on the same system as the British Association for the Promotion of Science, a similar association has been formed in France. The first meeting was held at Bordeaux during the past month, and the number of members was at that time 700—a much greater number than that with which the British Association commenced its meetings; for, when it started into existence, in 1831, it commenced with the more modest muster-roll of 370, although it has now swelled into some thousands, and can afford to spend £2,000 a year in the furtherance of science. The President of the French Association hopes that a similar degree of prosperity awaits the newly-formed body. The founders of this association say that one of the greatest intellectual wants of France is a decentralisation of science, and it is their desire to encourage, by every means in their power, the creation and development of scientific centres in all of the great towns in the provinces. This the French Association is calculated to do.

A considerable time has now elapsed since it was discovered that cupro-ammonium, or an ammoniacal solution of the oxide of copper, would dissolve cellulose, but no special use has been made of the discovery. This solvent completely dissolves the cellulose without destroying either its chemical or physical properties, so that it can be precipitated in a prime state from the solution. It is now proposed to make commercial use of this discovery, by acting upon woody fibre, vegetable tissue, old rags, and such-like substances, in such a way as to obtain a numerous class of articles from them. As the solution of cellulose is effected with great rapidity, paper may be rendered impermeable by immersing it for a very brief period of time in the cupro-ammonium solution, followed by rolling and drying. This renders paper impermeable even to boiling water. With a few strips of paper treated in this way, it is proposed to form substitutes for leather. To form the solvent, sulphate of copper may be dissolved in ammonia. It is of importance that the strength of the solvent be great, for when weak it does not attack the cellulose. Precipitation takes place when the solution is diluted with water.

A subject, possessing no small degree of interest, has been brought before the notice of the Physical Section of the British Association, by Mr. Gaffield, an American gentleman. Several years ago he observed that some kinds of window-glass, more especially the finer and more colourless kinds, became discoloured on exposure to strong sunlight. This led to a protracted and very complete course of experiments, extending over a period of nine years, and embracing eighty different kinds of glass, of English, American, French, Belgian, and German manufacture, of rough and polished plate, crown, and sheet window glass, of flint and crown optical glass, of coloured pot-metal, and of flashed and stained glass of various colours. The changes that were produced in some specimens, after only a few weeks of exposure to sunlight, were very remarkable, and were easily appreciable, from the fact of a portion of each piece of glass that was exposed being in part quite shielded from the light. The changes in the colourless glass were from white to yellow, from a greenish colour to a yellowish green, from brownish yellow to purple, from greenish white to bluish white, and from bluish white to a darker blue. By the colours of colourless glass was meant those faint tinges of colour that were seen by looking through the edges of the glass. They are not noticed in looking at the surface, unless when the glass is laid against a sheet of white paper, or other white material, to form a background. In his first experiments of a few months, Mr. Gaffield found only a slight change in a specimen of purple pot-metal. A subsequent experiment, continued for five years with red, yellow, blue, and purple glass, produced no change in any pot-metal except purple. A change was observed in the colourless body of some of the flashed and stained specimens; a yellow or purple tint was produced when the colourless body was uppermost, and also when the coloured surface met the sun's rays, and transmitted them at different degrees to the colourless body beneath. He had during the past year commenced an experiment with pot-metals, not of the primary colours, but of the intermediate ones, which most nearly approached those produced in colourless glass by sun-light exposure. A great change took place in the colour or shade in a short time; in some instances, a few days, by exposure in the month of June of the present year, sufficed to show the commencement of the sun's influence. Among the changes that took place, glass of an amber colour became of a rose tint. As glass of this latter kind was used in the painted glass windows of the past ages, this series of experiments may be considered as an important aid in solving the question of the alleged superiority of the old cathedral window glass, which it is not improbable has been much modified in respect of tint by the pencil of the sun acting on it for so many centuries. A curious fact was mentioned in connection with this discolouration of glass, namely, that no matter how deeply it became stained or discoloured by light, it can be restored to its original colour by being exposed to the heat of the glass-stainer's kiln for a short time. Concerning the cause of the change, it is well known that peroxide of manganese has long been used as an ingredient in glass-making, its presence having been necessary, on account of the facility with which it parted with oxygen, which consumed any impurities of an organic character, or any oxidised opaque metallic particles. There is another theory to account for the action of manganese in rendering glass colourless, which is this, that in almost all kinds of window-glass, as well as in some of the poorer qualities of flint-glass, materials are used which are not chemically pure; iron is generally present, the protoxide of which gives to the glass a green colour; and to correct this, after the batch is partially melted, a little oxide of manganese, or glass-makers' soap, as it is called, is put into the crucible. Some of the oxygen of the manganese flies off to the iron, and converts the protoxide into the peroxide of iron, which gives a yellowish colour to the glass, and this being complementary to the natural pink of the manganese, is neutralised, and the glass is thereby made of a light colour. When the sunlight acts upon glass thus made, the nice equilibrium between the oxygen of the iron and the manganese is disturbed, and sometimes the yellow, sometimes the pink or purple colour is produced. Concerning the recomposition by heat of the glass that has been decomposed by light, the violet colouration seems to be due to the fact that the peroxide gives up part of its oxygen to the protoxide of manganese. The re-heating of the glass thus altered produces an inverse reaction, which explains the decoloration.

At the fair of the American Institute last year, a machine for engraving glass was exhibited in practical operation by Mr. Tilghman, its inventor. It consisted of a stream of sand introduced into a rapid jet of steam or air, so as to acquire a high velocity, and when directed against glass, or any other hard and brittle substance, cut away the surface with great rapidity. If the glass be in part protected by any soft material, the sand has no action on such parts, and in consequence the new invention has been much used for engraving patterns upon glass or metal, the designs being painted or printed on the surface by a gelatinous or caoutchouc ink. During the brief period of its existence the invention has been applied to numerous purposes, but hitherto it has been found necessary to have mechanism of a more or less expensive nature to provide for a blast of sufficient power. A new discovery has, however, been made in connection with this invention, by which it will in future be reduced to a state of extreme simplicity. It consists in the substitution of the force of mere gravitation for that of steam or blast power. A box, or hopper, of suitable dimensions, is placed near the ceiling of the room, and from it depends a small tube of about eight feet long. No machinery whatever is used. The sand or emery-powder to be used for engraving is placed in the hopper, and regulated by a slide at the top; it falls down through the tube, under the end of which is held the glass, watch-case, cup, or other object to be engraved. In a few minutes the designs are cut with a great degree of exactness and beauty. Sufficient protection is afforded by designs of paper being pasted upon the surface to be engraved. The cutting powder is used over and over again, being transferred from the tray in which the work is placed to the hopper.

GENERAL NOTES.

Discovery of an Ancient Treatise on Illuminating.—A very interesting discovery has been made in the library of the National Museum at Naples, namely, "A Treatise on Miniature (Illuminated) Painting," which treats of the art generally, of the preparation of colours, the laying on of gold, and other technical matters. It is believed that this treatise, which dates from the fourth century, has never been printed, and is not to be found in any catalogue.

Great Schools of Paris.—The Municipality of Paris have for many years maintained three highly important schools, where a sound education, including commercial training, is to be obtained at a moderate cost; these are the Ecoles Turgot, Chaptal, and Colbert. Two of these have recently been rebuilt on a grand scale, so that they are able to receive a much larger number of scholars than formerly; nevertheless, the authorities have decided on increasing the number of these useful schools for the middle-classes, and a fourth is to be opened in a few days, under the well-chosen name of the Ecole Lavoisier. It may safely be said that the public school accommodation of Paris has within a few years been nearly if not quite doubled.

The Irrigation of the Casalese.—The surveys for the irrigation of the Casalese, or district of Casale, a plain of considerable extent on the right bank of the Po, are now nearly completed, and the Italian Irrigation Company, who have undertaken this work, intend to let at once a contract for the construction of part of the main canal, which is to be derived from the Po at a short distance above the town. A contract for making "prisme," as the blocks of artificial stone or concrete are termed, and which are used for protecting river works in the North of Italy, was let about two months ago. These "prisme" will be employed for protecting the embankments and dams at the headworks of the new canal. The fertilising properties of the waters of the Po will not fail to be appreciated shortly in this district, and following the example set by the land proprietors on the left bank of the river, the farmers of the Casalese will not be slow to avail themselves of the new canal. Abundant water-power in the neighbourhood of the town will also be furnished.

Sand Paper.—The *American Builder* gives the following method of making sand-paper of a superior quality, at almost a nominal cost. The device for making sand-paper is simple, and at hand to any one who has occasion to use the paper. A quantity of ordinary window glass is taken—that having a green colour is said to be the best—and pounded fine, after which it is poured through one or more sieves of different degrees of fineness, to secure the glass for coarse or fine paper. Then any tough paper is covered evenly with glue, having about one-third more water than is generally employed for wood-work. The glass is sifted upon the paper, allowed a day or two in which to become fixed in the glue, when the refuse glass is shaken off, and the paper is fit for use.

Common Schools of Paris.—The Municipal Council of Paris has decided on the formation of thirty-five new schools within the city boundaries; these schools are to provide for 22,300 children. The funds of the city will not allow of all the schools being commenced at once, but, during the interval, the existing schools are to receive an addition to the number of their pupils. The whole of the new schools are to be of one uniform type, settled by the municipal council, the greatest space possible being assigned to the school-room, and but little to vestibules, corridors, &c., while only the director or directress will have lodgings there. The buildings will be constructed of common stone, and all useless ornamentation will be excluded from the design. The foundations are to be of brick or unhewn stone; and, instead of plaster, which is declared to be damp and unhealthy, hydraulic lime is to be substituted. The system of heating and ventilation is being carefully studied, and it is likely that it may be made the subject of public competition. Finally, whenever the site will permit, a covered gymnasium is to be provided for the children. Each school is to comprise five classes, with the addition of a drawing school capable of accommodating all the pupils of the first and second classes. According to the estimates of the council, drawn from actual experience, the cost of each school, site, construction, fittings, and furniture all included, will amount to £20 per scholar.

The Trade of Mexico.—There are no complete or authentic statistics of the commerce of the country, the Mexican Government never having made a systematic and thorough collection of data. Owing to the unsettled condition of the country, however, it is believed that its entire foreign commerce has not within the present century exceeded 40,000,000 dols. per annum, including imports and exports. Of this the United States gets about one-fourth our imports, these being double the exports, and including cochineal dyewoods, gold, silver, gypsum, horsehair, argols, corn, wheat, flour, coffee, cocoa, copper, chemicals, fruits, hides, lead, oil, salt, wine, and wool. The export of the precious metals from that country average 9,000,000 dols. to 10,000,000 dols., nearly all of it going to England. Great Britain has long monopolised about one-third of the trade of Mexico, being able to supply the manufactured articles wanted there cheaper than any other country; her shipment to Mexico of cotton goods alone amount to 10,000,000 dols. per annum. It is hoped that when American enterprise shall construct railroads and canals to transport its commodities, the present figures may be very considerably increased. Agricultural products—now about 250,000,000 dols. yearly—must be quadrupled, for the soil is of unsurpassed fertility, and there is no plant that will not flourish in Mexico. The silver mines now yield only 12,000,000 dols. per annum, but may easily be made to produce a hundred million. The people of the south look forward to the time when they shall be instrumental in developing the immense resources of Mexico, and hope to share largely in the great traffic that will come from them.

Waterproof Glue.—The liability of glued articles to come to pieces when exposed to the action of water, especially hot water, is familiar to every one. By adding to the water with which the glue is mixed when required for use a small quantity of bichromate of potash, and afterwards exposing the part to which it is applied to light, the glue is rendered insoluble, and articles fastened with it resist the action of water. The proportion of bichromate of potash to be taken must be determined by experiment, but for most purposes one-fiftieth of the amount of glue employed will be sufficient.

The Growth of Berlin.—A French journal, the *Français*, draws attention to the wonderful growth of Berlin during the last two centuries, and declares it to be the most important city in all Germany, which is beyond question. The augmentation of its population, says the writer, corresponds with each of the steps which the house of Hohenzollern has made towards the domination of Germany. In 1640, when the Grand Elector arrived, it contained only 12,000 souls; in 1786, at the death of Frederick the Great, there were 145,000 inhabitants; in spite of the sufferings inflicted upon Germany by the Emperor Napoleon, it had increased to 175,000 in 1815; by the year 1860 the number had grown to half a million. Since the battle of Sadowa, and the events which have made Berlin the capital of the empire, the growth has been prodigious; the population of Berlin is now said to be considerably greater than that of Vienna, which numbers 800,000, and the last calculations make it approach one million.

Utilisation of the Water-Power of the Rhone.—A highly important work is just completed at Bellegarde, for turning to practical advantage the famous fall of the Rhone. This impetuous river, after issuing from the Lake of Geneva, falls into a deep chasm, which it has cut for itself through masses of calcareous rock, eating away below, and leaving the upper portions overhanging like gigantic ruins. After passing, by impetuous bounds, for some distance between these walls of stone, the river falls suddenly into a huge fathomless gulf. An American conceived the idea of turning the force of this mass of water to account, and creating a power for a number of industrial operations. England and Switzerland found the necessary capital, seven millions of francs, and the work is approaching completion. The fall takes place at about five hundred yards from the junction of the Rhone with a little stream called the Valserine. About a hundred yards above the fall, is a dam and a basin, by means of which the water is diverted into a tunnel, six hundred metres long, ten metres wide, and twenty metres high, and which opens into the ravine of the Valserine. At this point a large building is erected to receive turbines, which are calculated to give a force equal to three thousand (steam) horse-power. The subterraneous aqueduct is continued seven hundred metres beyond this first point of operation, and conveys the water to another set of turbines, of five thousand nominal horse-power. The total force of the water diverted is said to be equal to twelve thousand horse-power, so that four thousand remain for future application. The motive power is obtained and brought into subjection, and will soon be applied to various industrial purposes. On the summit of the rock which dominates the turbine-house is erected a massive construction, in the form of a truncated pyramid, in which to receive a quadruple system of large pullies, on which will run steel wire ropes with hempen cores, to give motion to a similar system of driving pulleys in another station, about a hundred metres distant; these stations will be repeated at like intervals, with arrangements to the extent of the power, thus forming a long current of motive force for the use of a number of factories and workshops which are growing up around Bellegarde. An inaugural ceremony took place the other day, under the presidency of the Prefect of the Ain, when several deputies and a large number of notables were present. The company explored the tunnel, laid the usual monumental stone, and finished the inauguration with a grand banquet and speeches. At this moment, when coals are so scarce and dear, and especially with a view to the future, every effort to turn to use the grand forces of nature is of interest; and this bold undertaking of getting twelve thousand horse-power out of the waters of the Rhone will certainly rank high amongst the engineering achievements of the age.

Refrigerator Cars.—The perishable products of the western prairies of America are now conveyed to Eastern markets in "refrigerator cars," a device which must have an effect on the value of western lands something akin to that of steam itself. The cars are owned by the various roads over which they run, and of course move rapidly and make close connections, and their success is such that the companies guarantee the delivery of the articles in as good condition as when received. They are built double all round, with inside double doors, filled in with charcoal, and have a capacity for holding two tons of ice. They are also arranged so as to be furnished constantly with a current of cool, dry air. At the principal stations they are carefully examined, and ice added whenever it is deemed necessary.

Suez Canal Company.—Although it is said that the Sultan, or the Khedive, has sanctioned the alteration of the system adopted by the company of the isthmus, the matter is not yet settled; the Messageries Company is determined to try the legality of the act, and has brought an action against the Suez Company, and the decision has been left to the Paris Tribunal of Commerce. It would almost appear that the opinion of the money market is against the Canal Company, for the shares fell suddenly last week 32frs. 50c., without any known reason, and have since fallen 5frs. lower. The number of commercial steamers which have passed the canal, bound for the port of Bengal alone, is stated to have been 116, carrying out 76,000 tons of cargo, and bringing home 70,000 tons. These totals do not include the boats and cargoes of the Peninsular and Oriental Company.

Cuba.—A letter in the *Daily News*, speaking of Cuba, says:—"The marvellous fertility of Cuba, even on her mountains, keeps in store for the struggling patriots other vegetables which they have found to grow wild there, in the shape of farinaceous roots, to which they have recourse whenever cultivated vegetables become scarce with them. They also devour the jutia, or Indian rat, which, being twice as large, and almost as good food as the hare, and very abundant throughout the mountains, has taken the place of beef and pork, cattle and swine in Eastern Cuba having been partly slaughtered and partly driven away since the war broke out. Their substitute for lard is cocoanut oil, there being within easy reach thousands upon thousands of cocoanut trees, from which the ripe fruit drops abundantly. It can be gathered by tens of thousands, not only for oil, but also for milk, which is manufactured from the snow-white meat of the generous fruit, as another substitute for cow's milk. Of the last substitute I may say that, whilst at the head-quarters of General Perez, I drank several times milk mixed with coffee, and found it as palatable as cow's milk. The patriots being in one of the best coffee-growing regions in the world, that article, together with other family groceries, reaches them occasionally from the neighbouring plantations, and even from Spanish camps themselves. But generally they have to manufacture their own sugar from the cane which they get from abandoned sugar estates. From the leaves of the yarey tree, and inner fibres of the majagua tree bark, they make cloth for their own dress, which wears well, as the majagua fibres are comparatively tough, and from the jutia's hide, tanned by them, they make shoes, which also wear tolerably well."

Journal of the Society of Arts.

No. 1,039. Vol. XX.

FRIDAY, OCTOBER 18, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

EXAMINATIONS, 1873.

In accordance with the Report of a Committee appointed to consider the propriety of rescinding the resolution for discontinuing the Examinations, the Council have decided to continue them in the following subjects, for the year 1873:—

Arithmetic.
Book-keeping.
Floriculture.
Fruit and Vegetable Culture.
Logic.
Political Economy.
English History.
English Language.
French, including Commercial French.
German, including Commercial German.
Italian.
Spanish.
Theory of Music.

It will be seen that several of the subjects in which Examinations were held this year have been omitted, and that French and Commercial French have been combined, as well as German and Commercial German.

The object with which these Examinations were instituted was to give a stimulus to the acquirement of certain branches of knowledge by adults of the working and middle classes, but some of the above subjects are now, or shortly will be, under the recent Education Act, so generally taught that this stimulus will no longer be necessary, and the Council have only retained them in deference to the strong wish of several of the Institutions. These remarks specially apply to Arithmetic, and it appears that about one-fifth of the Candidates who obtained Society of Arts' Certificates this year in that subject also passed in Elementary Mathematics under the Science and Art Department.

The Programme will be issued as soon as possible. With the exception of the omission of the subjects already referred to, it will not differ materially from that for the examinations of 1872.

The Papers for the Elementary Examination will be supplied as usual.

Secretaries of Institutions and Local Boards are requested to make this decision public as soon as possible.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

INTERNATIONAL EXHIBITION, 1872

The Council, having been informed that Her Majesty's Commissioners do not intend to publish reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such reports, for publication in the Society's *Journal.* The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following is the fourth of the series. The others will appear from time to time.

PAPER, PRINTING, AND COTTON MACHINERY IN THE INTERNATIONAL EXHIBITION.

The report embraces, under the head of—

		Cotton Machinery.			
36	articles	from India,	contributed by	2	exhibitors.
48	„	the United Kingdom	„	18	„
		Paper Machinery.			
33	„	the United Kingdom	„	20	„
		Printing Machinery.			
29	„	letter press „	„	22	„
11	„	lithographic „	„	8	„
3	„	copperplate „	„	3	„
69	„	apparatus used in printing, such as type, rolls, cases, &c.	„	27	„

Cotton Machinery.

There are thirty-six examples of the primitive machines used in India for the cleaning and preparation of cotton. Clumsy, uncouth, rough—very roughly made, to the majority of those who pass by they perhaps seem to be laid aside for fire-wood. There are, however, triumphs of mechanical contrivances in them which well repay one who, looking to the times when they were produced, can bring himself to appreciate the patient originating skill to which they owe their formation. Of these thirty-six examples fifteen are "churkas," gins, or machines for separating cotton from its seeds. They are the handicraft work of rustic Indians, and consist generally of very small rollers. As toothed wheels were there unknown, these rollers are in contact with each other, the driving-power being transmitted from one to the other by means of right and left handed screws, working as though they were toothed wheels. The smallness of one of the two rollers (it is less than half an inch in diameter) is characteristic, the object being that thus the cotton may be drawn in and yet the seed excluded.

So long as men are to be found who can admire what is old, so long will these primitive churkas claim regard. The extension of manufactures, and consequent increasing demand for raw material, has rendered the ancient churka an antiquarian curiosity. In recent years, honours and rewards have been offered for machine-driven churkas, under the name of "cotton gins;" three such are in the Exhibition. As a competition in the relative rapidities and cleaning powers of machine gins has recently taken place in Manchester, and doubtless a report will ere long be forthcoming touching the quality of the result, the rate of ginning, and the power required to drive each gin, a description of the mechanical arrangements of those in the Exhibition is all that is needed here.

For the "Chaufourier" gin, the English agents are Messrs. Edward Caspar and Co., 40, Finsbury-circus, E.C. This gin has been derived from the original churka. It consists of two metal rolls, so small and close that whilst the cotton fibre may be drawn in, the seeds cannot. These are driven in contrary directions at a high velocity, and, to obviate the consequences of frictional heating, a fan-blast of air plays upon them. The seed-cotton is supplied along an endless web of leather, having on its surface many projecting metal points, for the purpose of drawing the cotton along. To partially open the cotton, it is struck in its travel by an oscillating comb, and so the fibres are raised for the small rolls to seize. The cotton is thus drawn from the seeds, which fall into a wire-shoot on one side, and the ginned cotton is collected on the other. The distance between the wires of the shoot are adjusted to the average size of cotton seed, so that cleansed seeds only fall through, those with cotton remaining on them being returned for a second ginning.

No. 5,642 is a knife roller cotton gin, made by Messrs. Dobson and Barlow, of Bolton. It consists of a long cased-in roller, with raised featherings. These featherings are of a cusped form, the lines of cusps being parallel to the axis of the roller. This roller rotates rapidly. The cotton-covered seeds, spread upon a table and thence supplied, are thrown from side to side, and ultimately a leather-covered roller, pressed by a blade of steel used as the blades generally called "doctors" are used, and rotating parallel to the former one, lays hold upon the fibre, and the seeds are so cleansed that they fall through perforations, of a suitable size, in a zinc plate, curved to the roller, the cotton being deposited on another side. This machine is certainly a very voracious one—its wide capacious mouth seems ever open to receive more; and if, in the opinion of competent judges, quantity is a test of merit, few are likely to equal, and fewer still to surpass it.

No. 5,639, an improved cotton-gin, made by Messrs. Platt, Brothers, and Co., of Oldham, consists of an oscillating frame, having at the extremities of the oscillating sides, and parallel to its axis, a piece shaped not unlike the end of one of the jaws of a pair of wire nippers. This nipping edge oscillates past a fixed edge, and between these surfaces the cotton fibre, with its attached seed, is held as in a vice, but not cut. The advance of the moving edge tears off the seed, which falls upon wire fingers, and if it cannot escape between these, it is by an oscillatory motion returned to the nipping jaws, which are supposed to lay hold of the cotton so long as any adheres to the seed. There are means of adjustment amongst the wire fingers, some of which are fixed and some movable. This adjustment is for the purpose of arranging the size of the opening through which the seeds may escape; it is of course determined by the character of the cotton being "ginned."

There are examples of machines for other processes of preparing this cotton fibre made by Messrs. Dobson and and Barlow, who exhibit the gin previously described.

The carding engine (No. 5,643) made by this firm has a special attraction for visitors, because the covers of the large card cylinder, which consists of 18 slips of wood, called "flats," of 3ft. 6in. in length, and 2in. breadth, with card or wire brushes attached to the under sides, are seen, one at a time, at intervals of two or three minutes, to rise up silently, without apparent cause or means; then a long brush, as silently, passes underneath and clears off the refuse cotton. The flat desends to its place, and the quietude of the surface is resumed until another, with ghost-like solemnity, rises up, to be silently brushed and then laid down again.

No. 5,647 is a cotton spinning "mule," so called because it was the result of combining two operations in one machine. The one in the exhibition was made by Messrs. Dobson and Barlow, of Bolton. Few of the machines employed in the cotton manufacture have retained so much of original form and mode of operation, and yet undergone so many and varied internal changes, as the "mule." In addition to these improvements, which have stood the test of long experience, this mule embraces an improvement in the construction of the "copping" rail; and, owing to the mode in which the prime mover transmits motion to the machinery, the man in charge can stop the carriages at any part of their return travel. These and other details in respect to the machine are of too technical a character for this report.

No. 5,641 is, in the catalogue, described as an "eight-head cotton-combing machine." These words do not convey to the uninitiated a clear description of the purpose to which the ingenious mechanical arrangements of the apparatus are applied. In no manufacture are there such accumulative mechanistic contrivances as in that relating to cotton. The mule (5,647) and the carding engine (5,643) to many persons are still novelties and wonders of ingenuity.

In this cotton combing machine, however, are embodied many of those arrangements which have rendered the mechanism to which they were first applied so extensively useful, and still give to the cotton machinery of England an unrivalled pre-eminence.

After cotton has been passed through five preliminary machines, called the "gin," the "opening machine," the "lap," the "breaker card," and the "Derby doubler," it might seem to be prepared for being formed into "yarn." Not so, however, for the finer class of goods. Although, to the eye, the cotton seems well prepared, yet, partly owing to the action of the gin, and partly that of the other machines, there are a number of short fibres mixed with the long ones. A moment's consideration shows that the strength of a thread or yarn depends upon the length of these fibres. In relation to them is the force of the proverb, "a rope of sand." Sand is fibreless, hence it cannot be formed into rope. Malleable iron is fibrous, hence a tenacity, as in a rope, which, owing to its granular character, cast-iron never attains. From such considerations as these it is requisite, if possible, to comb out all the short fibres. The machine No. 5,641 does this.

The last of the five machines previously named furnishes cotton in sheets or webs, eight inches broad. These sheets are rolled in long lengths on wooden rollers, which, when full, are of fourteen inches in diameter, and called "laps." Eight such laps are introduced to the apparatus. The following description applies to one, the remaining seven being identical:—

Each lap is laid between guides upon a pair of large fluted wooden rollers. The end of the long web is now introduced between a pair of small-diameter fluted steel rollers, which cause the cotton to be advanced. When thus advanced so far as may be requisite (and this is determined by the length of the staple or fibre of the cotton being operated upon) a comb-toothed nipper-bar falls upon the advanced cotton, holding it firmly upon a cushioned plate. Thus gripped, the ends project. Then, no less than seventeen combs, increasing in fineness or closeness, of small pin-like teeth, and fixed in succession on a roller, pass under the projecting ends, and draw out the short unheld fibres, leaving of course, neatly and evenly combed, all those fibres which the nipper-bar retains. Assume now that this operation takes place after a succession of previous ones. Then the previously finished or well and cleanly-combed cotton being held between small fluted rollers, is by a cam-action brought back so as to overlap the ends of these last combed fibres. The rotation of the previously-named rollers, which for a short period had been reversed, is now direct; the consequence being, that the newly-combed cotton is drawn between them, and so pulled through the fine comb at the end of the nipper-bar. It is thus incorporated into the dressed collection, and therefore advanced. After them follow new uncombed fibres, the continuity of the web is again broken, the combing repeated, and the interlacing re-established. About sixty times per minute this separating and re-uniting takes place, and when the cotton appears it is as a beautiful gossamer fabric, so delicate that a breath would destroy it. These gossamer fabrics are condensed by passing through a cone-shaped brass funnel, and on emerging from it they are called "slivers." Each is then bent lightly round a delicately-formed brass finger or hook. The very slight pressure on these hooks is sufficient to hold up what may be called the tails of them under the tables; hence a bar, connected with a catch holding the forked guide of the strap which gives motion to the machinery, can slide freely. If a sliver should break, and a hook's tail drop, the sliding bar is caught, a spring released, the strap thrown on the loose pulley, and the machine is stopped. Until such a casualty happens the aforesaid little brass fluted rollers reverse, and oscillate with almost imperceptible rapidity. The work they are doing is so non-apparent that imagination may hear them saying, in relation to the now cleaned and well-combed fibres—

> "We draw them all along, they flow
> To join the brimming river."

The spectators see the eight beautiful slivers oozing continually from their concealed fountains, and passing noiselessly along a smoothly-polished scooped-out sliver-bed; they there, joined in one, may complete the stanza for the crowd always watching this machine when at work, saying—

> "Men may come and men may go,
> But we flow on for ever."

At length they enter a wide-mouthed brass chasm, and whilst therein, lost to sight, are, by what workmen technically call drawing-rollers, extended to many times their original length. They are then passed between small, but heavy, calendering rolls, and so solidity or substance in thickness is given. After this, by the pressure of the advancing calendered sliver, and the resistance of a loaded lip upon the mouth, out of which the combined slivers are ejected, solidity or substance is given in length, and the eight gossamer fabrics leave the machine a narrow, crimped-up web of cotton, without twist, all the fibres thereof being in parallel lines, clean, well-dressed, and of that quality which permits them to be considered as the aristocracy of the cotton race. The seventeen combs were left charged with pieces of dirt and short fibre. Before they appear again in the presence of the to-be-combed cotton, a rapidly-revolving bristle-covered cylinder has brushed off all this; a stiff, wire-card covered roller cleans these bristles, and then a comb or "doffer" takes from this latter and deposits in a tin the short fibres, to which the not inappropriate name of "nihil" is given. There is nothing in the Exhibition which tells us whether this "nihil" ever appears in public under another title. It is cotton still; and perhaps more than a simple trace of its existence may be found in certain shirts, which have unexpectedly exhibited the marionette performance of separating into many parts, without the marionette skill of re-uniting to form a perfect whole.

There are two looms (Nos. 5,651 and 5,652) exhibited. No. 5,651 is a power-loom, with a "positive letting-off and compensating motion," made by Messrs. Davies and Yates, 35, Back George-street, Manchester. The objects contemplated by the makers are of so exclusively technical a nature as to be appreciated only by those practically engaged with looms. Briefly described, they are intended to retain on the threads of the warp the same tension from the commencement to the end of the woven web. This is accomplished by a spring and an arrangement of pressure bars. The threads of the warp are delivered off the beam on which they are by a special contrivance, and the "healds," intended for a very different purpose, are not required to draw forward these threads, as is the case in some looms.

The beam and shuttle driving arrangements only of No. 5,652 were at work, the shuttle being driven by a blast of air from two cylinders or pumps attached to the back of the beam. How far this blast of air, passing behind the shuttle in each of its flights between the threads of the warp, may affect the success of the scheme must be decided by experience. It is clear that some one anticipates advantages from it, for the inventor has thrown over it the protecting ægis of ten patents.

There is a simple, but ingenious spooling machine (No. 5,650), showing the process of winding by hand the thread on the small bobbins on which it is sold. It is accomplished by two small shafts, on one of which the bobbin is held by friction in the hole immediately beneath, and parallel to it is a second shaft, having on one half of its length a right-hand screw, and on the other half a left-hand screw. The person who sits at the machine can rapidly cause either screw to act, and so determine the backwards or forwards travel of the thread. The little bobbins are thus very easily and rapidly filled. Although the machine is specially a personal and not a power machine, and might easily be worked by the foot, as a sewing machine is worked, yet the one in the Exhibition has, on a lower shaft, a wheel which by a treadle arrangement is thrown into frictional rim-gearing with a similarly surfaced and shaped wheel, driven by a strap from the engine. The apparatus is, in all its parts, much more simple than that which a few years ago was used for forming the "Mogul" balls of cotton.

No. 5,653 is a very curious net-making machine. The artisan does most of the work, and the steam power simply draws the thread where, in an ordinary machine, it would be carried by a shuttle. It is in daily use and doing good work, nevertheless it may be regarded as an antiquarian curiosity from Scotland, and the more remarkable because surrounded with so much of modern machinery.

Printing Machinery.

In the East Machinery Annexe (No. 5,840) is the "Walter Printing Machine." This machine may be said to be a novelty in the printing of newspapers.

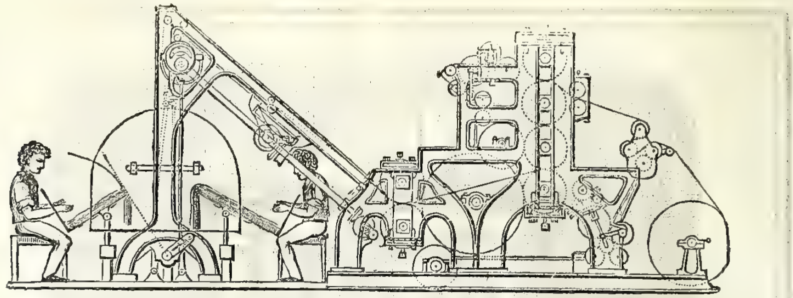
The kindness of the publisher of the *Scotsman* newspaper allows of the introduction of a woodcut, which conveys an idea of the general form of the machine.

The designers of it have determined to dispense with the boys or men who, with other machines having the same object, were employed in feeding in the blank sheets. This determination necessitated many changes throughout the entire construction; hence, in external form, it is not suggestive of a printing machine.

As the manufacture of paper had passed from the simple production of single sheets to the rolling on a cylinder of a continuous web of felted paper of good quality, there was, in this article, that which enabled the designers to meet their first want.

The paper, as now manufactured and supplied for the *Times* and *Mail*, consists of webs of the breadth of a double page of these publications. This continuous roll or web varies in length from three to five miles, and weighs from 600 to 1,000 lbs., and can be divided into from 4,000 to 6,000 sheets. With such a mass of raw material to operate upon, it is evident that the required machinery must be large and strong. The chief forms and arrangements have been apparently suggested by the machines for calico-printing so generally used in Lancashire.

The large roll previously spoken of is readily mounted



THE WALTER PRESS.

upon its machine axle, and by a light carriage transferred to the bearings prepared for it. Gripping or drawing-in rollers take hold of the end. It must be borne in mind that paper of this size and quality, when evenly pulled, can bear great tensile strain.

Amongst the scientific apparatus is the piece of a roll of paper, as used in this machine, sustaining a weight (evenly distributed) of five cwts., and reported to be able to carry nine cwts.

When the process of printing commences, the web is unrolled, and, passing with a high, but adjustable, tension, it is held in close contact with damp or moist covered pressure rollers. Thus prepared, it may be brought to the type. The type is arranged on cylinders in the machine as "stereo" plates. These are prepared thus:—The type-setting machine (No. 5841) having composed, say one sheet of the *Times*, a cast of this is taken in what may be called paper-pulp. This cast is rapidly dried. It is then placed on the surface of a concave mould, and the usual arrangements for casting being made, liquid "stereo" metal is poured in; the cast, quickly set and cooled, is taken out, and, by suitable arrangements, is adapted to the cylinders of the printing machine. From the completion of the type-set page to the production of the "stereo" and its being in use in the machine, a less interval than twenty minutes is sufficient.

Having passed the type and received an impression on both sides, the time has arrived when sheets must spring from the web. To separate, evenly and without visible irregularities, sometimes more than twelve thousand sheets from a web of paper travelling between rollers at the rate of nearly fifteen miles per hour, was a problem worthy of solution.

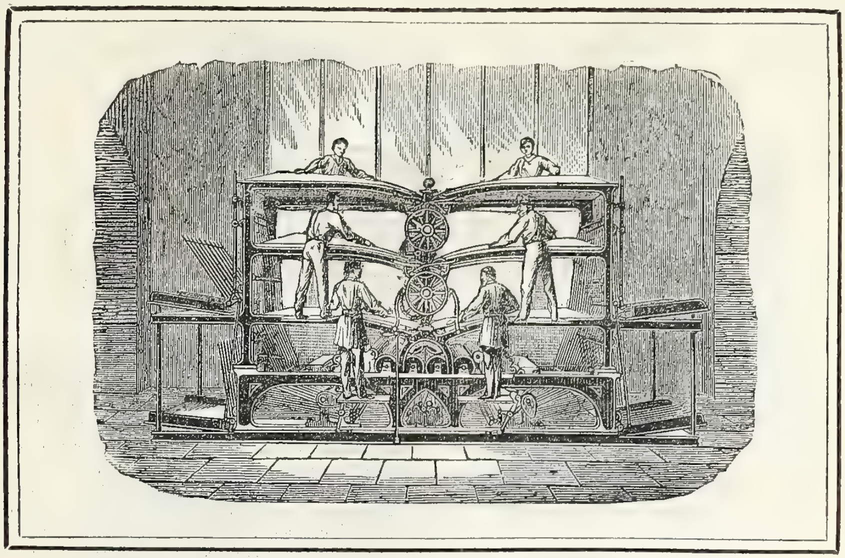
The designers of this machine accomplish the separation thus:—There are two blank cylinders, the circumferences of which are of a length of the open sheet of the *Times*, or of some integral sub-multiple of this length. Between these the printed web of paper is passed on its way from the printing cylinders to the tapes by which it is to be distributed ready for circulation. Assume that the circumferences are of the exact length. In one of these cylinders is a deep fluting parallel to the axis—this is a sheath into which the edge of what we must call a knife enters. In the other cylinder is a projecting knife (to be described hereafter), having on each side of its entire length a copper guard, formed like one-half of the letter T. This angle-guard is held in projection by springs. If pressure is exerted on these copper guards, they are depressed, and the knife exposed. When the pressure is removed the springs recover their position. Assume now that the guard is approaching the deep-fluted roller, it will be depressed, and between it and the upper roller will be momentarily held, not stationary, but in its travel, the web of paper. With a rapidity too great for the powers of vision the knife acts, the other side of the cut being held by the other spring.

The foregoing description assumes that the separation is complete. It is not so. The knife is not one continuous blade, but is formed of long angular projections; these perforate the paper much closer, but as cheques are sometimes separated from the counter-cheques, indeed, similar to the divisions in the postage stamps, but so that the pieces which hold the stamps in sheets are separated. Near each marginal end a narrow joining of the paper is actually left. These two joinings are utilised thus:—It is essential that the travel of the paper should always be with its marginal edge parallel to the medial line of the machine. When the cut has been effected, the paper is delivered from the machine to the carrying tapes. To secure the parallelism on its entrance into these tapes, the normal character of the paper is preserved by means of these narrow joinings, and therefore, as a web, it is advanced until the grip of the tapes between two rolls, travelling at a higher velocity than the web, is sufficient to draw the web forward, and so separate the end shreds by which the sheet still retains connection with the original roll of paper. Not only is the sheet thus completely separated, it is actually drawn in advance about two inches. The tapes carry on the sheets to an oscillating taped frame, which delivers them first on one side then on the other of long wooden fingers, which lay the sheets on the two tables prepared for them. Whilst the aforesaid blank two inches of tapes are passing, the oscillating frame moves from side to side of these fingers. If the machine were worked up to its full speed, more than three papers per second would be delivered on these tables.

The effect of the cutting arrangement, previously described, the form of the edge of the knife, and the position of the shred-holdings, may be traced by anyone who carefully examines either of the lower edges of the *Times* or *Mail*.

In Room 4 (No. 5,709), is a "rotatory six-feeder perfecting press," used for printing part of the fourth edition of the *Echo*. This machine was made by Messrs. Marinoni, of Paris. To Messrs. Cassell, Petter, and Galpin thanks are due for the loan of an electro which furnishes this illustration of the Marinoni press. The type on which Messrs. Marinoni have based their improvements, is that of the American machine called "Hoe's." This latter was first made in England, some years ago, at the works of Sir Joseph Whitworth, in Manchester. It was there the writer of this report saw it in operation, before its erection in Printing-house-square. To print both sides of the sheet required two machines. Mr. Marinoni has arranged that one machine shall do this; he has also increased the number of sheets that may be fed to the machine in a fixed time. It may be well to state that machines which thus print both sides by one continued operation are called "perfecting" machines.

Since the sheets of paper are passed over the type with a space of less than one inch between each, it is clear that many thousands may be thus printed per hour. Twenty thousand copies of the *Echo* can be printed per hour by the machine in the Exhibition. It should, however, be borne in mind that the *Echo* is a half-sheet newspaper, and printed in duplicate. The delivery of such a stream of paper on one table was a great difficulty, which has been overcome in this and the



MARINONI'S ROTATORY SIX-FEEDER PERFECTING PRESS.

"Walter" machine, by oscillating frames of tapes. There are slight differences in the application of this method in the two machines, but no remark upon these is needed here. The effect of the oscillating frames is to divide the stream of printed papers, and then, by the usual method of tapes and mechanically-moved "fingers" or "flyers," the papers are delivered upon different tables. In the Marinoni machine there are three sets of these oscillating taped frames. The first divides the stream of papers right and left, alternately; each of these streams is again divided, so that the printed matter is finally deposited on four tables. In the Marinoni machine paper of the size of the *Echo* is printed in double sheets, the division being accomplished by means of a rotating circular knife in the middle line of the machine. This knife cuts in the line of travel of the paper; that in the Walter press cuts tranversely to this line of travel.

If a suggestion to those who have so perfected newspaper printing as the designers of the Walter and Marinoni machines have done may be made, it would be that the former would perforate, much as postage stamps are, the line of fold (an adaptation of the present ingenious contrivance would do this); and, further, that by the delivery of the sheets to folding machines, the somewhat clumsy arrangement of "flyers" might be dispensed with. There seems no reason why the operation of printing should be attended with so much noise; careful formation of cams, true forms to teeth of wheels, and good workmanship, especially in joints, would materially reduce an element which often proclaims a tremulousness in the machine, and, as a consequence, a falling short of perfection in the work done by it, and a profitless waste of power.

That the inking arrangements are even yet imperfect, is deducible from the many and various panaceas which constitute variety, and, by those who adopt them, are called improvements; and that the inking problem is very difficult of solution, may be inferred from the somewhat inconvenient arrangements adopted in the Walter machine.

Nos. 5,841, 5,842 are respectively "composing and distributing machines," used in the *Times* printing office. In each there is provision for storage, in separate tubes, of 192 different types. In the composing machine these tubes are arranged vertically, much as organ pipes. Upon tiers of keys, similar to the keys of an organ, the fingers of an operator act. Each pressed key releases a type; such released types are directed by 192 channels or grooves, which converge as rays to the focus of a convex lens. When each letter is in its proper place, a simple treadle arrangement advances the line. It is curious to watch, through a sheet of plate glass, the types falling down their grooves, uncertain which may first reach its destination, and whether the result is not likely to prove an anagram, for an answer to which the prize-offering journals might safely promise a reward. This is averted by a careful consideration of the relative weights of the type. The heaviest types have the longest paths, and thus, although the keys are pressed in very rapid succession, yet the types reach a common destination in their appointed order.

No. 5,842 is a "distributing" machine. In principle it is the converse of 5,841. The type being advanced in line, an operator, by means of keys, opens certain directing switches, and these guide the types to tubes, in which they remain ready for the composing machine. These tubes, when filled, are placed vertically in a fixed frame, and can be taken down for use in the composing machine, as books are removed from shelves in a library.

There are five printing machines, Nos. 5,689, 5,692, 5,699, 5,711, and 5,715, to be used for book-work, which are so novel in all their features, and give such promise of rapid development and general utility, as threatens to send into—

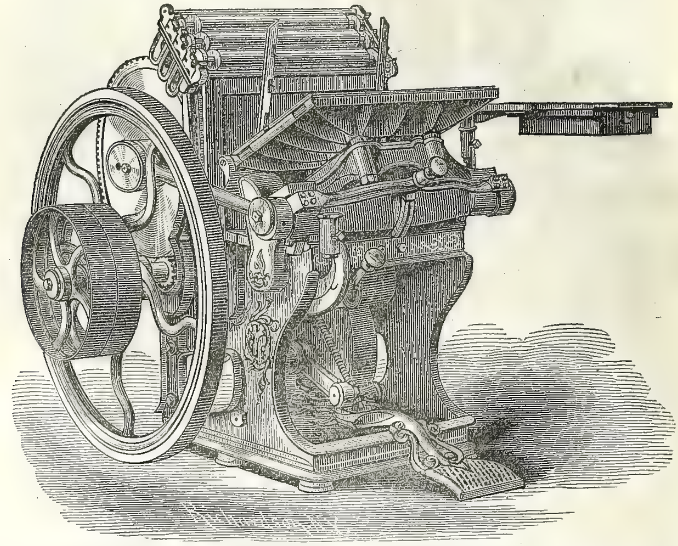
> ———— "a world far off,
> Into a Limbo large and broad,"

all other machines for quarto and even folio work. The original of these machines is American, and they were introduced into England, so far as can be ascertained, about three years ago.

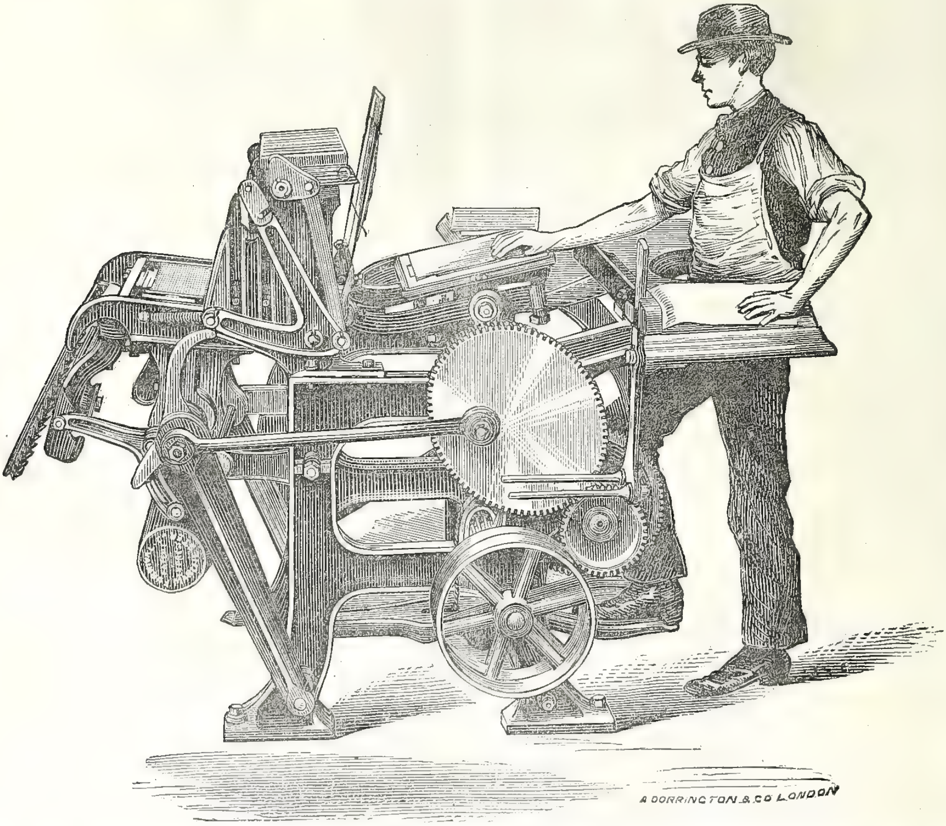
No. 5,692 is a recently-imported American-made machine, with such changes in its construction as previous experience in the land of its birth may have suggested. It can be worked with the foot by a treadle, and the ease with which this can be done is much the same as that of a turner using a light lathe. The person who treadles feeds the machine, and, where a self-acting delivery is not attached, he removes the printed sheet and can supply another during the inking motions.

The machines are compact, well-balanced, silent, and in all respects promise to be durable, and not easily put out of repair. It behoves those who are contemplating any change in their printing machinery to see the most recent improvements in this class. No verbal description, within a limited space, can do justice to the originality of form, or the mechanical ingenuity, which has very rapidly brought them to a high degree of commercial utility. How different they are from preceding machines may be inferred from the woodcuts which the respective makers and merchants whose names are attached have lent for the purpose of this report.

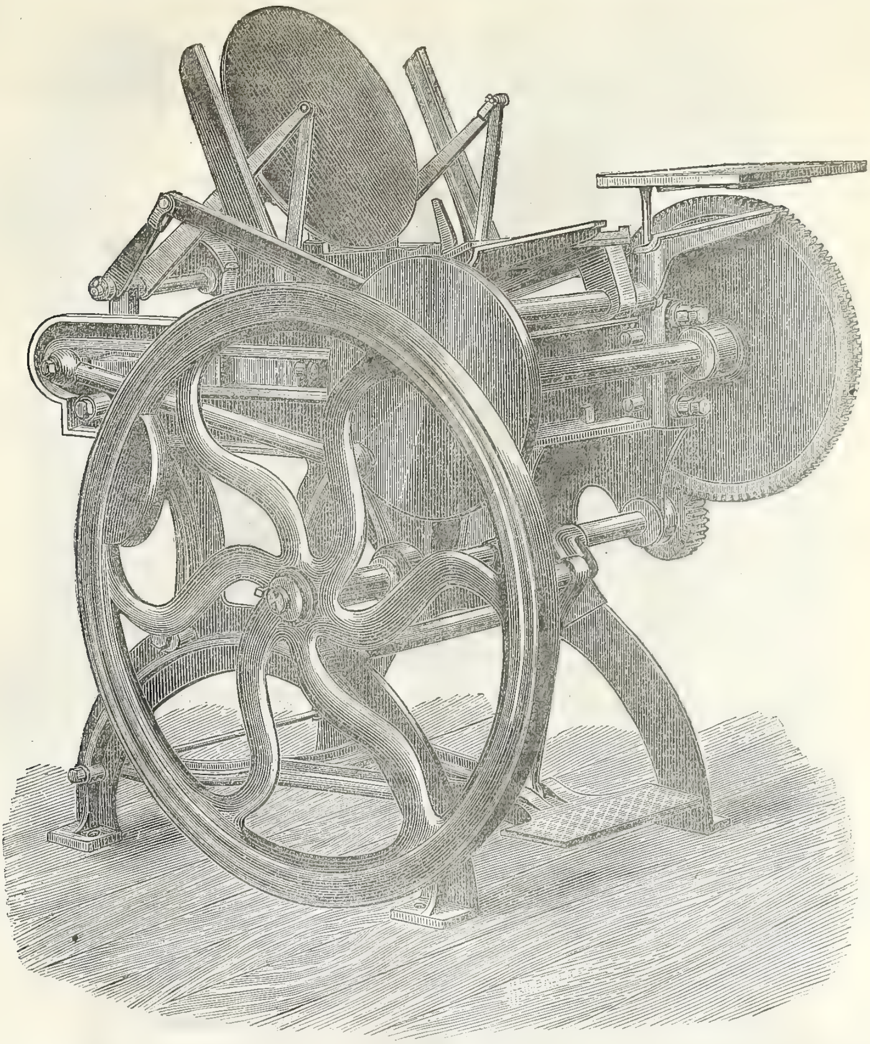
Whilst the general principle in all of them is the



No. 5,692.—For particulars, application should be made to Messrs. Coddington and Kingsley, 3, Bedford-place, London, W.C.



No. 5,699.—This machine is made by Messrs. Furnival and Co., 52, Ogden-street, Fairfield-street, Manchester.



No. 5,711.—The address for reference to this machine is, Mr. Samuel Cropper, 70, Cheapside, London, E.C.

same, viz., by a careful balancing of apparently irregular loads, an up-and-down treadle-motion may, without any jar or tremulousness, communicate a variety of movements to parts of a machine which subserve very different purposes, and yet must, as regards punctuality, promptitude in action, and efficiency, be really perfect; nevertheless, very great diversity exists in the application of this leading idea.

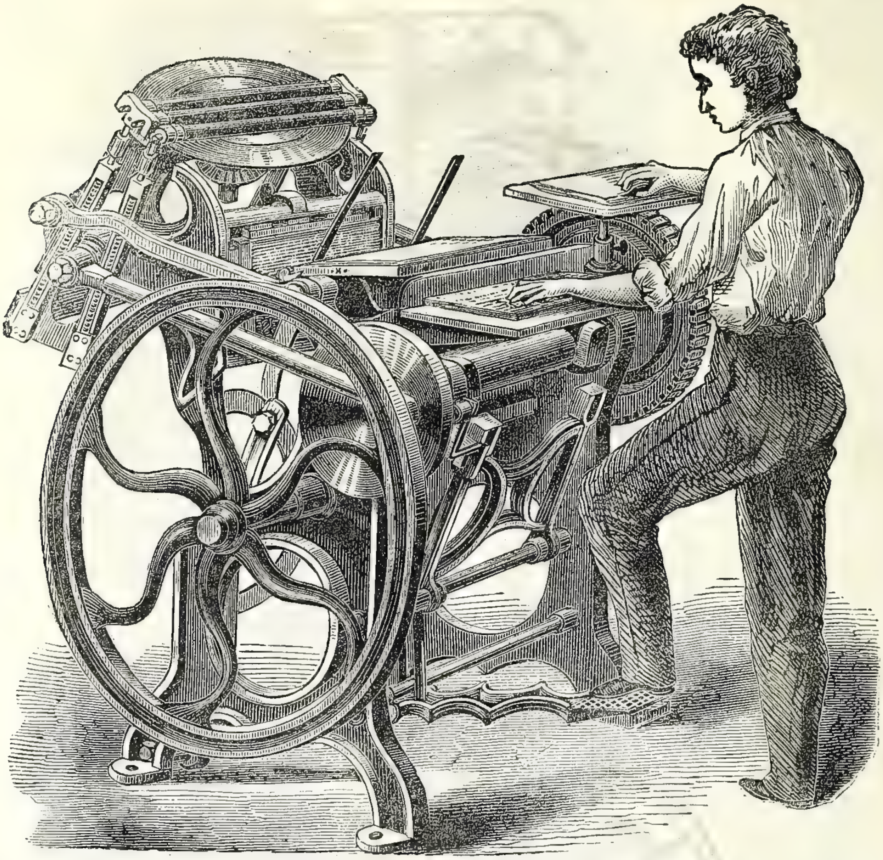
In some, the ink is upon a distributing-table; in others in a trough, with a "doctor"—a longitudinal traversing roller-motion being given by a screw returning into itself.

In another there is a "quick return" motion; here there is a circular distributing table for ink, and with what may be called a backward movement of a portion of its central area. In one, motions are communicated by links, in another, by cams. A comparison of the varieties which each maker adopts, and calls important improvements, must be left to the opinion of intending purchasers. This remark, however, may be made with reference to all of them—many of the parts seem needlessly heavy. Granting that rigidity is of primary importance, it should also be borne in mind that this can be secured by a judicious use of the principles which a knowledge of strain and thrusts, as employed in constructive mechanics, can produce, rather than in masses of cast-iron, where weight is sometimes mistaken for strength, and size is assumed to indicate enlarged utility.

There are other machines, which may be classed as of the ordinary form of power-printing machines. These are all of the same type. The paper is fed by hand, drawn into the machine by grippers, and passed round cylinders. The type is on a flat oscillating table, and having received the ink from the rollers, the impression is transferred to the paper on the cylinder.

Whilst to the eye there may seem little or nothing to distinguish one from the other of these machines, yet there are differences on which success in certain specialities in printing greatly depend. It is as difficult to discover as it is to describe some of these.

The "Bremner machine (5,720) has an automatic break-motion. This can be made self-acting, according to the nature of the printing. For example, if heavy work is being printed, then, as the cylinder of paper begins contact with the type, a cam action puts on the break, and so retards the speed, and therefore keeps in longer contact the type and the paper. An arrangement of cams, readily varied, enables the printer to adapt the



No. 5715.—The makers of this machine are Messrs. H. S. Cropper and Co., Hockley Mill, Nottingham.

duration of retardation to the size of the paper. This break-action can also be used to assist in stopping the motion of the heavy type and table before the direction of travel is reversed. The reversing of heavy masses required to be kept at a high velocity always produces objectionable strains. In the mule, in cotton spinning, the object is accomplished by a screw cam, or double fusee. In this machine the automatic break does the work.

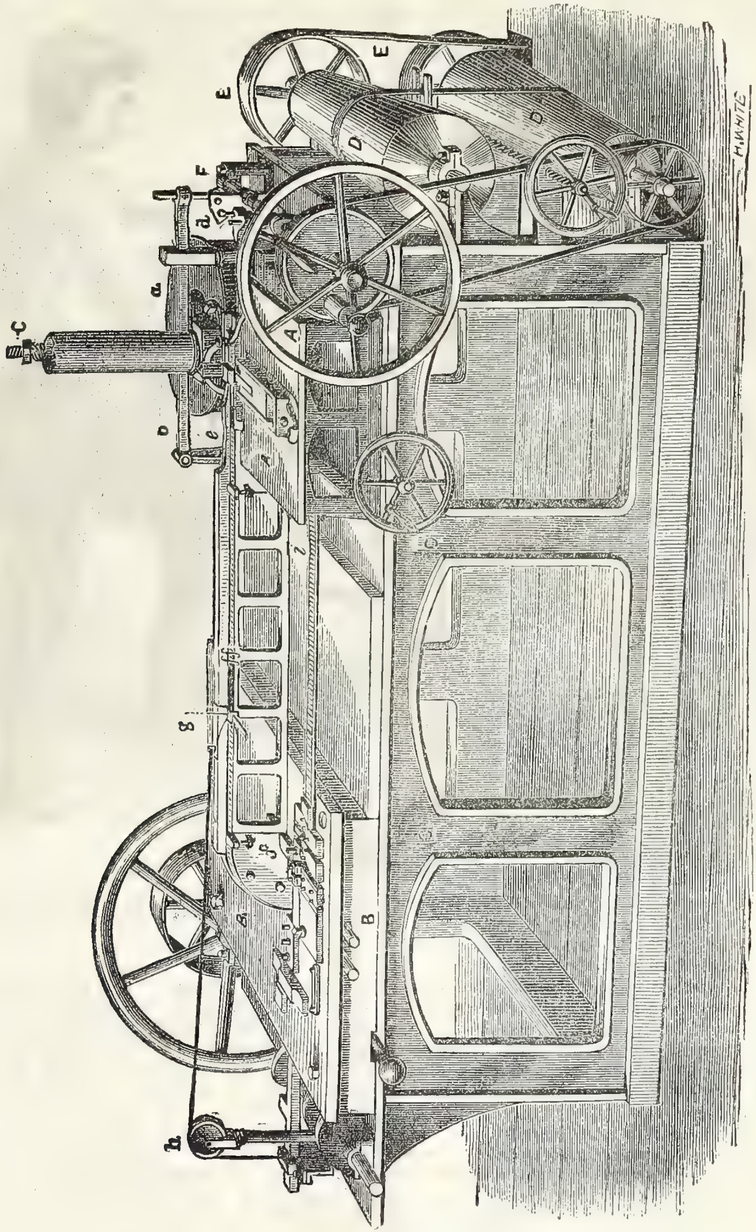
There is also a mechanical arrangement by which extra inking—say twice passing the type under the inking rollers for one impression on the paper—may be readily adjusted. The withdrawal of the register points and the alternate cessation of the action of the feed-board and grippers, the printing, in fact, only once, for two travels of the machine, is under ready control, and the cylinder being driven by a pall from the ratchet wheel, it can, at any stage of the operation, be brought to rest by pressure on a handle which releases the pall.

No. 5,724. To avoid the tendency to jarring consequent upon a wheel and rack motion, the type-bed of this machine is driven by what may be described as the thread of a screw upon a large cylinder returning into itself in one revolution of the thread. It has also an averagement for submitting the type to the operation of the inking rollers four times before their being passed under the paper. The action is smooth and silent.

No. 5,723 has an arrangement by which the grippers cannot be tampered with and reversed.

There are other printing machines, each of which has doubtless some peculiarity which can secure the commendation of the users. This report, however, can only refer inquirers to the prospectuses of the respective makers, whose addresses will be found in the index to the catalogue of the Industrial Department.

No. 5,789 is a machine for casting type, particulars of which may be had from the Manager of the Type Founding Company, 31, Red Lion-square. The letters on the illustration of it are referred to in the prospectus of the Company. This is certainly a most successful contrivance. The type metal, which is reported to be of a quality of more than ordinary durability, is melted by gas flames. By a cam action upon what may be called the handle of a force pump, the liquid metal can be forcibly ejected from an orifice about 1-16th of an inch in diameter. Opposite this orifice is an entrance into the metal mould for the type, which is cooled by an unseen stream of water. With great rapidity the mould is opened, the type advanced on a ledge, the mould closed, and a second action of the pump produces a second type. Thus, on a shelf in a lengthening row, the types are passed until they are brought through a number of little planing chambers. Here the sides are all planed, the ends are planed, the requisite grooves are introduced, and the finished type delivered, no hand touching them from the time the liquid metal enters the mould until they may be taken up and used by the printer. The casting and dressing can be accurately adjusted to each other, or either may be worked independently of the other. The machine is simple and sufficient, accurate and durable.



TYPE CASTING MACHINE.

Paper Machinery.

The manufacture of paper is now in a transitional state. Even for such small articles as envelopes, it is found most advantageous to form the paper from the rags into large rolls, similar to those described under No. 5,840 (the Walter press). By the aid of machinery like to that in the Exhibition, ordinary note paper results from the cutting up of webs whose length is measured in miles, and whose weight is recorded in hundredweights; the water-mark being introduced many times in the breadth of the roll, and ultimately appearing once on each sheet.

Nos. 5,828 and 5,829 are large models of the complete establishment for the manufacture of paper. The room required to carry out this work, the continuous attendance, and the non-stoppage of the machinery at stated brief intervals, effectually hinder the authorities from attempting the actual manufacture in an exhibition.

Nos. 5,830, 5,831 and 5,832 are portions of the apparatus by which water-marks and other specialities are introduced into the paper during the process of manufacture.

No. 5,695 includes a series of nine machines, illustrating on the large scale the complete process, from the web (or roll of paper) to the finished envelopes in packets. Although the separate machines may have been the production of different makers, yet the range now to be briefly described is exhibited and kept in operation by Messrs. Dickenson and Co., 65, Old Bailey, London.

The web, drawn along by suitable rollers, is cut into sheets. Economy of manufacture requires that the rate of advance of the web should admit of an easily adjustable and variable ratio with that of the cutting knife. Change wheels hardly comprehend the necessary delicacy of variety. It is, however, accomplished by the use of expanding pullies. On the shafts of the roll and the knife are two deeply flanged pullies. The rims of these pullies are formed in circular segments; the radial arms carrying these segments are each operated upon by a wedge attached to a collar which can be slid along the shaft. The advance of this collar advances the rim segments and so alters the diameter of the pulley. The nature of the case requires that these pullies should be connected by a broad and tight strap, and, therefore, the circumferential variations in them must be duly proportioned. This is accomplished by tooth wheels on the square threaded screws, by which the previously-named wedges are moved; these wheels are driven one from the other, by means of what may properly be named a flexible wheel having internal teeth; it is, in fact, a chain with peculiar links, each of which operates upon one tooth. Thus the circumferential proportions of the pullies are preserved, and the sheets can be cut exactly as required.

When out, the sheets are glazed by being passed between milling rolls. They are then heaped under a press to the thickness of an inch, and by means of a steel die, of the size and shape of the opened envelope, each descent of the press separates an envelope from every sheet of the heap. Minor operations, such as special embossing, black or blue bordering, &c., are next performed.

There are in the Exhibition other folding machines for envelopes besides the three in use by Messrs. Dickenson.

No. 5,694 is exhibited and used by Messrs. Goodall.

No. 5,700 is exhibited and used by Messrs. Fenner.

The machines of this class are all cam-machines, and exceedingly ingenious are the contrivances for the many minute requirements in envelope folding, for example, lifting them from the compressed heap in which the stamping machine produces them. In one machine this is done by exhausting the air from a contrivance which can be placed on the top of the envelopes—one sheet is thus taken and committed to the machine, and then another. The amount of gum to be placed upon the parts intended to adhere has evidently occasioned some perplexity. In one machine there is a deep trough of gum. Below the surface of the liquid is an edge of brass, similar in size and form to the portion of the envelope to be gummed. Immediately above the trough is a brass piece, which, if lowered, would touch the former. When the machine is in operation the piece rises out of the sea of gum, the other piece descends, they kiss each other, and the lower piece immediately retires, as though it were a mermaid unwilling to be seen. The upper piece, by a rapidity and peculiarity of movement indicative of cam-action, transfers its kiss to the envelope, and thus leaves behind a narrow light strip of gum, and immediately returns to repeat the operation. The envelope machine No. 5,694 is remarkable for its quiet, continuous action. Verbal description cannot do justice to machines of this class.

No. 5,790 is a book-folding machine, made by Messrs. Simon and Son, of Nottingham. No, 5,718 is a book-folding, and 5,844 a newspaper-folding machine. The two latter are made by Messrs. Harrild and Sons, of London.

Book-folding machines are supposed to do the work with greater precision than newspaper-folding machines, and certain mechanical arrangements of a precautionary character enter into them. For example, 5,718 has register pins, upon which the book sheet is so placed that the folding may be true to the margins. In 5,844 these register pins are not needed. Again, in a newspaper-folding machine it is sometimes requisite to fold a sheet within a sheet, at other times a half-sheet within a sheet; this is not required in a book-folding machine.

The machines Nos. 5,718 and 5,844 are tape machines, *i.e.*, the paper to be folded is brought over a narrow opening between two boards, a wooden or metal knife (not sharp) descends and presses the doubled paper into the opening. Sets of tapes, moving in opposite directions, carry the paper forward until it meets with an adjustable stop. A second knife, moving parallel to itself in a plane at right angles to the former, advances, causes a second crease and delivery to tapes. The paper is again stopped, and, if need be, another and another knife complete the work, and the folded sheet is laid on a self-adjusting table by fingers, as described in the Walter and Marinoni presses.

The machine No. 5,790 has no tape arrangements; the knife itself descends, carrying the folded sheet to an adjustable stop. The blade is rapidly withdrawn, the paper remaining held between strips of india-rubber; a second, third, and, if needed, a fourth knife, decreasing in length succeed, in appointed order. The last knife transfers the folded sheet to gripper and pressure rolls. These rolls perfect the work, and deliver the printed sheet in book-pages, without the assistance of fingers.

The mechanical arrangements of these machines consist of cams and links; the motions are silent and satisfactory; the work is well done; the power required but small; and the saving of labour very great.

However varied may have been advances in the application of steam-power and self-acting machinery to printing, there is good reason to anticipate a future of equally continuous and rapid development. For employers of machinery there seems no rest; the so-called "perfect" machine of to-day is next year regarded as an antiquity. The advance is chiefly in the self-acting and perfecting of the work, indeed, in rendering the employers of machines independent of strikes. There is no mechanical hindrance in the way of rags entering a machine in one room and being delivered as handsomely-bound printed books in another, no hand touching and no eye seeing the intermediate operations.

EXHIBITIONS.

Provincial Exhibitions in France.—The exhibition of Nevers, which is now open, contains more than six hundred works of art, a considerable portion of which are by artists well known at the Paris *salons*, and some by very eminent hands, including several female artists of distinction. The Society of the Friends of Art of Versailles announces the opening of its nineteenth exhibition of works of art for the tenth of November. The exhibition is to be held in the historical Salle du Jeu de Paume.

Exhibition of Coral.—The Jardin d'Acclimatation is about to add to its attractions what is called a park of red coral, or, in other words, a splendid collection of that beautiful natural production, brought from the Indian seas, by Captain Johnson, of the English Navy, and confided to the care of M. Milne Edwards, the celebrated naturalist. The collection is described as superb.

The Nuremberg Museum.—This museum, originally local, is now national, but it is little known abroad, so that an extract from an article in the *Gazette de Cologne* will not be uninteresting. The museum has recently made some important acquisitions, which have a special interest for artists and students of the history of printing. These consist in a series of engravings, on wood and metal, of the fourteenth and fifteenth centuries, which have been added to the famous collections of the works of Wohlgemüth and his contemporaries, and Albert Durer and his contemporaries, pupils, and followers, down to the seventeenth century. Another recently acquired collection illustrates the history of printing, and includes fine examples of block-cutting, and of the earliest printed books, a number of works by the most celebrated printers, whether native or German, settled in Italy during the fifteenth century. This collection includes many remarkable illustrated works of great rarity, some being unique. Another series consists of niellos and engravings in what is called the *criblée* style. The department of the museum devoted to the history of copperplate printing is highly important, and late acquisitions have filled up many blanks. The collection of MSS. has recently been enriched by the acquisition of a fragment of a Bible of the commencement of the sixth century, consisting of twenty-four leaves, which, being remarkable for the beauty of the writing, is placed at the head of the series illustrating the history of caligraphy.

CORRESPONDENCE.

THROUGH RAILWAY TO INDIA.

Sir,—I have read with great interest a paper by Mr. Hyde Clarke, on the "Through Route to India," in the *Journal of the Society of Arts.* Allow me to send you a few observations on the same subject. Notwithstanding the importance such a line would be to England, the necessary capital will not be raised there unless it can be proved in what way interest and funds can be paid.

The Ottoman government is doubtless greatly interested in having a line of railway from one end of Anatolia to another, but it is not in the power of that government to guarantee interest for the expense of making such a line, seeing that the exchequer is already overburdened with the interest on other railways, especially on the Roumelia line. I do not mean to say that the government will not in the end find money there, but many years will elapse before these railroads will yield, directly or even indirectly (by increasing the supply), sums large enough to cover the guaranteed interest, and till then the exchequer must pay.

The exchequer will do well if it discharges the payments with which it is burdened, in consequence of existing agreements. Other resources must therefore be proposed. Above all things, the expense of construction must be lessened. Actual traffic will doubtless increase, but not in the same proportion as elsewhere, because for years the only exports will be from agricultural products; besides, Greek, Armenian, and Yuruks have no taste for agriculture. Emigration and acquisition of land still present many difficulties. The system of taxes, and the manner of raising them, weigh too heavily on the labourer. There then only remains the Mussulman population, which has not increased for a good number of years, and which is also too conservative to adopt all at once agricultural improvements. The interest of capital, with current expenses, should not, from the beginning, exceed the revenue. Government feels the need of, and intends to make, routes, and has voted a certain sum for this purpose in the budget for public works. Turkey not having routes, in spite of great outlay of money, is not because she lacks the will, nor because economy is badly directed, but from an institution only to be found in Turkey. The carrying out of a law, or of an order, is not confided to an individual but to a council. The Grand Vizier, the Minister, the Governor-General, the Governor, the Under-Governor, the Mudir have each an executive authority. Notwithstanding, in the interior, the greater part of the members of the council (Mejliss) are not paid, every one is eager to belong to it, and it is they who prevent the construction of routes, so as not to bring the Stamboul population there, or other strangers, who would spoil their custom. And it is so easy to hinder the execution of an order; it is only necessary to make a simple request or give a report, even though a false one. No one is responsible for it; the majority of the council decides. Until this report has passed through a quantity of councils, an inquiry is ordered, the order arrives from Stamboul, is executed, and all is forgotten but the cost.

It is this institution which paralyses all progress in Turkey, and I could write volumes on the subject; but I am persuaded the government would willingly confide the construction of routes of communication directly to a *bonâ-fide* company, to avoid the Mejlisses having anything to do with it.

If the government grants the necessary land, a grant of £60,000 the kilometer, the permission of placing rails on this route and working it, then the company has only to give the difference between the grant and the actual cost, plus the sleepers, rails, rolling material, and buildings. The surplus of the grant might be fixed beforehand; a great portion of the sleepers could be cut in the course of the route; rails should be as light as possible; rolling material strong, simple, and inexpensive; and the buildings should be sheds and stores for merchandise. There would be the ordinary distance between the rails, in mountainous parts, or steep inclines must be used, and curves of small radius. In flat countries the earth-works would be made as far as possible without steep inclines and curves, so as to be able to use there, if length permitted, carriages of greater speed; and even in hilly parts inclines and curves might be adopted and fitted for greater speed, if such could be done without increasing the cost per kilometer, more than a certain part, to be fixed beforehand.

The bridges and works should be cheaply constructed of wood. If traffic raises the receipts above the required interest, this surplus, and even fresh capital, can be employed in changing temporary into permanent works. Houses and depôts, instead of sheds, can be built, iron bridges made, inclines could be lessened, or the line could be changed in such places where inclines and curves are too steep, and stronger rails and sleepers laid down. Thus, without risking a large capital from the first (30,000 fr. the kilo.), in time a good railway to India might be made.

There now only remains for me to make some observations upon the itinerary of Anatolia beyond the Black Sea, six ports with a certain exportation, that is to say, Ismid, the Gulf of Ghemlek, Panderma, Aivaly, with the coast opposite the Isle of Mitilene, Smyrna, and the Gulf of Alexandretta (Scanderoon).

Smyrna need not be considered in the project, as she already possesses two railways. But to reckon on all the sources which may feed the railway, and to make known the intentions of the Ottoman Government, it will be desirable to communicate with all these ports.

For the great Indian line, there is only the one proposed by Colonel O'Reilly remaining to join to the branches.

From Ismid to Eski-Shehr.—In the environs of Eski-Shehr towards Angora, and the junction of the route from Broussa and from the Gulf of Ghemlek.

From Eski-Shehr to Kutahieh and Afioom Karahissar.—At Afioom Karahissar, there will be a junction from Aivaly, which will join to Saura by the route of Aivaly, of Balykessar, Panderma, and Kirkaghatch, Smyrna.

From Soussourlou, on the route from Panderma to Balykessar, a branch line to Broussa will be made, as well as Smyrna, by Kirkaghatch, Soma, Balykessar, Soussourlou, Broussa, Moudanoh, thus arriving at Constantinople with only three hours' sea passage.

From Afioom Karahissar to Konieh, and from thence to the Gulf of Alexandretta, from there to Bagdad and Bussorah.

These are the lines which are necessary, and which would have a certain traffic, and which could pay in case of need. It will be desirable to join Yusgat, Sivas, Kaïserieh, Muracoh, Oorfa, Diarbekir, &c., which time and careful study will show.—I am, &c.,

F. Humann, Engineer.

Constantinople.

DANGEROUS TENDENCY OF EXHAUSTIVE VENTILATION IN COAL MINES.

Sir,—In our coal mines, the upcast shaft is as busy as it can be in virtually pumping out the air, and forming a vacuum—or partial one—in the passages of the mine below; and into these passages again all the surrounding gases, air, and fire-damp pour, until the equilibrium is again restored. True, a volume of external air may be passing in by means of the downcast shaft; but it must be borne in mind that it is the nearest which are sucked in first, and that it is not until all these inflammable gases have been exhausted from the seams of the coal around, that the air at greater distances is called upon to supply the deficiency.

Undoubtedly it must, in many cases, be, that had it not been for the partial vacuum created by the exhaustive influence of the upcast shaft, the fire-damp would never have been sucked in; and that, consequently, had it not been for the fire-damp the fearful explosion could never have occurred. Or, admit that the explosion might have occurred, then it may be considered as all the more certain that its disastrous effects would have been very much less had it not been for the exhaustive operations of the upcast shaft.

This, therefore, can hardly be gainsaid, that the tendency of the system of ventilation in operation in many of our coal mines is to occasion these fearful explosions of fire-damp where otherwise there might have been none; and, in other cases, to intensify to a very great extent the terrible results, in loss of life and property. Such a system may be dangerous in any coal mine, but in our fiery ones it should be positively prohibited.

That these results are not theoretical, is shown by both barometric and thermal observations on such occasions. If a barometer is connected with an air-pump, and the air exhausted, then, in exact proportion as a partial vacuum is formed, will the barometer fall. When the temperature of the atmosphere rises, the effects in a coal mine are, that the air, being more rarified, has a greater tendency to escape upwards out of the mine, and so to form a partial vacuum below. Of course, if this goes on, the colder and fiery gases of the mine rush in to supply their place. But, be these things as they may, attention is particularly requested to the following. It is perfectly independent testimony, having been stumbled on casually while turning over the leaves of a monthly:—"It is shown, as a rule, that the explosions take place after a fall in the barometer, or a rising in the thermometer. In either case the fire-damp pours into the mines in greater quantities than when the barometer is high, or thermometer low." (See *Chambers' Journal* for May, 1872, page 336.) This extract is short, but it is to the point.

There only remains to call attention to the masterly manner in which, in his last most able letter, your correspondent Mr. Reveley discusses the subject of downward ventilation.—I am, &c.,

H. F. Alexander.

Edinburgh, 8th October, 1872.

ARTIFICIAL FUEL.

Sir,—The valuable letter of Mr. W. G. Herdman, in your issue of the 20th September, on "Artificial Coal," induces me to offer also some humble suggestions on artificial fuel.

A few years ago, I made some experiments with the dead leaves of trees, about which I addressed a few lines to you, on the occasion of the discussion about fuel on Indian railways. My experiments, as those of an amateur, were but of a crude and superficial nature. The results, however, appeared to be:—

1. That if dead leaves are compressed by machinery, they make very good fuel.
2. That if dead leaves are steeped in any kind of oil or fatty substance, and are then compressed, they make better fuel still.
3. That various kinds of leaves yield bright gas, and also oil. For instance, oak, ivy, and holly leaves.
4. That many trees seem to produce every year as much weight in leaves as they increase in weight in solid wood; such are, apparently, the oak, the elm, and the horse-chestnut.
5. That sundry plants produce a large quantity of leaves of great heating power, with but little solid wood, for example, the ivy and the holly.
6. That it might be in our power to make both trees and plants yield more or less leaves by regulating their growth.

At the present time some thousands of tons of leaves fall in these isles, which are either trodden under foot or left to rot in the lanes, and ditches, and forests, not to mention the accumulation of leaves from former years. These leaves, with the present high price of coals, would form a very valuable addition to the sources of fuel.

Various objections might be raised against this scheme of utilising dead leaves for fuel, such as—Are they not not more valuable as manure for fields and trees? Is, or would ever, the quantity of leaves be large enough to make it worth while to embark in such an undertaking as manufacturing from them artificial fuel? Could this fuel be used for machinery or for households? Or, finally, would it pay?

With regard to the utility of leaves for manure on fields, it may be simply stated that they are but very little used; and with regard to trees they do not appear so necessary as is supposed, for do not plenty of trees thrive well in parks and gardens, and in country lanes and fields, without the manure of their own leaves, which are swept away?

As for the rest, it would be necessary that some scientific men should test, by experiment, the value of various leaves with regard to the amount of caloric which they are capable of yielding, the gas which they might produce, the oils which would be extracted from them, &c.

If these experiments should prove satisfactory, a system of plantation might be adopted with the numerous hedges of this country, so as to make them growers of fuel in the shape of leaves. The waste lands of this country would, perhaps, be utilised for this purpose, by planting upon them some suitable fuel plants. There are besides, of course, the forests of this country, and of the various colonies of the empire.

With regard to the latter, which still contain vast forests, it may be said that by using the leaves the trees would be saved, which must produce every year a larger quantity of leaves in proportion as the trees increase in size. The labour of collecting leaves being very light, the cheapest kind of workpeople could be employed, namely, women and children.

To a certain extent the experiment on the above suggestions has been tried in Paris. I sent over a short *mémoire* on the subject a few years ago, and in the *Pall Mall Gazette* of the 2nd November, 1871, it is stated that workmen were then set to collect fallen leaves in the parks and on the boulevards in Paris, for the purpose of compressing them, to make fuel, which was given to the poor.—I am, &c.,

L. Bing.

North-end, Bishop's Stortford, October 14th.

LIEBIG'S EXTRACT OF MEAT.

The following letter has been extracted from the *Times* of October 15th:—

Sir,—Having been absent from England, my attention has only just been called to a letter of Baron Von Liebig on my paper at the Brighton meeting of the British Association, and to your very valuable leading article on the subject of food, which were published by you on October the 1st; and, although late, I trust that you will allow me to offer a few remarks thereon.

The first half of his letter refers to subjects which were not discussed in that paper, such as "economy of nutrition," "the small morsel of meat," "fish," and "tea," to which he refers by quotations in inverted commas. I made no such remarks, as the abstract published by you on August the 20th shows, neither have the extracts been taken from any published works of mine, and, in fact, I have never written the remarks which he has quoted. This is most unaccountable, and I call upon the Baron to explain as to where he has obtained his quotations. Whether, therefore, such observations are right or wrong, they are misplaced, and I need not further refer to them.

The subject of Liebig's extract of meat is one with which the name and reputation of the Baron are intimately connected, and he is entitled to be heard with due respect. On this, however, strange as it may appear, there is no real difference between us, and, in fact, he has entirely corroborated the views which I expressed. I affirmed that, while it afforded scarcely any nutriment, it had some value in nutrition, and was justly comparable with a cup of good tea or coffee. Now, the Baron writes to you, "Neither tea nor extract of meat is nutriment in the ordinary sense;" while my remark was, "but they can only in a modified sense be called food." I did not affirm that tea and coffee had no beneficial action (neither, indeed, did I discuss their action at all); but any reader of my works on food knows that I have affirmed that they are nervous stimulants; and in the paper at Brighton I wrote, "Hence its (the extract of meat's) nutritive value is that which classes it with tea and coffee, and makes it a nervous stimulant."

The important part of the subject, however, is the composition of this substance, and the Baron nowhere ventures to contradict my statement. He adds some crude remarks about its mode of action, thus:—"The physician does not employ them as specific remedies. They serve the healthy man for the preservation of health. Taken in proper proportions, they strengthen the internal resistance of the body to the most various external injurious influences which combine to disturb the general vital processes, and they adjust these latter." Such general and hazy observations explain nothing, neither do they add to knowledge.

The public discussion in England on the value of Liebig's extract of meat has been very tardy, and later than in other countries. It is true that, a few years ago, the Food Committee of the Society of Arts took evidence which showed the very small nutritive value of the substance. Analyses published by Dr. Hassell and others confirmed this opinion, and scientific men now generally concur therein; but these views have not had that public expression which they deserve. In other parts of Europe there has not been the same apathy, and in Sweden particularly proper attention has been given to it. A remarkable passage of arms occurred in 1868 between Professor Almen (Professor of Medical Chemistry), of the University of Upsala, and Baron Liebig, in which the former maintained the views which I have expressed, while the Baron strove ineffectually to refute them. The discussion was considered by the Society of Naturalists at Stockholm, and the views of Professor Almen were adopted. Professor Meissner published a paper in 1868, having the same tendency. The Russian Minister of War appointed a committee of seven scientific men, under the presidency of Professor Ritter, to report upon the merits of the extract, and as they reported unfavourably, and in accordance with the views of Professor Almen, he declined to sanction its use.

These views were well expressed by Professor Almen in three papers, in the Transactions of the Medical Association of Upsala, "On the small nutritive value of Liebig's Extract of Meat, and of Bouillon;" but, as they were printed in the Swedish language, they have not been generally read.

Allow me to add, that the nutritive value of a food is essentially a scientific question, and one to be determined by the method which the Baron has so well enunciated in his long and distinguished career—viz., by its chemical constituents, and not by quoting general observations of its action when administered with other foods. *Ex nihilo nihil fit*, and if there be no nutritive material in Liebig's extract, it will not nourish the body. Let it be clearly understood that, at length, the Baron is in accord with other scientific men, and that all may adopt the words of Liebig—"Neither tea nor extract of meat is nutriment in the ordinary sense"—and all I have contended for is accomplished. Then we shall no longer have sick and dying men, women, and children fed with it, under the delusion that it is nutriment in the ordinary sense. Liebig's extract is meat flavour, a nervous stimulant, and has good qualities, but it is not food.

It is a mistake on the part of so great a man to unjustly depreciate the knowledge of others in controversy, as when he writes to you, "if he were possessed of even a faint notion of the science of chemistry;" but it has always been his manner in discussion, and, perhaps, injures others less than himself.

I am, &c.,
EDWARD SMITH, M.D., F.R.S.

140, Harley-street, W.

NOTES ON COMMERCE AND TRADE.

The fourth series of periodical wool sales at Liverpool commenced on the 24th September, and ended on the 5th inst. The imports of East India wools during the two months since the last sales comprised 9,908 bales; the quantity catalogued was 11,811 bales, of which 10,542 bales changed hands. The attendance of buyers was large, but a decline of 1d. to 2d. per lb. was experienced on the best and clean middle whites; grey wools were well sought after. The course of the domestic wool market during the interval which has elapsed since the close of the public sales in August has been marked by continued depressions, and sales have only been practicable at a serious decline on the opening prices of the season. Manufacturers still complain of the notoriously high price of domestic wool, compared with the remuneration they receive for their goods, and have abstained from purchasing until they can operate at a price to do some good. Lately, there has, however, been a better disposition to operate by both buyers and sellers, and a rather more hopeful tone is noticeable in some qualities. This, doubtless, has exercised a corresponding influence on foreign low wools; with large imports from the Mediterranean and South European ports, stocks have rapidly accumulated, and they have been extremely difficult of sale. Fine wools from the River Plate and west coast of South America afford, however, a striking contrast to the position occupied by carpet and combing descriptions, being in demand at better prices. English buyers have acted with extreme caution throughout. The bulk of the purchases, 9,000 bales, which have changed hands have been on foreign account. The demand for alpaca and mohair is still sluggish; 4,000 bales of the former and 1,500 bales of the latter have changed hands.

The fourth series of public sales of colonial wools in London have also just terminated, and prices have been fairly maintained. Some importers have great faith in the stability of the market for some few months to come. There has been a very full attendance from all departments of the home and foreign trade, all of whom, instigated by the very light stocks of wool available till the arrival of the ensuing clip, have operated with great animation. More than half the quantity sold has been taken for foreign account. Colonial advices give good hopes of the condition and weight of the coming clip from Victoria and New South Wales. The next London public sales will commence on the 21st November, and there will scarcely be 50,000 bales to offer. The imports of wool to date this year are about 591,000 bales against 693,201 total import last year.

An important law for regulating the trade in spirits in France was lately passed by the National Assembly, by which all the growers of wine who intend to convert it into brandy will be compelled to take out a license, and the wines distilled on the premises will be placed under the control of the excise, for pure wine spirit the excise will grant white permits, for wine spirit mixed with grain or beetroot spirit, blue permits, and for grain or all other spirits not made from wine, red permits. In addition to these precautions, to stop adulterations and misrepresentation on the part of the growers and distillers, any farmer distilling brandy, who may have purchased any other spirit, will have to make a declaration to this effect, when he removes his brandy from his cellars to the Cognac merchant's stores; and the merchant receiving such mixed spirit will have to make a similar declaration when making his shipments. If this law be strictly enforced on the distillers in the Cognac district, it will be of great service and protection to the respectable shipping houses, and will tend to materially diminish the quantity of mixed spirit that now comes forward under the name of pure Cognac brandy.

The uses of asbestos have hitherto been too limited to make it of much importance as an article of commerce, but this mineral appears calculated to play a very important part in several branches of practical mechanics and industrial manufactures. Hence the new information recently acquired relative to the nature and extent of asbestos deposits, more especially in the northern portion of the American continent, becomes of interest. Although hitherto in modern times asbestos has had but a comparatively limited use, it has been proposed to employ it for a variety of purposes—such, for example, as fire-resisting packing for the necks of revolving retorts, as a material for packing piston-rods, pump-rods, and valve-spindle stuffing boxes, for making inconsumable paper-roofing, &c. Some of the ancient nations were well-acquainted with certain of its remarkable properties, and are reported to have used it to a notable extent. What the earliest uses of asbestos may have been it is scarcely possible to be positive about at this remote age. The ancients were, however, acquainted with its fire-resisting properties, and spun it into yarn, which was woven into cloth; and those nations which burned the bodies of their dead are reported to have wrapped them in asbestos cloth, in order to keep the human ashes separate from those of the funeral pile. Accounts, too, have come down to us of asbestos cloth having been used for napkins and articles of dress, which, when soiled, were cleansed by subjecting them to the action of fire. It was also employed as a wick for the lamps kept burning in ancient temples, and is, indeed, used for that purpose now by the Greenlanders. Besides being one of the most refractory substances, asbestos is, probably, one of the most perfect non-conductors and insulating mediums known; but, like all non-conductors, if cold, it takes protracted exposure to heat to change its temperature; but once hot, it in like manner tenaciously retains heat. This fact prevents its being used successfully for fire-proof safes. When the metal and fire are together, as in the cupola, or blast-furnace, it would appear to constitute a most enduring and heat-confining lining, and particularly adapted for use where the metals or ores contain sulphides, as sulphides have no effect on asbestos, neither has any acid or combination of acids at present known. That the better qualities can be spun and woven is a well-known fact, as that has been accomplished in recent as well as ancient times, and cloth, closely resembling linen, produced, fully equal in strength and regularity of texture. In the matter of paper-making, sufficient experiments have demonstrated the fact that paper can be made of it of superior quality; but, owing to the extraordinary affinity of asbestos for water, experiments in this direction for the present are in abeyance. A limited liability company for the manufacture of asbestos has been in operation for some time at Glasgow. By far the most extensive deposits of this mineral, at present known, exist in the United States, Italy, and Corsica. Beyond central Vermont, on the eastern slope of the Green Mountains range, and in New York State, on the eastern slope of the Anderondacks, there occur some of the most remarkable and extensive formations of asbestos and amianthus at present discovered. The fibre is of extreme fineness and high tensile strength. An examination of the several varieties of asbestos appears to indicate a gradual increase in the tenacity of the fibre found in a direction proceeding from Georgia to Vermont, and this quality appears to culminate in that met with in Northern Vermont. The fibre in this locality varies in length from two to forty inches; and in colour, when taken near the surface, resembles that of unbleached flax; but, as the veins are worked into from the surface, it becomes of a pure white, endowed with great flexibility and tenacity.

The progress of the Argentine Republic in commerce is shown by the increase in its chief articles of export, wool and hides. In 1861, 39,000,000 lbs. of wool were shipped; in 1867, 131,500,000 lbs.; and in 1870, 175,000,000 lbs. In 1861, 1,156,551 hides were exported; in 1867, 2,231,728 hides; and in 1870, 2,800,000, without counting hides taken by weight.

A strange feature to notice in our foreign commerce is the large trade in artificial flowers, and yet their manufacture has made great and effective progress in this country within the last few years. An average annual sum of upwards of £300,000 is a large amount to pay for such a trifling article as foreign artificial flowers, chiefly used for the personal ornamentation of the fair sex. It is curious to trace the progress made in this article of luxury. In 1856 the value of the imports was rather under £100,000, and at this amount, with but slight fluctuation, it continued until 1866, when the value of the artificial flowers rose to £276,256; and in 1869 to £365,407.

An instance of the damaging effects of an absence of scientific and commercial knowledge in shipments was recently afforded by the receipt from the West Indies of some sixty or seventy tons of the small fruit of a palm (apparently *Acrocomia sclerocarpa*), supposed to be an oil-nut, and on which heavy advances were made; but when offered, through one of the leading firms of oil-brokers, not a bid could be obtained, as they are utterly unfit for the purpose supposed, being, in fact, a very tiny miniature cocoa-nut, scarcely larger than a cob-nut, with a very hard, black shell, and but little albumen. If larger, they would suit admirably for turners' purposes, since coquilla nuts, of any useful size, have now became scarce. Some hard seeds, such as those of the so-called candle-nut, the fruit of species of *Aleurites*, have a commercial value for the oil-presser, as there is a large oily kernel, which furnishes a good drying oil.

The last monthly returns from the Board of Trade, giving the figures of our commerce for the nine months of the year, are still marked by unexampled progress in all branches. The aggregate value of British produce and manufactures exported amounts to the large sum of £190,314,662. The value of the articles imported is given at £261,310,336. Looking at the imports of food articles, although there is a decline in the number of living animals received, the quantity of salt provisions imported shows that 1,532,224 cwts. of bacon has been imported, or more than double the amount received in the corresponding period last year. In beef salted, or slightly salted, there is a decrease of about 42,000 cwts.;

of hams, 126,000 cwts. were imported, against 38,632 cwts. in 1871. Of preserved meat 239,854 cwts. were imported, against 156,845 cwts. in 1871. The increase of eggs is enormous, 3,862,251 great hundreds, against 2,688,067 in the nine months last year. The supplies of foreign butter have been smaller by about 150,000 cwts., and in cheese there is a small decline of about 76,000 cwts. In the imports of lard, 550,182 cwts. were received, as compared with 359,558 in the nine months last year. The value of the poultry and game was about £25,000 more. The imports of potatoes was very large, 1,377,410 cwts., against 437,290 cwts. Rather less coffee was imported, but the home consumption continues steady at about the same figures as the last two years. The imports of sugar progresses, especially unrefined. The consumption continues to make rapid strides of more than 4,000,000 lbs. a year.

GENERAL NOTES.

The French Mails.—The contract of the Churchward Company having expired, the French mails between Calais and Dover are now being carried by three vessels of the French navy, the *Faon*, *Vigie*, and *Averne*. The Churchward Company's boats continue, however, to run as passenger boats, and the number of travellers is at present large. During the month of September, 20,515 persons passed between the two ports.

New Source of Meat Supply.—The public will learn with satisfaction that, viewing the importance of supplies of foreign meat being imported into this country without delay, the Food Preserving Company (Jones' Patent) have resolved on immmediately commencing operations on the River Plate. The manager is to leave London in October, and the necessary apparatus will be in working order in January, so that the first supplies of foreign meat, preserved in entire joints, may be expected to arrive in this country during March next; weekly shipments will then follow, equal in quality to fresh meat, and to be sold retail at fixed moderate prices.

Metrical Congress.—The conferences of the International Commission for considering the policy of the adoption of the metre as a general unit of measurement, commenced at the Conservatoire des Arts et Metiers, Paris, on the 23rd September, under the presidency of M. Teisserenc de Bort, Minister of Agriculture and Commerce. The number of representatives is considerable. France is represented by MM. Mathieu, General Morin, Le Verrier, Fizeau, Sainte Claire-Deville, Becquerel, Péligot, General Jarras, and Tresca; England by her Astronomer-Royal and Mr. Chisholm, conservator of standard weights and measures; Russia by MM. Jacobi, Struve, and Wilde; Germany by Dr. Forster, director of the Berlin Observatory, and General Boyer; Austria by Dr. Joseph Herr, Dr. Victor de Lang, Professor Krusper, and Professor Carlomar-Iziley; the Papal See by the learned Signor Secchi, director of the Roman Observatory; and eighteen other states are represented each by one or more eminent scientific men. Whatever may be the decision of the congress, it is admitted that the execution and maintenance of the standards of the metre and the gramme present practical difficulties of the most serious kind, only to be met by the establishment of means of verification which shall possess almost mathematical precision, for it is evident that the slightest departure might lead to serious errors, especially in the case of so low a value as the gramme. Since the above was written it has been announced that the congress has adopted unanimously the French metre as a universal standard, and that the decision has been announced to M. Thiers, who has communicated it, in his turn, to the members of the Conseil d'Etat.

Health of Europe.—The mortality accounts show a large increase in the number of deaths in Paris, the return for the week ending the 20th September giving 875 against 807 in the previous week. The comparative returns for the same week give the following results.—London, 19 deaths per thousand inhabitants; Turin, 22 per 1,000; Paris, 24 per 1,000; Brussels, 27 per 1,000; Vienna, 30 per 1,000; Berlin, 33 per 1,000; Florence, 34 per 1,000; and Rome, 42 per 1,000.

Address of the Prefect of Paris.—According to custom, at the opening of the new session of the General Council of the Seine, a memoir, drawn up by the Prefect, was placed in the hands of each member of the council. According to this document the claims of 22,500 sufferers from the siege have been partially met by sums paid on account, but the state of the finances and the demands of the budget, will not allow of a time being fixed for the complete satisfaction of the claims of the population. With respect to the proprietors and others who have suffered by the fact of the late insurrection, a bill has been presented to the National Assembly, which, if voted, will enable the council to reimburse the sufferers to a large extent, and also to resolve the question of the payment of twenty millions of francs in respect of damages caused by the entrance of the army into Paris in the month of May. The memoir states that, taking into account the damages done by the enemy and for the defence of the city, in the retaking of Paris by the French army, the disasters of the Commune, and the war contribution paid to Prussia, the losses inflicted on the city of Paris, without taking into account the destruction of the Hôtel de Ville and other municipal buildings, amounts to about five hundred millions of francs, or twenty millions sterling! A table annexed to the memoir shows the distribution of the indemnities between the various communes of the department, only two of which, Bagnolet and Saint-Maudé, escaped both German and French shells; the heaviest losses were those of Saint-Denis, 104,633 francs; Issy, 115,800 francs; and, Neuilly, 245,095 francs.

Population of Paris.—The *Journal* of the Statistical Society of Paris gives the results of the late census. The gross total for 1872 is given at 1,749,380, which shows a diminution of 5,600, as compared with that of 1866. It is a remarkable fact that, while, with the exception of one arrondissement in each case, there is a diminution in all the central quarters of the city, there is an augmentation in the working and outlying arrondissements. The most remarkable cases are the following:—The arrondissment of the Louvre shows a falling off to the extent of 10,600 odd; that of the Bourse, 8,800; the Pantheon, 8,300; the Luxembourg, 9,000; and the Palais Bourbon, 10,800. On the other hand, the arrondissements of Saint Laurent and Popincourt exhibit augmentations of 15,300 and 13,700 respectively; and each of the other outer districts, excepting only the Gobelins, an increase varying from 1,000 to 5,000. The gross result is, that the best parts of the city have lost 64,700 inhabitants, while the other portion has gained 59,100. The fact of the government and many of the officers being at Versailles will account, in some measure, for the diminution in the former case, while the flatness of trade and commerce, and the absence of the court, may account for the rest. As for the increase in the other parts of the town, no plausible explanation offers itself; certainly the excess of 13,000 and 15,000 in Saint Laurent and Popincourt is not to be accounted for by transmigration to cheaper neighbourhoods; it would be like the inhabitants of the West-end of London removing to Shoreditch and Spitalfields. The diminution in the arrondissements of the former Corps Legislatif and the Hotel de Ville is intelligible; but a similar falling off in the Luxembourg quarter, now the seat of the municipal government, is incomprehensible, or must be attributed to a falling off in the schools and university.

The Manufacturing Towns of France and the Tariffs.—The Lyons Chamber has sent a petition to the Minister of Commerce at Versailles, asking that the new tariffs may be discussed at a meeting of all the Chambers of Commerce in France invited to send representatives. In the petition it is stated that the fabrics of Lyons are articles of taste, and that if foreigners, in their discontent, should take to measures of reprisal, they would certainly commence with silks. It must not be forgotten that the industry of Lyons depends principally on exportation; nearly three-quarters of the produce of the factories there are sent abroad, and that on this account all the taxes voted since the war fall heavily upon Lyons, because she cannot demand of foreign buyers any part of such duties. Furthermore, the industry of Lyons is now pushed very hard by foreign rivalry. She has no longer the monopoly she enjoyed when rich stuffs were in fashion; and it is only by great efforts that she is able to maintain her position in foreign markets. It is, therefore, impossible not to fear that the alterations contained in the projected tariffs, and the Custom-house restrictions which are likely to result from them, will fall heavily upon Lyons, and that she first, and above all other districts, will have to defray the costs of the new *regime.* "How can we be without apprehension," ask the petitioners, "when the law on raw materials, not yet applied to silk, has already had the effect of stimulating the market of Milan to make it a rival of ours, and, moreover, of preventing the development of our direct importations of Asiatic silks, which had proved so important to our commerce and silk industry. The government has often stated in the National Assembly that, in proposing the regretable law on the import duties on raw materials, it only bowed to fiscal necessity, and was not animated by protectionist principles. We have not failed to take note of these declarations, and our confidence in the loyalty of the government is not shaken; we therefore trust that its actions will accord with its words. At the same time, without throwing any doubt over the wisdom of the Superior Council of Commerce, or the sentiments which animate it, or the guarantee which it offers to industry and commerce, it appears to us that those guarantees of competence and impartiality would be singularly strengthened, if the representatives of the Chambers of Commerce were allowed to give their advice, and to discuss the tariffs now in preparation." The concluding paragraph of this petition has great importance at the present moment. It runs as follows:—"In imploring the government not to desert the road opened by the commercial treaty of 1860, and those which have followed it, we beg of the minister that the chambers of commerce may be consulted upon the drafts of these new tariffs, &c." It is not yet known whether the government will accede to this urgent appeal of the Lyons chamber. The chambers of commerce of Bordeaux, Nantes, and many other large industrial and commercial towns, are following the example of that of Lyons in soliciting the government that the customs tariffs, which are about to be revised in consequence of the denunciation of the treaties of commerce, may not be submitted to the Assembly before the chambers of commerce have been consulted on the subject. Negotiations relative to the future tariffs had been opened between France and Switzerland, but they have been suspended till the inquiry set on foot by the Federal Council shall have terminated, which is not expected to be the case for some weeks. In the meantime, however, the duties on raw materials have been put in force; but as they only refer at present to articles of secondary importance, they have had little effect on trade, Moreover, in this partial application of the law, it has been interpreted in the most favourable manner for the Swiss. "It is certain," says the *Patrie,* "that the issue of the negotiations with England must materially influence the determination of other nations, and that the solution must everywhere depend on the conclusion of the Anglo-French Treaty.

Postal Cards.—It is said that the Berlin Post-office is about to carry the post-card system a step forward, that is to say, these cards are to be so arranged as to serve for the answer as well as for the original message. One side is to be arranged to receive the name and address of the person to whom the card is first sent at the top, and those of the sender below, so that in case of reply the latter serves for the address, while the other side will be divided into two portions—one for the original communication, the other for the reply. The double postage may be paid at once, or the person sending the reply may affix the second stamp. Certainly such an arrangement would almost insure an immediate answer to an inquiry, especially when the sender pays the return fee, for who could be so churlish or so careless as not to scribble a few words in the space provided, and re-post such card. It is a good sign that the French public is beginning to wake up to the short-comings of the French Post-office. The *Moniteur* says:—"The administration of the French post would do well to listen to the complaints of the public, and some of the ameliorations which have rendered the English and German post-office so prosperous and so convenient." If it be true, as stated, that the recent increase of the internal postal rates of the country has caused a serious deficit in the receipts, some ameliorations are not unlikely to be made. The present system is completely superannuated. There are three different rates of postage in operation. Within Paris the initial charge is three sous for a letter weighing less than half an ounce; within any other postal district in the country the charge is the same, but the weight is reduced to the third of an ounce; this initial weight also applies to letters passing from any one district to another, while the charge in this case is five sous; of course these complications give rise to errors without end.

Consequences of the Rise in English Coal.—An American paper writes as follows:—"The great rise in the price of the shipping coals of Great Britain in a single year, the current rates at the Bristol Channel ports being 33s., against 11s. a year ago, has not only put a stop to shipments, but turned the demand of some of the dependent countries, even British possessions, upon the United States. Coal is now being shipped to the West Indies and South America, which formerly drew their supplies from England, and there are orders here for tonnage to load at the provincial ports for the East Indies, and even to London; others have been taken up to load at Baltimore for Rio, and at Picton for the River Plate. The British and French West India coaling stations now draw their supplies from our own and provincial ports, and the export trade in coal is rapidly increasing. This is a very curious state of affairs. Cheap iron, coals, and labour have made England what she is; there is nothing of such prime importance to England as cheap coal. If she is deprived of this, she will lose the very prop to her manufacturing and commercial prosperity. The rise in coal means a rise in steam, and, therefore, in the price of all goods produced by its aid. It is the same with iron; that metal is necessary for all kinds of machinery; the price of it, therefore, is an essential element in the cost of machinery, and in the value of goods produced thereby; and as coal and machinery are equally useless without labour, a rise in it must necessitate a rise in produce. A general advance in the price of all English manufactured goods is therefore inevitable, if the advance in the price of coal be maintained; but 'it is an ill wind that blows nobody any good,' and England's loss will be others' gain. The enhanced value of British goods will offer a new opportunity to increase American manufactures. As soon as England ceases to be able to undersell her competitors, her hold on foreign markets, which is the basis of her commercial supremacy, will diminish."

Journal of the Society of Arts.

No. 1,040. Vol. XX.

FRIDAY, OCTOBER 25, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

EXAMINATIONS, 1873.

In accordance with the Report of a Committee appointed to consider the propriety of rescinding the resolution for discontinuing the Examinations, the Council have decided to continue them in the following subjects, for the year 1873:—

Arithmetic.
Book-keeping.
Floriculture.
Fruit and Vegetable Culture.
Logic.
Political Economy.
English History.
English Language.
French, including Commercial French.
German, including Commercial German.
Italian.
Spanish.
Theory of Music.

It will be seen that several of the subjects in which Examinations were held this year have been omitted, and that French and Commercial French have been combined, as well as German and Commercial German.

The object with which these Examinations were instituted was to give a stimulus to the acquirement of certain branches of knowledge by adults of the working and middle classes, but some of the above subjects are now, or shortly will be, under the recent Education Act, so generally taught that this stimulus will no longer be necessary, and the Council have only retained them in deference to the strong wish of several of the Institutions. These remarks specially apply to Arithmetic, and it appears that about one-fifth of the candidates who obtained Society of Arts' Certificates this year in that subject also passed in Elementary Mathematics under the Science and Art Department.

The Programme will be issued as soon as possible. With the exception of the omission of the subjects already referred to, it will not differ materially from that for the examinations of 1872.

The Papers for the Elementary Examination will be supplied as usual.

Secretaries of Institutions and Local Boards are requested to make this decision public as soon as possible.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

THE LIBRARY.

The following books have been presented to the Library:—

A Chart. Tabular view of the orders and families of Fishes; also of the Mollusca. Presented by Augustus J. Harvey, F.R.B.S.

British Association of Gas Managers. Report of proceedings of the Ninth Annual Meeting, held at the Society of Arts' Rooms, June, 1872.

Leeds Philosophical and Literary Society. The Annual Report for 1871-72. Presented by the Society.

Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire. New series, part I., pp. 1 to 56, 1871-2. Presented by the Society.

INTERNATIONAL EXHIBITION, 1872

The Council, having been informed that Her Majesty's Commissioners do not intend to publish reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such reports, for publication in the Society's *Journal.* The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following is the fifth of the series. The others will appear from time to time.

RECENT SCIENTIFIC INVENTIONS AND NEW DISCOVERIES AT THE INTERNATIONAL EXHIBITION OF 1872.

The department of the International Exhibition which concerns itself with "Recent Scientific Inventions and New Discoveries," at all times a very interesting and attractive one, contains, this year, a creditable range of objects that are deserving of attention and notice.

There are several notable instances in which inventive science has taken it in hand to remove sundry petty inconveniences and discomforts that are of daily and hourly occurrence in every man's home, and there is, perhaps, no province in which its beneficent powers are more pleasantly or advantageously exercised. For this reason precedence is given in this report to the "Domestic Applications of Inventive Art."

Mr. John Meakin, of Baker-street, has a charming contrivance, by which the upper sashes of windows are made almost to open and shut themselves, and quite to fasten themselves, whether partly opened or entirely closed. A lady, sitting before her dressing-table, in front of a window, if using this invention, would take hold of a couple of handles attached to cords, working through pulleys, and, by a gentle movement of her arms, would pull down the sash, passing four different catches on the way. To close the sash, she would only need to employ two other handles in the same manner, and the fixing-catch is first thrown out of gear, and then the sash runs up. All this convenience, in very neat workmanship, the lady would have for a cost of 16s. 6d. for the window.

Mr. B. W. Maughan, of Goswell-road, has made it his care that hot water may be be had in every dressing-room, whether there is a fire in the house or not, in a very small fraction of a minute. He provides for this purpose what he calls a patent geyser, a machine like an ordinary gas-stove in appearance, and to use this machine you have to light a jet of ordinary gas at a burner, and turn the jet in by a small hinged bracket, so that it, in its turn, ignites a myriad of pigmy flames within the utensil. An inverted cone of metal, something like an open umbrella, hangs over the flames, and receives upon its upturned surface a shower of cold water, which is turned on above by a tap. The water first passes through a sieve, then makes its way down among a series of coils of tinned copper wire, and is afterwards collected round the bottom of the hot cone by a kind of gutter, which leads it to a tap below. You thus light your gas in the geyser, turn on the cold water above, and immediately it begins to flow out below as a stream of hot water. The water runs out directly at about a temperature of 140° ; but if the stream of inflow is diminished, the water at outflow is proportionally hotter. The smallest geyser gives half-a-gallon of hot water, or a pint of boiling water, per minute. The largest gives four times that quantity of either. In summer time 40 gallons of hot water are prepared at the expenditure of one pennyworth of gas. The great convenience of this apparatus is, that with it a stream of hot water is always to be had whenever it is required. It, however, does not need the wisdom of Solomon to point out that the same gas-flames, acting upon a broad-bottomed kettle of water, would give the same quantity of boiling water in the same time. Mr. Maughan has made a very ingenious apparatus for producing at any instant an immediate stream of hot water, but he has not made an apparatus that can multiply or augment the heating power of flame.

Mr. A. G. Southby, of New-inn, exhibits a gas-stove of novel form, in which the products of combustion ascend inside a tube, over the burners, and then travel down outside of it through a large cylinder, and are thence ultimately discharged into the outer air through a pipe. Under this contrivance the heated products of combustion give all their heat for useful employment before they are discharged. The stove neither vitiates the air of the apartments in which it is used nor wastes its own heat up the chimney.

The Rev. J. Langton Clarke, of Ealing, has provided a very simple and effectual protection for candles, to prevent them from guttering and running down in waste when carried about by the hand or exposed to draughts. The protection consists merely in a glass lip, like an ordinary sconce of small aperture, which rests on the candle top as it burns, and is kept in position by an inflated cylinder hanging down round the candle a short distance below. The cylinder and lip are each in one piece, and in some forms are ornamented by coloured beads of glass. The inclination of the contact portion of the lip has been very carefully adjusted for the work it has to do, and to prevent the adhesion which is caused by one-sided heating, as the wick is turned over during combustion, a small ring of quickly-conducting silver wire is twisted round the throat of the upper orifice. When candles of the hardest form of composition are used, a broader ring-shaped plate of metal is advantageously employed instead of the wire. Ingenious save-alls are applied for economising the candle-ends. Mr. Clarke has obviously brought a good share of patient study and intelligent observation to bear upon the science of candle burning.

Messrs. Nicoll and Co., of Paternoster-row, show how light garments of all kinds can be made uninflammable, by dressing them with starch prepared by the inventors in some special way. The starch is not poisonous, does no harm to the colours of fabrics, and contains neither alum nor soda. The lightest muslin fabrics, when stiffened by this starch, merely char, without flame, when held over a burning lamp.

Messrs. A. Paget and Co., of Loughborough, exhibit a well-planned little garden engine, which is worked by the foot, like the treadle of a harmonium, and which throws, under the instrumentality of an air reservoir a continuous jet of water thirty feet high, or scatters it in a lateral shower, if a handle attached to the nozzle is pressed. The water may be supplied from a bucket, and is thrown from a small, bellows-like chamber, which is filled by the pressure of the foot, and emptied by the action of a spiral spring, in the latest and best form of the instrument, attached to the rim of the feeding bucket. The pressure in the air chamber can be raised to about thirty pounds on the square inch. The instrument is entirely devoid of the drawbacks of stuffing-boxes and pistons, with their concomitant friction and risk of derangement, and may be turned to very good account in cleansing windows and in performing other similar work. It is also intended to serve as a small domestic fire-engine on any instant of need. This very useful little apparatus is supplied at the small cost of twenty-five shillings.

The Universal Paint and Waterproof Fibre Company, of Farnworth, illustrate their process of preparing sheets of waterproof material out of paper pulp. The process, in the main, consists in saturating paper, or any fibrous substance, with an ammoniated copper solution, formed by digesting scraps of copper in a concentrated solution of ammonia. This ammoniated solution dissolves both lignine and paper, and, at the same time, renders both substances impervious to water. Several sheets of paper are moistened on the surface, and then placed on each other and thoroughly pressed. Under this treatment they adhere together firmly, without the intervention of any kind of paste. The slabs are then fashioned into forms convenient for various purposes, some of them being corrugated, like the well-known roofing plates of corrugated iron. The paper is also moulded into cylindrical columns and flutings for internal decoration, being either gilt, or stained in imitation of wainscot, and for this kind of purpose must prove very convenient and manageable. It is said by its inventors to be of great durability, even when exposed to the outer air and rain.

Another ingenious and even pretty use has been made of paper by Messrs. Pavy, Pretto, and Company, of Hamsell-street and of Chilworth. They have contrived curtains of what they call "Japanese" paper. The inventors state their object to be to provide curtains for the million, which, although of very low price, will be highly ornamental, and capable of wearing, and which will keep fresh in appearance, with ordinary care, for a number of years. The fabric is fast in colour, but little amenable to moisture and impervious to dust. The curtains hung to several of the doors in the exhibition look like very pretty chintz, and the inventors say that they can produce imitations of French silk, damask, and cretonne. The material of the fabric is derived from various animal textures mingled with vegetable fibre, which are disintegrated, purified, bleached, rolled, pressed, and then, finally, printed on. It differs from ordinary paper in being more tough, elastic, and soft, so that it is less easily torn, and more readily falls into folds when used as drapery. The colours, being body colours, are more durable than the dyes used most commonly for woollen fabrics; and the inventors state that exposure to sun and air effect very slight injury, and that moderate amounts of moisture only make it more soft and yielding. Curtains 44 inches wide and 3 yards long, are supplied for 6s. 6d. and 7s. 6d. the pair, with 6d. a yard extra for printed linings.

George Wright and Company, of Westminster-bridge-road, have a billiard table of the dimensions of eight feet by four, which is converted at will into a convenient dining table, by covering it with a series of flaps, and lowering its height by six or eight inches. The arrangement for lowering and elevating, is a system of fine threaded screws, acting by slow motion simultaneously upon rods running along the four sides of the table, and by this apparatus the raising and lowering is effected without any disturbance of the level of the billiard board. The invention is designed to give the man who has but one room at command the opportunity to indulge in a game of billiards after he has dined, if he chooses to pay 50 guineas for the luxury.

David Nicholl and Company, of Manchester, exhibit an excellent elastic spring mattress, which they supply of the usual size for one person for two guineas. The mattress consists of a stretched meshwork of stout iron wire, supported by a strong wooden frame, and the elasticity is supplied by making two sides, or rather ends, of each elongated hexagonal mesh to consist of wire rolled spirally into the form of a spring. The mattress possesses delightful elasticity, is very light, and therefore admirably suited for camp use; and it must be very durable, and very easy of repair, on account of its great simplicity of structure, and all its parts being immediately in view.

Benjamin Turner, of Bartholomew-close, has patented a very excellent door-spring, for double-acting swinging doors. The door is carried by a shoe and upper pivot, the shoe resting immediately upon a strong iron shaft, that falls into a compact case, designed to be let into the floor. The shaft carries upon its front a knob, which runs right and left against curved levers acted upon by a strong spiral screw beneath, which can be adjusted to any tension. The spring is in most energetic action when the door is closed, and relaxes conveniently as it opens. The contrivance, which is eminently good, has also the additional recommendation that the entire mechanism can at any time be removed, for examination or adjustment, without unhanging the door. That is a practical hint which all builders who pride themselves on their powers of hiding away gas-pipes and water-pipes, and bell wires, and other derangeable house fittings, where they are never likely to be found afterwards in any case of emergency, would do well to consider.

C. E. Zimdars, of Red Lion-square, furnishes a very excellent suggestion, in Walcker's pneumatic bells. The apparatus consists of a bottle of india-rubber, a tube, and a kind of bellows-case at the further end. The tube takes the place of the bell wire, and is to be carried from room to room after the same fashion, or as gas-pipes are now laid down. When the elastic bottle is pressed by the hand, the air is squeezed from it through the tube into the bellows-chamber, and the top of this is then raised, as the top of an organ bellows is, by the working of a lever. As the top of the bellows rises, it carries up a toothed racket, which operates upon a pinion, and turns a brass wheel. The wheel has its own teeth also, and these, as the wheel turns, in rapid succession lift and release the hammer of a bell. When the hand is removed from the bottle, the air falls back into it, and the top of the further air-chamber, or bellows, subsides for the next occasion for sounding. Some of the hand apparatus is arranged so as to be pressed in from the top by a knob, as in the ordinary table-bell. There is one large bell which only gives a single loud stroke for each squeeze of the hand bottle. The recommendation of this apparatus is, that a small metal pipe is less obnoxious to derangement than complicated twistings of wires and cranks, and that the acting part of the mechanism, the only portion amenable to derangement, is always under observation, and within easy reach for repair.

Major E. R. Wethered has made a contribution to domestic comforts, in the form of a simple apparatus, by which any man may at once let himself down out of his second or third-floor window when his house is on fire beneath. This domestic fire-escape consists of a canvas cradle, with a guard band to be passed beneath the arms, a strong rope, and a pulley furnished with a clamp, which can be worked by the hand as the fugitive makes his descent. Both sashes of the window are to be thrown into close correspondence near the top, and the rope is then to be passed round them at one side, and hitched with a hook, so that the lateral pull of the weight jams the sashes in the frame. The pulley is fixed a little distance above the cradle, or web, and consists of five friction rollers, between which the rope runs sinuously, with a clamp pressed upon it by a lever and handle. When the handle is held transversely up, the pulley and cradle are fixed firmly on the rope, but when the handle is brought down the clamp is freed, and the cradle slides down with greater or less speed, according to the pressure made. The free end of the rope is wound upon a reel, which is to be thrown out of the window, so that it unwinds as it falls. During the escape, as an extra precaution, the left-hand of the person descending runs down the rope, and can at any time check the fall by tightening its grip. The apparatus costs 30s., and is so compact that it would occupy a very small nook of space in any sleeping-room.

Messrs. Lynch and Company, of Aldersgate-street, have considered that all households should be protected from unintentional poisoning in the dark, as well as from burning in the still hours of the night, and accordingly have contrived and patented a knobbed form of bottle, which at once signals "poison" to the hand, as the red signal light of the railway says "danger" to the eye. The bottle is of dark blue glass, and of various convenient sizes, costing accordingly from 9s. to 25s. the gross. It is as efficient a guard from this class of accident as can possibly be devised, and should certainly be at once adopted as the standard utensil for storing poisonous compounds and serving poisonous medicines.

In the French annexe, Mons. A. E. Eliaers, of Paris, exhibits a very complete reading and resting chair for invalids. It is strongly made, with light cane back and seat, and can have the back and leg-rest adjusted easily to any angle, the leg-rest having attached to it a spring self-adjusting foot-board. There is also a reading-easel, which puts itself in any position that may be desired, and which is convertible into a table as well.

Messrs. Whitley, Partners, of Leeds, furnish a very perfect water-tap (also available for steam-cocks), which is now rapidly superseding the old unsatisfactory "globe valve." The principle of the contrivance is simply a pair of sliding disc plates, thrust down transversely into the ordinary channel of the water-pipe by a screw, and forced home against their bearings on either hand by a wedge-piece. When the disc plates are withdrawn, and the valve is therefore open, the water has a straight and altogether unobstructed passage through the pipe. The valves are made both in gun metal and cast-iron, and the prices vary from 4s. 3d. for three-eighth-inch bores to £40 for 18-inch bores. The Messrs. Whitley have also a compound-lever ball-valve for cistern supply, of very excellent construction, furnished from 4s. 6d. to 50s., according to size, in which a metal plug is forced home by the action of a compound lever that gives great power, and that in that way guards against the possibility of waste from overflow. The water-tap is known as the "Peet-valve tap," and the cistern valves as "Chandler's compound-lever ball-valve," but the Messrs. Whitley are the sole English makers of the patent.

Mr. G. S. Lidstone, of the Old Bailey, has planned a small and very uncostly apparatus, for purifying foul air that is allowed to escape from sewers in the process of ventilation. It is a familiar fact that the water-valves of closets, ordinarily used, do not prevent the bubbling of noxious vapours into dwellings whenever there is backward pressure of a certain amount, as from wind, exerted upon the air in sewers. The obvious preventative is to furnish an open vent, short of the closet valves, but such vent, if used, is apt to be near to windows, or places occupied by breathing men and women, and is therefore objectionable. Mr. Lidstone's invention is a zinc, tin, or copper case, to be placed on the vent, with a discharge-pipe leading out from the apparatus above. The foul vapour has to find its way through the interstices of charcoal, or other absorbent and deodorising material, lodged in the chamber of the ventilator, round a perforated end of a receiving-pipe, and upon a perforated diaphragm. The noxious impurities are fixed and retained in the packing of the chamber, and the air is discharged from its top, under good management, comparatively pure. The cost of the little apparatus is from 10s. to 15s. Mr. Lidstone suggests that the larger street sewers should be ventilated by purifiers placed at the bottom of lamp-posts, with tubes discharging at their tops. The practical points for consideration are, how effectually the absorbent material can be made to do its work, and how frequently it would need to be changed.

Upon the threshold of the domestic applications of inventive science, the observant visitor of the Exhibition is met by a very efficient contrivance for economising the light supplied at night for illuminating external thoroughfares. At a cost of £1 15s. 6d., Mr. T. A. Stretton, of Essex-street, furnishes a "Catoptric" street lamp, which catches all the otherwise waste light scattered from the gas flame to the upper two-thirds of the lantern case, and throws it down to the spaces where the light is required. The upper two-thirds of the lamp are made of narrow strips of silvered glass, set like the splines of Venetian blinds, at the proper angle to reflect downwards, in tin grooves, whence they can be easily removed for cleaning. The outer protecting glass pane shuts in all the slips from external contamination, and prevents the wind from blowing in between them. This form of lamp is in nightly operation, and acts very efficiently, upon Waterloo-bridge.

Among the more general applications of invention to mechanical purposes, there is a neat form of bowser for tightening ropes, exhibited by Messrs. Paget and Co., of Loughborough. The rope is carried round a grooved cast-iron wheel, with an attached ratchet or detent, which is worked either by a hooked lever resting on the axis and catching against projections on the wheels, or by an iron spoke inserted into holes in the circumference of the wheel. The bowser is of very compact size, and is intended to take the place of the ordinary cleat or belaying pin on board ship. A taut rope can at any time be released from its grip instantly.

There are five good forms of hand hoists and pulley blocks of new construction in the Exhibition; two of them belonging to Messrs. Tangye Brothers, of Lawrence Pountney-lane and Birmingham, and three to Messrs. Head and Co., of Stockton-on-Tees. The Cherry's dynamic pulley block, of the former firm, for lifting 2½ cwt., and costing £3, is a very curious application of a toothed and bevelled eccentric slow movement to communicate power. The Weston's safety hoist, of the same exhibitors, costing £1 without the chains, and lifting 5 cwt., acts through double ratcheted wheels concentric upon the axle, and has the pecularity, when lifting the weight, that a slight back action upon the hand rope clamps fast the moving parts, and arrests the rising load. By turning the spochet wheel the reverse way, the self-acting brake is continually released as the wheel revolves, and the load can be lowered with perfect safety.

Moore and Head's hand-hoist, price £4 19s., to lift 10 cwt., communicates the slow movement and power through a toothed pinion on the axle of the lifting-wheel to an eccentric smaller wheel, which hangs by its teeth on the pinion, and has the load-chain traversing its axis. Moore's pulley-blocks, to lift two tons and five tons respectively, cost £5 15s. and £10 2s. 6d., and are well-planned and well-finished appliances. The hand-chain and wheel turn an eccentric epicycloidal movement geared between two pulley-wheels, which revolve opposite ways, and so lift the raising chain simultaneously by both ends. The source of power is thus threefold, and in the larger pulley the power is multiplied from 35 to 40 times. In all these hoists and pulleys the bite upon the chain is effected by rugosities on the circumferential grooves of the wheels entering the hollows of the links, and its efficacy becomes somewhat impaired by wear in the course of time. The wear is, however, of necessity least in such forms as the Moore's pulley-block, where the quick motion has small weight or pressure, and where the weight is borne upon very slowly-moving parts.

Christian P. Thal, of St. Petersburg, shows the model of an ingenious duplex steam-hammer, which strikes horizontally, and also upon both sides of the work at once. It clips the mass between its blows. Two steam-cylinders work lever-handles of the hammers, which are suspended vertically from pivots above. A weight underneath the work is attached by oblique arms to other arms that rise from the backs of the hammers, so that force is given to the blows of the hammers by the simultaneous descent of the weight.

Messrs. Whitley, Partners, of Leeds, exhibit Allen's engine governor, of which they are the sole European constructors, a contrivance that seems to be making rapid way in general esteem by its own merits. The principle of the governor is a corrugated cylinder, containing oil, with a paddle-wheel of six floats within, carried round by a belt traversing also the fly-wheel shaft of the engine. Rapid rotation of the paddle-wheel drives the oil against sundry projecting plates in the interior of the cylinder, and gives it a tendency to move in the same direction. Its movement lifts a weight hanging from, and adjustible on, a lever arm, and at the same time closes the steam valve. When the movement relaxes, the weight takes down the lever and opens the valve. The governor is adapted to marine engines, by antagonising the lift of the revolving cylinder by a coiled spring instead of by a weighted lever. A pinion on the axle of the corrugated cylinder works a ratchet that is attached to a lever-arm, which communicates with the steam valve, and this arm is carried in one direction by increasing rotation in the cylinder, and in the other direction by the spring. The governor is so delicate in its operation that the valve feels the slightest variation in the speed of the fly-wheel, even answering to as little variation as half a revolution per minute; it is at the same time so comprehensive that it is capable of admitting the entire force of the boiler to be thrown on the piston in an almost imperceptible way, and without strain.

Mr. J. Head, of Middlesborough, contributes a model of a new form of centrifugal governor, in which the arms are suspended from the extremities of a transverse yard, as in a modern form of Watts' governor, but they cross each other before they are pivotted to the guide rods. There are heavy balls at the end of the arms, which rise with centrifugal action, and act upon the throttle valve in the usual way; but they rise in an arc that very nearly corresponds with the curve of the parabola, and are stated to be very immediate and sensitive in their controlling power.

The same exhibitor has a very neat application of mechanical power, for the easy and smooth reversal of rolling mills. A central-piece is connected with each clutch-wheel by elastic arms, and is carried by a lever alternately to the right or the left, as it is desired, to gear the moving power with the rollers, so as to give either direct or retrograde motion. The elastic arms take the first impulse of the reversed motion, so that the shock which is ordinarily produced when the clutch is thrown suddenly into gear is avoided. The clutch goes gently and gradually into its bearing and work through the instrumentality of the elastic connection. Mr. Head has also a diagram to show a plan for suspending large boilers by counterpoises, so that they almost touch, without pressing upon, the masonry, and so obviate the strain that is due to mechanical constraints during the process of expansion.

The railway axle-box of Mr. R. Glover, of Stratford, is a contrivance for retaining a constant supply of lubricating liquid in contact with the axle while the wheel is in work. This purpose is effected by the instrumentality of a flexible impermeable band, with one edge adjusted to the back of the box, and the other to a plate encircling the axle. The lubricating band is pressed against the wheel, or axle, by springs bearing upon a collar fixed to the axle. No escape of the lubricator can occur, excepting between the rubbing surfaces.

Mr. W. Stroudley's ramps, exhibited by Messrs. Tangye Brothers, of Birmingham, are simply strong iron shoes or inclined planes, broad at bottom and narrowing to a groove at top, so curved as to be easily hitched over the flange of any rail in the roadway. The clamps are fitted to be placed at either side of the lines of rail, and by their aid a locomotive off the line may be easily run up and guided into its proper place.

Mr. C. Burrell's model of an elastic wheel-tyre for road-engines (from Thetford), shows a thick india-rubber padding, kept in place on the outer running surface of the wheel by a series of flat iron clamps, fitting so closely together that they virtually take all the wear, while they pass the shock of inequalities of roads through the elastic india-rubber.

Lieutenant-Colonel Clarke, Director of Works for the Navy, exhibits a really beautiful model of three-legged shears, adapted for use on a wharf too narrow to admit the back leg to traverse backward and forward horizontally in the usual way. The back leg moves up and down, so as to be virtually lengthened or shortened, by a sliding movement carried on each side by strong endless screws, acted upon by a toothed wheel. The machinery is sunk into a cavity in the masonry, and serves, in some measure, as a counterpoise to the load. The slide is worked by a hand crank, acting upon a slow movement, which either operates upon the adjusting slide or upon bevelled wheels and endless screws, which turn a windlass, accordingly as it is geared.

The screw bolt and nut of Mr. G. Wilson, of Sheffield, have the thread of the screw so fashioned as to take as little as possible out of the strength of the bolt, and to give a good working section to the thread. The line of contact of the threads of the nut and bolt, seen in section, is of a regular wave contour.

The Nickerson's or Allen's angular cut rasps, exhibited by Messrs. Whitley, Partners, are rasps with the teeth set at such an angle, and so formed, that they cut with a drawing stroke instead of tearing, and throw out the refuse as they do so. The rasps are stated to do double the work in half the time, as compared with the old-fashioned tool, and to last twice as long.

Messrs. Allen, Ransome, and Co., exhibit a mitreing machine, invented by R. G. Shute, which is simply a guillotine knife, pressed down along a guide-plate by a handle and lever.

Two forms of non-conducting cement, for packing boilers and steam-pipes, are shown ; one by Fox, Head, and Co., of Middlesborough, consisting of thick sheets of compact dark felt, with a polished surface, costing 8s. the twelve square feet. In the case of pipes, the cement is bound into its place by meshings of wire. The other form belongs to Leroy and Co., of Gray-street, Commercial-road, and is of still higher finish, having quite an ornamental appearance.

Mr. A. Davies, of Duke-street, Westminster, illustrates, in a drawing, an arrangement for an hydraulic lift, in which the piston-road, driven by the water, works a multiplying pulley.

Mr. H. Simon, of Manchester, contributes a model in explanation of Janicki's construction of a floating dock, so arranged as to lift a docked vessel by pneumatic power. The keel of the vessel rests upon an inverted bottomless tank, steadied by large floats at the side, and raised by the injection of air into the interior. The floating load necessarily rises with the accumulation of air between the top of the tank and the surface of the water.

Mons. Leon Goffin, of Liège, has an apparatus for cutting and crushing sugar, in which the loaf is first operated upon by a circular saw, very much as inch planks are cut from logs of wood, and then chopped by a broad chisel into smaller fragments, which are sorted into various sizes, and drop through the bottom of the machine.

Mr. W. H. Barlow, of Old Palace-yard, has constructed a table by the help of which the earthwork of railways can be calculated up at the rate of ten miles an hour. The contrivance is simply a movable circular scale, that can be adjusted to external radiating columns of figures, which give the numerical results for 18 feet slopes, varying in inclination from $\frac{1}{2}$ to $2\frac{1}{2}$ to 1.

Messrs. Biddle and King, of Percival-street, have a very convenient arrangement for cutting glass shades, of whatever form. The shade to be cut is hung over a support at proper height, and firmly clamped between two screw holdfasts, and the thickness of the glass is then clipped between two guiding friction rollers and a diamond pressed home by a spring, and in this clipped state the diamond is carried round by running the supporting chariot along a flat table, and cuts its way as it goes.

Among other pieces of minor contrivance, Mr. A. W. Ackermann, of Kensington, shows a small porcelain pallette for keeping ink, or liquid colour, moist. There is a water reservoir beneath, and a cover above, with a self-adjusting ball, or valve, to fall upon the opening through which the brush is passed for its supply. A small plug is thrust into a central hole in the pallette while the colour is ground, but removed after the grinding, to allow moisture to pervade the covered space.

The deck sockets of Mr. J. Snowden, of New Brompton, are water-tight brass indicators adapted for fitting into the decks of vessels, in such a way that an officer on deck can at once open communications in the interior spaces of the ship, such, for instance, as between water-tight compartments. These sockets are in use in some of her Majesty's vessels of war.

Mr. C. W. Siemens exhibits the working parts of his pneumatic dispatch tube, in use between the central telegraph stations of London. A steam jet is caused to exhaust one end of an iron tube, and the atmospheric pressure from the other end then shoots a case, containing the written messages, through the tube. The case is made of gutta percha, covered with felt drugget, with discs of the same material on the end, to constitute a closely-fitting piston plate, and with a lid held on by an elastic band. A lever turns the segment of the tube out of line when the case has reached its destination, and at the same time throws another piece of tube into line, to allow the influence of the exhaustion to be still carried on through the tube, for the service of other stations.

The boat-lowering apparatus of Mr. E. J. Hill, of Westminster-chambers, is illustrated by a complete working model. It consists of a pair of strong hooks, held together by a connecting rope, which fall out of the suspended eyes by their own weight, when both ends of the falling boat are simultaneously buoyed up on the water, but which hold on taut if only one end of the boat strikes the water.

The system of iron tubes employed for the protection of covered telegraph wires in Brussels, is shown by M. Leon Delperdange. The tube is very much like the ordinary gas service-pipe, but has a T-shaped flange, so fixed in by cement that it can be at any time broken out, for examining or adjusting the wires, without removing the pipe, and be then replaced with fresh cement. The joints of the pipes are made water-tight by a band of india-rubber, pressed firmly home by a screw-clip.

Mr. W. Lyon, of Cowper's-court, has an economical suggestion for reducing the rate of words in a telegraph message containing numbers. The numbers are represented by letters, which are so articulated together as to make one word. Thus 3750 is written "dhgn," and count as one instead of four.

Mr. C. W. Siemens shows his deep-sea photometer, for measuring the chemical power of the solar ray in depths of translucent water. A roll of sensitive paper is hermetically closed in a glass tube, and this is then placed in a recess of a thick disc, which is attached to the bottom of an iron frame prepared to be dropped, by a coil of covered wire, into the sea. The frame also carries an electro-magnet, which can be brought into play by sending an electric current down through the suspending wire. A spring keeps the tube in a dark recess until the magnet is formed; the tube then springs out into the light, and continues there until the soft iron is demagnetised by the arrest of the current, when the spring draws the tube back into darkness. There are three similar tubes, to be employed at different depths. The actinic force of the light is, of course, expressed by the amount of darkening of the paper in a given time.

Colonel Stuart Wortley contributes three negative photographic plates, prepared by his modification of the emulsion dry-plate process, in which the nitrate of silver is suspended in bromized collodion, and so applied to the glass plate, instead of being held in solution in a dipping bath, in the more usual way. Colonel Stuart Wortley claims to be able to make this form of emulsion retain its sensitiveness a longer time, and to render it as quick in its action as the ordinary wet plate of the photographer, by adding nitrate of uranium to the compound. The three plates exhibited are of excellent quality, fairly clean and soft, especially one giving some glimpses of a faintly-lit interior through an open church door.

Mynheer Lefevre, of the Hague, sends a model of what he terms the "Kiosk Hollandea," a structure contrived to enable the sound of concerted music to be distinctly heard in neighbouring apartments. The kiosk has the form of a large canopy of resonant metal, which reflects the sonorous vibrations produced by musical instruments upon a hollow floor, beneath which a metal tube conveys the sound until it finally delivers it by two trumpet-mouths placed in another apartment. If eight of these tubes are carried off in different directions, there may be eight distinct rooms in which the concert produced in one orchestra may be heard. The tubes carry the sound, without any loss of distinctness, to a distance of 600 yards, and the inventor of the contrivance states that the sounds are actually improved by the softening down of the harsher bursts, or, as Mynheer expressively calls them, "fanfares," of the loud instruments. Mynheer Lefevre also exhibits a phonotographic cylinder for the automatic record of sonorous vibrations. A vibrating tuning fork or diapason traces its own vibrations, by brass points carried on its poles, and pressed down upon the cylinder as it is turned round, like the wheel-work of a clock, by a pendant weight.

Messrs. F. C. Rein and Son, of the Strand, show a case of very beautifully finished ear-trumpets, in white and gilt metal, with elastic tubes, and with short ivory ear pipes, and also metallic auricles, to be attached to the ears by a semi-circular steel spring passing over the head. The Messrs. Rein have been eminently successful with instruments of this class, which are designed to receive the voice of the speaker into the mouth of the trumpet, and to concentrate its tones upon deaf ears. They have one form in efficient use, by which the voice of a preacher in the pulpit is conveyed distinctly to the ears of a deaf auditor seated in the body of the church.

By no means the least interesting piece of scientific apparatus in the Exhibition is the electro-motor clock of Messrs. Cooke and Sons, of York, which gives time throughout the building. The clock is of solid and simple construction, and of faultless finish. It consists of a heavy seconds pendulum, with the gravity escapement which is now common in turret clocks of the best form. There are two spiral copper wires, which run from the top of the pendulum-rod to the bottom of the gravity-arms of the escapement, and the communications of these wires are so arranged that, with every swing of the pendulum, when rubbing contact is made between one arm of the escapement and the rod of the pendulum, an electric current is sent through a long wire, which runs the round of the vast building, and takes in successively eight large dials on its way. With each alternate contact the current is reversed, running from the zinc pole of the battery in one case, and from the copper pole in the next, in order that all residual action in the electro-magnet may be prevented. In each dial there is an electro-magnet of soft iron, which, when it becomes magnetic under the passing current, acts upon a lever and toothed-wheel, the lever being returned into place by a spring when the iron ceases to be a magnet. Every pull of the lever drives the wheel one tooth, and the wheel as it turns operates through its spindle upon a tangent screw, which in its turn drives the minute and hour wheels and hands. Small spring catches prevent the wheels from going the wrong way, or from moving more than one tooth with each pull of the lever. The battery power that in this instance suffices to work the eight large dials consists of three ten-celled Daniell's batteries. One and the same current, of course, acts simultaneously upon all the separate dials, being sent successively through them all before it is allowed to go to earth.

There is one other servant engaged in the active work of the Exhibition that is deserving a passing notice, namely, the tubular steam boiler of the Patent Steam Boiler Company of Birmingham (Root's patent), which is employed to give motion to some of the machinery. The boiler consists of a series of slanting tubes, far asunder, and resting far above the burning coke. The tubes are all perfectly distinct, and can easily be removed and replaced. There is not one piece in the boiler that cannot be carried by a couple of men. There is a continuous circulation of water in the tubes, and the steam is generated in the upper ends of the tubes. This particular boiler is of twenty-five horse power, and consumes only $4\frac{3}{4}$ cwts. of coke in the day, with a conversion of 10lbs. of water into steam for every pound of coke consumed.

Among the most notable of the illustrations of inventive science contained in the Exhibition, are certainly the large series of costly and most exquisitely finished apparatus for demonstrating the laws of sonorous vibrations, and the principles of accoustics generally, contributed by Dr. Rudolph Kœnig, of the Rue Hautefeuille, Paris. These formed prominent objects in the French annexe, and it is exceedingly to be regretted that their exhibitor was prevented, by an unfortunate casualty, from carrying out his original purpose of employing the apparatus, with his own skilful hands, in explaining the phenomena of sound and of musical rythm. The series comprised above forty instruments, compounded of a great diversity of diapasons, organ tubes, and vibration indicators, having among them some very elaborate and complicated pieces of mechanism, such as the double syren of Helmholtz, the chronoscope tuning-forks of Wertheim, the optical comparateur of Professor Lissajous, and the resonnateurs of Helmholtz. But many of the most remarkable of the instruments shown were either inventions or improvements in apparatus of Dr. Kœnig himself. It is not unworthy of remark, as furnishing a proof of the rapid advance that has been made in this particular branch of physical science, that not a single one of these beautiful pieces of accoustic apparatus is described in manuals of physical science emanating from Paris as recently as ten years since, as shown, for instance, in the case of "Ganot's Treatise on Physics."

First and foremost amongst Dr. Kœnig's own instruments stand his beautiful contrivances for demonstrating sonorous vibrations by dancing flames (*des flammes manometriques*). The object is accomplished by causing a stream of ordinary illuminating gas to pass through a small chamber or capsule, so that in it the gas is only separated from the vibrating air of an organ pipe, or other tube, by a thin stretched membrane of india-rubber. The inflammable gas issues from a jet or burner, where it can be lit up into a flame at will. When the gas is lit, the organ pipe is made to sound, and forthwith the flame begins to dance in correspondence with the sonorous vibrations. With each tap of the vibrating air upon the stretched india-rubber wall the flame leaps in response, and the leaping of the flame is contemplated by watching its image in four plane mirrors, set at right angles to each other upon a square column, and made to rotate rapidly, so that an interference is caused in the vision of the flame-image with the passing away of each successive mirror from the angle which reflects it to the observer's eye in the process of rotation. The images are seen as if they were a succession of distinct flames, and the different aspects of the succession of flames gives a picture to the eye of the successive march of the sonorous vibrations. By different modifications of this apparatus, Dr. Kœnig shows the subtle influence of nodal points in modifying vibration, decomposes visibly the various musical sounds into their component elements, and otherwise performs all sorts of legerdemain with the liege servitors of the ear to bring them within range of the eye. The vibrations of tuning forks are communicated to the flame by catching them in open-mouthed brass balls ("*resonnateurs*" of Helmholtz), and passing them on through air enclosed in tubes, until they impinge upon the india-rubber membrane that is *en rapport* with the gas stream. Dr. Kœnig also exhibits a most charming modification of Meldé's apparatus for demonstrating to the eye the simple and compound undulations of stretched strings. A series of diapasons, or tuning-forks, attuned to harmonies and concords, are moulded in pairs, and carry on one fork of each pair a metallic arm and eye, through which silk strings can be passed, so that they may be more or less stretched at will, while the tuning-forks are vibrating. The vibrations are then seen in various kinds of elliptical figures assumed by the strings, and these figures vary with the tension applied from one long ellipse, extending the entire length of the stretched string between the tuning-forks, to a series of two, three, four, and five ellipses; and the elliptical figures are still further complicated by combining for the experiment tuning-forks of different pitch and capacity. Dr. Kœnig has a large siren, in which the sonorous interruptions of the rushing air are effected at the circumference of the drum instead of at its flat ends. This instrument is of a very high order of ingenious complexity, and Dr. Kœnig roundly states that he cannot himself yet see to the bottom of the capabilities of his own creation. There are two of the results of Dr. Kœnig's investigations that are worthy of especial notice and praise, on account of the practical service they are calculated to render. One of these is a plan for "ausculting" diseased organ-pipes. The organ-pipe is stretched at full length upon water, and a bent-tube is passed along, one end through a slit in, and one end out of, the organ-pipe, until the seat of some casual derangement is found by the ear. The other is a plain matter-of-fact stethoscope for ausculting the movements of the heart and lungs of living men. It has the form of a flat hollow disc, composed of a brass ring, with india-rubber sides. The india-rubber sides can be somewhat blown out and put upon the stretch until they are in a degree convex. If one side is then closely pressed upon the chest over the heart, while an ear-tube, issuing from the other side, is applied to the ear, the movements of the heart are heard with marvellous distinctness in all their diversity of rythm and impulse. In one form of the instrument five ear-tubes are provided, in order that a physician, while listening to the sounds of a disordered heart or lungs at one, may explain what he hears to four students, who are also listening simultaneously to the sounds at the other four tubes. The single-tube stethoscope is supplied for ten, and the quintuple-tube instruments for twenty francs. This stethoscope gives very much more pronounced and developed sounds than the common form of the instrument, and is eminently deserving of the attention of the medical profession, on account of its very convenient form, as well as of its great power. The Commissioners are certainly very largely indebted to Dr. Kœnig for the splendid addition he has, on this occasion, made to the scientific and philosophic treasures of the Exhibition; and it is a matter of serious regret that the limited space at command in this condensed report does not allow a larger measure of justice to be done to this particular contribution.

Professor Lissajous, of St. Cloud, exhibits also in the French annexe his own arrangement for showing sonorous vibration by the intervention of the microscope. The object-glass of a microscope is carried on one arm of a tuning fork, so that a luminous point formed by it can be seen through a magnifying tube, when it is caused to dance into a lengthened line of light by the vibration of the fork. Compound vibrations of different character give, in this apparatus, characteristic luminous figures.

Messrs. E. and P. Seè, of Lille, show a micrometrical balance, by which the number of short lengths of yarn, and the weights of small pieces of woven fabric, can be readily counted and weighed.

Mons. W. Wiesnegg, of the Place de Sorbonne, furnish a very large series of implements and instruments designed to facilitate the operations of chemical laboratories.

Milde and Co., of Paris, contribute a simple and pretty form of electric clock, and a leviathan bell, sounded by an electro-magnetic alarum, worked at will either by the hand of a ringer or by a train of clock work.

The hydraulic telegraphing and railway signalling of the Marquis de Forville are exhibited by Mr. A. Schauschieff, C.E. Both these pieces of apparatus are in actual use upon the Russian lines. In the hydraulic-telegraph (so-called), the work which is effected by hydraulic power is simply the unwinding of a ribbon of paper at a regulated rate of speed, as it receives the dot and dash impress of the chemical pencil of a Morse apparatus in the usual way. A weight is wound up, and this then carries round a revolving paddle-wheel, which dips into water more or less deep. The speed is increased as the floats of the paddle-wheel are raised out of, and diminished as they are thrust down into, the water. The signalling apparatus is a small piece of electro-magnetic machinery, intended to be carried by a railway guard, who, in case of accident to his train, cuts one of the telegraph wires close by, and attaches an end to the apparatus, in such a way that it signals a word to the next station, the exact word sent being determined by the adjustment of a small notched barrel that acts somewhat on the principle of the barrel of the crank organ. The barrel, on being once turned round, makes the dot and dash contacts that spell the particular word, indicated by a point running along a sliding scale. The word that is thus automatically spelt by the signalman is simultaneously recorded upon a strip of paper in the instrument.

The "sanitary apparatus," entered in the catalogue as from "Portugal," and as exhibited by Miguel Pinder, is simply a closet-valve kept fast closed by a strong spring or elastic band, and intended to be opened and closed by the opening and closing of the closet-door. In connection with this, Mr. Pinder has a slow waste-pipe, designed to free a water-cistern from contamination by sewer gas.

Messrs. Gaskell, Deacon, and Company, of Warrington, illustrate, by a large drawing, their process of manufacturing bleaching powder. Chlorine is produced by passing streams of heated hydrochloric acid through porous material impregnated with sulphate of copper, and the gas is then thrown, in a thoroughly dried state, upon slacked lime, which absorbs it, and becomes converted into a chloride.

Mr. A. Batchelar, of Brockham, Surrey, furnishes a drawing and model of improved kilns for burning bricks, pottery, and lime, in which a series of four distinct kilns are so arranged round one common furnace as to allow of three of them being worked in rotation for drying, burning, and cooling, while the fourth is in reserve, emptying and refilling. The kilns save from four to five cwts. of coal per thousand bricks, and reduce the ordinary time of burning from ninety-six to forty hours, such result being obtained by utilising all the waste heat given off from the burning bricks.

Three models of novel forms of puddling furnaces are in the Exhibition. Mr. J. Danks, of Cincinnati, United States, submits one to illustrate the character and form of his remarkable revolving puddling furnace, an invention which is just now exciting so large an amount of attention among iron manufacturers, that a commission has been sent to America to investigate its capacity. The furnace consists of an iron chamber, which, when in use, is made to revolve on four rollers. It has a lining of pulverised iron ore and lime, and a fire-chamber fed by a fan-blast. Pig iron is melted in the rotating chamber, and the chamber is then caused to revolve six or eight times in a minute by steam machinery, acting through cogged wheels, and by this movement the molten charge is dashed violently about in the interior, producing the effect which is ordinarily secured by the more laborious process of manual stirring.

Messrs. Jones, Gjers, and Head exhibit the arrangements of a puddling furnace, in which one part of the chimney is enlarged into a chamber, in such a way that the heated products of combustion can be caught in it, and sent to do duty in heating a stove pipe, through which the air for combustion is driven by a steam-jet. The blast is delivered to the fire at a temperature of 650 degrees of Fahr., and by this one-half of the fuel usually consumed is said to be saved.

Mr. T. Whitwell, of Stockton-on-Tees, shows a model of a hot-blast smelting-stove, in which the blast is heated in channels of fire-brick, rivitted and caulked air-tight, and admitting the flues to be cleaned from the outside, while the stove still retains red heat. A blast of 1,400 degrees of temperature is commonly maintained, and this is capable of being raised at will to 2,000 degrees, without injuring the stove. With good management, each stove turns out 125 tons of pig-iron per week.

The noble art of war does not fail to assert for itself in this Exhibition the right to attention which it always claims when science attempts to demonstrate its inventive power. Mr. Bessemer has here a very striking illustration of his system of low-pressure ordnance. He shows, first, a mighty shell, of five tons weight, 30 inches in diameter, with a section of the gun that would be required to throw it, upon his low-pressure principle, with a bursting charge of 400 lbs. of gunpowder. By the side of this giant there stands the Woolwich shell of 700 lbs., being only a sixteenth part of the larger bolt in weight, with the section of the gun required for its projection under the old instantaneous explosion, having solid sides twenty-two inches thick. A diagrammatic section of the gun that would be required for firing the 5-ton bolt, under the old instantaneous explosion, is hung up on the wall; it represents a bore of 30 inches, with walls about six feet thick. The principle that Mr. Bessemer purposes to act upon in his low-pressure system is simply to bring the full force gradually upon the projectile, by exploding the gunpowder, in successive small discharges, as the bolt moves through the tube of the gun on its way to the muzzle. By this expedient the same effect is insured on the departure of the shot from the gun, although no part of the instrument has ever had to bear more than a comparatively slight pressure. A continuous pressure of three tons per square inch, kept up during the entire journey of the shot along the chase, would produce as much projective force as an instantaneous explosion giving enormously larger pressure on the square inch.

Mr. Bessemer also exhibits a very ingenious plan for firing large ordnance in a rolling sea, in such a way that the gun can only be discharged at one predetermined angle of inclination. This object is secured by an adjustible quadrant, carrying a kind of inverted pendulum or hammer mounted beneath on a knife-edge, in such arrangement that the hammer rests against a chuck on one side, until the heeling of the vessel throws it over to an opposite chuck, when, on the instant of contact, a metallic communication sets up an electric current and fires the gun. The exact angle at which the hammer is thrown over to fire the gun is settled by the previous adjustment of the quadrant, under the action of a tangent screw and graduated micrometer head.

Major Palliser has exhibited one of the old cast-iron 32-pounder smooth-bore guns, converted into a 64-pounder rifled cannon, in the factory of Sir William Armstrong, upon his principle of lining the tube with a coil of wrought-iron. This particular gun has been fired 2 300 times, and is still in an altogether perfect and serviceable condition.

Sir Joseph Whitworth and Company had in the East Machinery Annexe a 9-pounder breech-loading rifled field gun. This gun was removed, before the final close of the Exhibition, for testing experiments designed to prove its range, accuracy, penetration, strength, destructive effects, and rapidity of fire. The gun is formed of steel, subjected to a pressure of from eight to twenty tons on the square inch when in a fluid state, by which means it is condensed into a perfectly solid and homogeneous metal, free from air-cells, and uniform in strength and ductility. The steel column is shortened by this treatment as much as an inch and a half in the foot in five minutes; and it is then further strengthened by being drawn out and forged. In consequence of the enormous coherent strength of the metal, a larger powder chamber is provided, and a shot fired from the gun penetrates an iron plate one and a half times its own diameter, instead of a thickness of only the same diameter, which has hitherto been considered good performance. Sir Joseph aims, in the construction of these guns, at obtaining accuracy and penetration at great range, by the use of a long bullet, projected by a large powder charge, and impressed with great rotatory velocity.

Captain W. H. Noble, R.A., has designed a very efficient apparatus for estimating the pressure of explosions of gunpowder. This is done by placing a small cylinder of copper in the interior of a screw plug piece, used for insertion into the breech of a gun in such a way that the copper is squeezed between a fixed steel anvil and a movable piston, when the gunpowder in the gun is fired. A pressure of twenty tons on the square inch reduces the length of the copper cylinder from 0·5 parts of an inch to 0·229 parts of an inch, and, of course, a greater or less amount of pressure effects, more or less, a shortening in a proportion that admits of estimation and comparison with tabulated expressions. In connexion with this "crusher-guage," Captain Noble shows different specimens of gunpowder which have been made the objects of experiment, some looking like large lumps of plumbago, and others being fashioned like perforated pellets and large prismatic cakes bored with holes.

Captain E. Sawyer illustrates the peculiarities of a gun-carriage which he has recently contrived. One embrasure is served by two guns, which traverse semicircular rails on either side of it, so that they can be alternately brought into position. When one gun is fired it runs backwards by the recoil, up-hill, upon its own semicircular rail, bringing the other gun down-hill and loaded into position at the embrasure. The second gun, when fired from the embrasure, repeats the same operation with its fellow, which has been loading under the protection of the rampart, and in its reverse position, in the meantime.

Lieutenant J. C. Ardagh, of the Royal Engineers, contributes the model of a new form of drawbridge, which is mounted in equilibrium, and requires no counterpoise. Two-thirds of the bridge turns up, on friction rollers, that run down a curved rail on the abutment, as pivotted rods of suspension adjust themselves to the new position. The tilting up of the bridge is produced by drawing in the hand-rails, after unhooking four terminal lengths on the stationary third of the bridge, which had previously prevented the upward swing.

Major E. R. Wetherhed, the exhibitor of the domestic fire escape, also shows a convenient camp hammock, having the form of a piece of carpet stretched upon a light frame, jointed in the middle at each side. The frame hangs by a loop of cord from the tent-pole, and from a forked strut, at a very alluring angle of inclination, one end upon the ground.

Many of the objects contained in this department of the Exhibition are very far from carrying an open and frank expression of their meaning in their face. But for the kind and constant assistance furnished to the investigations of the writer of this report by her Majesty's Commissioners, through Mr. F. H. Bacon, of the machinery department, it would indeed have been impracticable to get at even as much of the purpose of exhibiting inventors as has been here described. It is most earnestly to be desired that a full and clear explanation of the inventor's object and design should be appended to every object of this class, when it has not the advantage of an initiated attendant, which very rarely happens. Mr. H. Bessemer has very admirably shown how efficiently the meaning of a scientific invention may be brought out, by attached explanatory placards, in the case of his illustration of the low-pressure system of heavy ordnance, and has set an example in this particular which it is to be hoped may be largely followed in future years. It is hardly possible to estimate too highly the importance of having this annual expression of the current movement of scientific invention at South Kensington as complete as it can be made. On account of the difficulty which has been alluded to, a very small residual list of non-descriptive inventions included in the Exhibition still remains to be entered in this report as a mere transcription from the official catalogue. This list consists of:—The pulse-pump of M. Mendelljeff (Russian); thermo-electric batteries of Francis Noë (Austrian); intermittent water-cocks of M. H. Chameroy (Belgian); caoutchouc joints for iron pipes of M. Somze (Belgian); the model of a regulator for the driving clock of an equatorial telescope of Mr. R. Rumquist (Swedish); the water-guage of M. Chameroy, Fils (French); the mortice-lock of Mr. L. Strafford; and a steam-engine governor, of novel construction, in the French annexe.

The number of foreign exhibitors of scientific inventions in the Exhibition of 1872, classed according to their nationality, are:—French, 9; Belgian, 4; Russian, 3; American, 1; Swedish, 1; Dutch, 1; Austrian, 1; Portuguese, 1. The English exhibitors of scientific inventions are about 50. These numbers, however, can only be taken as an approximate expression of a truth, as it is scarcely possible to say, in a large exhibition of this character, where the line should properly be drawn which would exclude instruments and machines from notice in the category of "Recent Inventions" and "New Discoveries." It should, perhaps, also be remarked that in the case of France, as well as of England, there are considerably more objects of invention than exhibitors. A large proportion of exhibitors have contributed more objects than one.

CLOSE OF THE EXHIBITION OF 1872.

The second of the series of Annual International Exhibitions finally closed its doors on Saturday last, the 19th inst. No ceremony marked the event, not even the singing of the National Anthem by the visitors in the Albert-hall, as was done at the close of the 1871 Exhibition. Possibly it was this, added to the bad state of the weather, that caused the last day to be marked by no greater excitement than the presence of the average number of visitors. Some few of those present at the opening did on the last day take a farewell walk through the galleries, largely denuded of their contents though they were, with just a little depression of feeling at the thought that the collection that had been got together with such trouble and care, and that represented so much thought and skill, was about to be dispersed for ever. However, the last gong sounded, and the place was finally left in charge of the officials.

The contents of the late Exhibition, and the branches of art and industry it included, have been so frequently referred to in the *Journal* that they need not be alluded to now. There are, however, one or two points that afford interesting information. The attendance this year has not been so large as it was last year. In 1871 the curiosity that had slumbered for nine years was re-awakened, and many persons visited the Exhibition, not so much for the sake of the individual exhibits as to see the Exhibition. To such persons all exhibitions are alike, and it is not surprising that they have not put in an appearance this year. It is, however, rather remarkable that the attendance has shown such a steady average. There has been scarcely any fluctuation, no large attendances one day and small the next, but a steady two thousand, or thereabouts, have passed through the turnstiles every shilling day the Exhibition was open. It is, therefore, fair for the Commissioners to suppose that they may count upon a steady stream of visitors to their buildings whenever they throw them open to the public. That they are satisfied with such a steady stream may be gathered from the fact that the daily receipts enabled them to pay all expenses, and to carry over a handsome balance to the Exhibition of next year. Not only, therefore, has the late Exhibition been a highly interesting one, but it has also been a commercial success.

One feature of this year's Exhibition must not be overlooked, and that is the opening of it on Monday evenings at a reduced charge. Before the Exhibition of 1871 opened, it was suggested in this *Journal*, by a correspondent, that such would be desirable. The Commissioners did not, however, see their way to adopt the suggestion till the middle of the present summer, when, for the first time, the Exhibition was thrown open to the visits of those who are prevented from getting to it before six o'clock. Scarcely any announcement was made of the fact, and but very little publicity of it has been given amongst those whose special benefit is sought. It is to be hoped that next year, from the very commencement, on one, or more than one evening, will visitors be allowed to enter, that greater advertisement of the fact will be given, and that exhibitors will be induced to leave their exhibits uncovered, so that the Exhibition may not be divested of many of its most important features.

During the extra days in October on which the Exhibition was open to the public, sales of exhibits were permitted, and exhibitors found it worth their while to have a regular staff of assistants. It would be better, however, if a reasonable limit to the duties of such assistants was assigned. It is not every one who wishes to buy; and to be followed half up the gallery by a shopman, importuning you to buy an article for two pounds which has been marked four in the catalogue, is not pleasant. Besides, why, if such article can be sold for two, should it be marked four pounds. Exhibitors should remember that the price, as well as the manufacture and the design, are taken into consideration alike in judging the worth of a manufactured article, and that to claim double price for an article is about as false as to claim for an imitation the value of an original.

A very considerable number of the exhibits will be forwarded direct to the Exhibition at Vienna, which is to be held next year. The great "Walter" printing machine is packed up ready to go, and many of the most interesting of the articles that have this year delighted the British public, will next afford food for consideration to the Austrians and their visitors. It is a matter for congratulation that, though the public have had greater liberty than ever for inspecting the exhibits, and that this year private property of exceptional value has been exhibited, the Commissioners are enabled to restore every article to its owner uninjured. Those persons who are the fortunate possessors of articles of value or rarity may thus safely place them before the public, and give all an opportunity of enjoying the beauty they only possess. The programme of the 1873 Exhibition appeared in the *Journal*, No. 1,033.

His Royal Highness the Prince of Wales presided on Monday last, at Marlborough-house, over a meeting of her Majesty's Commissioners for the Exhibition of 1851. There were present—His Serene Highness the Duke of Teck, Mr. Ayrton, Sir Francis Sandford, Mr. Cole, Mr. Gibson, Mr. Hawksley, Dr. Playfair, and Major-General Scott (Secretary).

EXHIBITIONS.

Vienna Exhibition.—A meeting of her Majesty's Commissioners was held at Marlborough-house on Saturday. There were present—His Royal Highness the Prince of Wales, K.G., President; his Serene Highness the Duke of Teck, G.C.B.; his Serene Highness Count Gleichen, Capt. R.N.; Lord Henry Gordon Lennox, M.P., Sir Anthony Rothschild, Bart.; Sir Richard Wallace, Bart.; Mr. Hawksley, President of the Institution of Civil Engineers; Mr. Henry A. Brassey, M.P.; and Mr. Philip Cunliffe Owen, secretary. At this meeting plans of the covered space in the Exhibition allotted to Great Britain were submitted. It was found that the whole of the available space has been applied for, and the Commission decided that no further applications can be received for space in the British sections of the industrial, machinery, and agricultural buildings.—M. Thiers has devoted half a million of francs to the acquisition of space at the Vienna Exhibition, in order that the products of the various artistic industries and manufactures of France, such as the Sèvres china, and the tapestries and carpets of Gobelins and Beauvais shall be fully represented. It is also stated that a considerable portion of the covered spaces or courts between the galleries devoted to the French Commission are likely to be covered over, and thus to be added to the exhibition space, partly at the cost of the exhibitors. It does not appear that these spaces have in other cases been appropriated, except for objects which can safely be shown in the open air.

ACCOUNT OF SOME EXPERIMENTS ON THE OXIDATION OF IRON.

By Professor F. Crace Calvert, Ph.D., F.R.S.

Some two years since, Sir Charles Fox inquired of me if I could give him the exact composition of iron-rust, viz., the oxidation found on the surface of metallic iron. I replied, that it was admitted by chemists to be the hydrate of the sesquioxide of iron, containing a trace of ammonia; to this he answered, that he had read several books on the subject, in which the statements referring to it differed, and, from recent observations he had made, he doubted the correctness of the acknowledged composition of rust. He further stated, that if he took a bar of rusted wrought iron, and put it into violent vibrations, by applying at one end the fall of a hammer, scales would be separated, which did not appear to him to be the substance I had described.

This conversation induced me to commence a series of experiments, which I shall now detail.

I first carefully analysed some specimens of iron-rust, which were procured as far as possible from any source of contamination. Thus, one of these samples was supplied to me by Sir Charles Fox, as taken from the outside of the Conway-bridge, the other secured by myself at Llangollen, North Wales.

These specimens gave the following results, when submitted to analysis:—

	Conway Bridge.	Llangollen.
Sesquioxide of iron	92·900	93·094
Protoxide of iron	6·177	5·810
Carbonate of iron	0·617	0·605
Carbonate of lime	0·295	0·295
Silica	0·121	0·196
Ammonia	trace	trace
	100·000	100·000

These results clearly show the correctness of Sir Charles Fox's statements, that the composition of the rust of iron is far more complicated than it is stated in our text books. Therefore, the question may be asked, is the oxidation of iron due to the direct action of the atmosphere, or to the decomposition of the aqueous vapour; or does the very small quantity of carbonic acid which it contains determine or intensify the oxidation of metallic iron? To reply to these queries I have made a long series of experiments, extending over two years, which, I hope, will tend to throw some light on this very important question; and, although it appeared to me an easy matter to solve, still I have had many difficulties to overcome, which will be described as they occurred in the course of my investigation.

The first series of experiments consisted in placing crinoline and steel wires, very carefully cleaned, in tubes containing pure, dry, or moist oxygen; and in another series of tubes, containing the same gases, were added one per cent. of carbonic acid or a trace of ammonia.

Before describing the facts observed, I must state that the oxygen was prepared from pure chlorate of potash, mixed with a little binoxide of manganese, and the gas obtained passed through several feet of U-tubes filled with glass moistened with sulphuric acid and caustic potash. The carbonic acid was purified by washing it with water, and passing it through U-tubes containing sulphuric acid. The ammonia was purified by first passing it through a saturated solution of ammonia, and then over caustic lime. These purified gases were then introduced into tubes having one centimetre diameter and thirty centimetres in length, which had been previously filled with dry mercury, and containing an iron blade, to the bottom of which had been fixed a small mass of gutta-percha, so as to isolate the iron from the mercury, and prevent galvanic currents.

The results of the above experiments were so unsatisfactory that I was led to infer that I had overlooked some source of error; and it was so; small globules of mercury having adhered to the perfectly polished surfaces of the iron, had become centres of galvanic action, determining the oxidation on the blades, and thus rendering the series of experiments discordant.

To overcome this source of error, cleaned blades of steel and iron, having a gutta-percha mass at one end, were introduced into similar tubes to those employed in the previous experiments, and were placed over a mercury-trough; the atmospheric air was displaced by a current of pure oxygen conducted to the top of the experimental tube, and it was then easy to introduce into them traces of moisture, carbonic acid, and ammonia. After a period of four months the blades of iron so exposed gave the following results:—

Dry oxygen	No oxidation
Damp oxygen	In three experiments; only one blade slightly oxidized.
Dry carbonic acid	No oxidation.
Damp carbonic acid	Slight appearance of a white precipitate on the surface of the iron, found to be carbonate of iron; two only out of six experiments did not give this result.
Dry carbonic acid and oxygen	No oxidation.

Damp oxygen and carbonic acid	Oxidation most rapid, a few hours being sufficient; the blade assumed a dark green colour, which then turned brown-ochre.
Dry oxygen and ammonia	No oxidation.
Damp oxygen and ammonia	No oxidation.

The above results prove that, under the conditions described, pure and dry oxygen does not determine the oxidation of iron; that moist oxygen has only a feeble action; dry or moist pure carbonic acid has no action, but that oxygen containing traces of carbonic acid acts most rapidly on iron, giving rise to protoxide of iron, then to carbonate of the same oxide, and, lastly, to a mixture of saline oxide and hydrate of sesquioxide.

As these facts tend to show that carbonic acid is the agent which determines the oxidation of iron, I am justified in assuming that it is the presence of carbonic acid in the atmosphere, and not its oxygen or aqueous vapour, which determines the oxidation of iron in common air.[*] Although this statement may be objected to at first sight, on the ground of the small amount of carbonic-acid gas existing in the atmosphere, still we must bear in mind that a piece of iron, when exposed to its influences, comes in contact with large quantities of carbonic acid during twenty-four hours.

These results appeared so interesting, that I decided to institute several series of experiments.

First Series.—Perfectly cleaned blades of iron placed in bottles, filled with ordinary Manchester water, were rapidly covered with rust, whilst similar blades, placed in the same water previously deprived of air and carbonic acid by boiling, remained free from rust for a period of four weeks; thus proving that oxygen and carbonic acid are necessary for the production of oxide of iron in presence of water.

Second Series.—Into bottles filled with some pure distilled water (which had been boiled and then allowed to cool in corked flasks) blades of iron were introduced, and a part of the water in the bottles was displaced by common air, pure oxygen, or carbonic-acid gas; but the results were unsatisfactory. I then decided to keep the upper part of the blade dry; to effect this, cleaned blades of crinoline-wire were introduced into bottles containing pure oxygen, and then boiled, and cooled distilled water was introduced by means of an aspirator, until only half the blades were immersed in the water. By this method I was enabled to ascertain the comparative degree of oxidation of that part of the blade dipping in the water, and the results observed were as follows:—

The section of the blades out of the water remained bright for several days, whilst that in the water became attacked in about six or twelve hours; and the deposit increased so quickly that, after two or three days, the blade was entirely covered with an ochre deposit of the hydrated sesquioxide of iron. This rapid oxidation of iron under these circumstances appeared to me to be entirely due to a galvanic current; for the oxide was deposited in two separate columns, which left the outside edges of the blade perfectly bright as well as the centre of it, each separate column apparently representing the poles of a battery. In fact, the production of this precipitate was so rapid that, after a short time, a considerable amount was found as a deposit in the bottle.

To be certain that the oxidation of the immersed portion of the blade was not due to the fixation of oxygen dissolved in the fluid, but to the decomposition of water through a galvanic current, I examined the gaseous mixtures existing in the upper part of the bottle, and found hydrogen in large quantities, thus proving that the water had been decomposed, its oxygen being fixed by the iron, whilst the hydrogen was liberated.

Action of Oxygen-carbonic Acid on Iron in presence of Water.

To ascertain the influence which carbonic acid exerts on the oxidation of iron, I prepared mixtures of oxygen and carbonic acid in the following proportions:—

25	of oxygen to	75	of carbonic acid.
50	,,	50	,,
75	,,	25	,,
84	,,	16	,,
88	,,	12	,,

Having introduced iron blades and the above gaseous mixtures into bottles, they were inverted over water, so that their necks dipped into this fluid; when half the gaseous mixture had been displaced by aspiration, as in the previous experiments, the following results were obtained, viz., whilst that portion of the blade standing out of the water in the previous experiments remained for weeks unoxidized, in this series the same section of the blade assumed rapidly a dark colour, which became afterwards of a dark brown. This change of colour was no doubt due, first, to the formation of carbonate of the protoxide of iron, mixed with carbon existing in the iron, and then the excess of oxygen in the mixture converted the carbonate into magnetic or saline oxide of iron, with a little sesquioxide of iron. Whilst these phenomena were proceeding with that portion of the blade exposed to the gaseous atmosphere, the one dipping into the aqueous solutions was observed to lose its brilliant and metallic lustre in a few minutes, presenting a black appearance, which became, at the end of three hours, of a dark greenish hue, due to the formation of similar compounds as those above described.

In all these experiments the water became not only turbid after a short time, but on the surface of the same floated a considerable amount of magnetic oxide and carbonate of the protoxide of iron, and which varied in quantity according to the relative proportions of oxygen and carbonic acid employed. This series of experiments confirms again the previous ones, that carbonic acid is a most active agent in determining the oxidation of iron.[*]

Action of Carbonic Acid on Iron in presence of Water.

Having studied the action of oxygen, and of carbonic acid and oxygen, on iron in the presence of water, I was desirous of ascertaining what would be the action of carbonic acid and water. I operated in a similar manner as in the previous experiments, and observed that the blades in the gaseous mixtures had assumed a dark grey appearance; that in the liquid was black, the carbon having been rendered perceptible by the iron having been dissolved as carbonate of protoxide of iron, soluble in the excess of the carbonic acid. After a few days, a perfectly white deposit was formed on the edge of the water, which gradually increased, and became so abundant that some fell to the bottom of the vessel. Water had been decomposed and hydrogen liberated.

I again made another experiment, which further illustrates that carbonic acid is the real determining agent of the oxidation of iron. Thus, a blade of steel placed in pure water, which had previously been deprived of all gaseous mixtures by long boiling, and then allowed to cool, the metal remains bright for several days, and when any signs of oxidation appeared, it was only on a few parts of the blade. The careful examination of this fact led me to infer that the limited action which had taken place might be attributed to traces of impurity in the iron; and this view was supported by the previous observations described, on the influence which minute globules of mercury exert on the oxidation of iron, as well as the known influence which a few thousandths of antimony, platinum, tungsten, sulphur, phosphorus, &c., impart to iron; and, again, the facts I published a few years ago, that, by covering the one-hundredth part of a blade of iron with zinc, the whole of the blade is prevented from rusting when plunged in soft or sea-water; whilst platinum, under the same circumstances, promotes, in a marked degree, the oxidation of iron. Therefore, if a minute quantity of a substance modifies the properties of iron, so as to facilitate or retard its oxidation, we may, I think, fairly assume that any impurity in the purest steel (watch-springs) may give rise to the few specks of oxide which were observed in the steel placed in boiled distilled water.

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[*] These results prove the statement of Bonsdorff (see Gmelin, vol. v., p. 185), that carbonic acid has no action on iron, is in correct.

[*] The composition of the various deposits above described was not assumed, but was determined by careful analysis.

Whilst I was engaged in the above experiments, it occurred to me that it might be useful to make a series with the view of throwing light, if possible, on a fact stated by Berzelius, and well-known to alkali and soap manufacturers, viz., that caustic alkalies have the property, even when dilute, of preventing the oxidation of iron.

Do the alkalies possess the curious property of rendering the iron "passive," or, as Berzelius has supposed, is the iron in a negative electrical condition? This is a very difficult question to solve. From many observations I have made, I am led to believe that the iron is in a passive state; and this opinion is based, not only on the known data that a blade of iron is not attacked by strong nitric acid, and that we have no electrical current, if one fluid and one metal are brought in contact, whilst if two fluids and a metal, or two metals and one fluid, are employed, a galvanic current is generated. My experiments show that not only caustic alkalies possess this peculiar property, but also their carbonates and bicarbonates; and I hope that the following experiments will throw some light upon this point. A blade of polished iron was dipped into a solution of caustic soda, and at each end of the blade was attached a wire, communicating with a galvano-multiplicator, and no galvanic current was generated; and, again, when blades of perfectly polished hoop-iron were placed in bottles half-filled with solutions of caustic alkali, carbonates, and bicarbonates, containing from one to five per cent. of these compounds, and only a part of each blade was immersed in the solution, the other parts being exposed to atmospheric air enclosed in the stoppered bottles, the results were that, after three months, neither that portion of the blade dipping in the liquid, nor that in the atmosphere, was in any way rusted in the solutions containing five per cent. of alkali; and in the experiments with one to two and-a-half per cent., only part of the blades out of the water were slightly oxidised.

I was much surprised to find that the carbonates and bicarbonates of the alkalies acted in the same manner as their hydrates, in preventing the oxidation of iron, not only on that part of the blade immersed in the solutions, but also on that which was exposed to a damp atmosphere of common air. Previously to obtaining these results, I was inclined to believe that caustic alkalies prevented the oxidation of iron by absorbing the carbonic acid of the atmosphere; but, as carbonates, and even bicarbonates, act in a similar manner, it is evident that this view of the action was erroneous.

The results above stated not coinciding with those obtained by Payen and given in Gmelen (vol. v. p. 185), I repeated his experiments, and found that the portions of the blades of iron immersed in dilute alkaline solutions, as described by him, are preserved from oxidation, but that the portion out of the liquor becomes covered with oxide, which increases in inverse ratio to the length of the solution, and that when the proportion of 1 part of the alkali to 2,000 parts of water is reached, the oxidation of the iron proceeds rapidly on that part of the place just above the surface of the water.

The series of experiments confirms the opinion already expressed that the iron exists in a passive condition, and that this condition only attains sufficient power to resist oxidation by atmospheric oxygen when there is 5 per cent. of either hydrate or carbonates of alkalies in solution.

I have repeated also M. Payen's experiments on the preservative action of weak solutions of carbonate of soda, and find that my results do not correspond with his. He states that 1 part of a saturated solution of carbonate, when diluted with 54 parts of water, will preserve iron from rust, while 1 with 59 will not. I find that the iron rusts in both cases, thereby proving that stronger solutions are necessary to prevent oxidation.

I have made many experiments with the view of discovering the cause of this interesting preservative action which alkaline solutions exert on iron, but have failed. Knowing the destructive influence which sea-water has on iron, and the serious injury done on iron ships through the action of bilge-water, a series of experiments were made with sea-water, to which was added such a quantity of caustic soda, or potash, or their carbonates, that, after the salts of lime and magnesia were decomposed, there still remained in the solutions 1 to 5 per cent. of alkalies or the alkaline carbonates; and when iron blades were introduced into such liquids, they gave the same results as when iron had been dipped partially into an alkaline solution of Manchester water. I would propose, in conclusion, that a certain quantity of soda-ash should be introduced from time to time into the bilge-water of iron ships, as by so doing a great saving would be effected, as it would prevent the rapid destruction of such ships.

After reading the above paper, Mr. E. Hunt inquired whether I had made experiments to ascertain if the presence of caustic alkalies or their carbonates, when mixed with sugar, prevented the marked action of that substance on iron. Considering this a most important question to determine, as iron ships are rapidly destroyed when used for conveying sugar from the colonies to this country, I instituted the following series of experiments:—

Blades of iron were partly immersed in a solution containing 10 per cent. of sugar, and in similar solutions to which had been added $2\frac{1}{2}$ to 5 per cent. of caustic and carbonate of soda; after a month the same results were obtained with the saccharine as with the aqueous solutions. But as it would be impracticable to use solutions of caustic or carbonated alkalies in the holds of ships laden with sugar, I thought it therefore advisable to try what might be the influence of zinc, when attached to iron, in preventing its oxidation, and am glad to say that a piece of zinc covering about a fifteenth part of the blade preserves the iron from rusting in that part of the blade immersed in the sugar solution. The use, therefore, of plates of zinc fixed on the sides of an iron vessel, or, perhaps better, the employment of galvanized iron plates in the construction of ships, deserves the attention of shipowners.

GENERAL NOTES.

Bethnal-green Museum.—A congratulatory dinner to Sir Antonio Brady, on the establishment of the museum, was given on the 22nd inst. The Society of Arts gave 100 guineas towards the building fund.

Telegraphic Communication was established on the 22nd inst. direct between Australia and England, and congratulatory messages were sent between the Lord Mayor of London and the Mayor of Melbourne.

Channel Passage.—A prospectus has been issued of the English Channel Steamship Company, with a capital of £100,000., in shares of £10, to construct steamers on the plan of Captain Dicey's patent, the particulars of which have been before the Society. The cost of the vessels is calculated at £75,000 each.

MEETING FOR THE ENSUING WEEK.

Fri......Geologists' Association, 8. Mr. Hyde Clarke, "On the Influence of Geological Reasoning on other Branches of Knowledge."

Journal of the Society of Arts.

No. 1,041. VOL. XX.

FRIDAY, NOVEMBER 1, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

EXAMINATIONS, 1873.

In accordance with the Report of a Committee appointed to consider the propriety of rescinding the resolution for discontinuing the Examinations, the Council have decided to continue them in the following subjects, for the year 1873:—

- Arithmetic.
- Book-keeping.
- Floriculture.
- Fruit and Vegetable Culture.
- Logic.
- Political Economy.
- English History.
- English Language.
- French, including Commercial French.
- German, including Commercial German.
- Italian.
- Spanish.
- Theory of Music.

It will be seen that several of the subjects in which Examinations were held this year have been omitted, and that French and Commercial French have been combined, as well as German and Commercial German.

The object with which these Examinations were instituted was to give a stimulus to the acquirement of certain branches of knowledge by adults of the working and middle classes, but some of the above subjects are now, or shortly will be, under the recent Education Act, so generally taught that this stimulus will no longer be necessary, and the Council have only retained them in deference to the strong wish of several of the Institutions. These remarks specially apply to Arithmetic, and it appears that about one-fifth of the Candidates who obtained Society of Arts' Certificates this year in that subject also passed in Elementary Mathematics under the Science and Art Department.

The Programme will be issued with next week's *Journal.* With the exception of the omission of the subjects already referred to, it will not differ materially from that for the examinations of 1872.

The Papers for the Elementary Examination will be supplied as usual.

Secretaries of Institutions and Local Boards are requested to make this decision public as soon as possible.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Bow and Bromley Institute, Bow, E.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

INTERNATIONAL EXHIBITION, 1872

The Council, having been informed that Her Majesty's Commissioners do not intend to publish reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such reports, for publication in the Society's *Journal.* The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following is the sixth of the series. The others will appear from time to time.

RAW COTTON AND THE COTTON PLANT AT THE INTERNATIONAL EXHIBITION OF 1872.

Ten years ago, during the Exhibition of 1862, the dominions of King Cotton were not only in a greatly disturbed condition, but were even threatened with revolution. The privations and sufferings of a protracted famine had produced much discontent, and various pretenders appeared from time to time, to assert their claims to supremacy, and to offer to the famished subjects assured comfort and plenty. The cotton famine had reached its height, thousands were destitute of employment and the means of subsistence, and, whilst every part of the globe was ransacked for cotton, inventive genius was busily at work to find a substitute which should never fail. Various were the materials which in succession came forward to take the place of cotton, and which were confidently declared to possess all the requisite qualities. Amongst the most conspicuous were rhea, flax, hemp, jute, willow-fibre, Italian grass, &c., all of which, when carefully tested by competent judges, were pronounced worthless for the purpose intended. "Jute-cotton" at one period was all the rage, and so firm a hold did it take of the imagination for a time, that the price suddenly advanced 70 per cent., but the bubble soon burst, and its glory departed. From Africa specimens were brought of a plant, the name of which was kept a profound secret, but which, when subjected to a chemical process, was said to yield a substance perfectly resembling cotton. Several pieces of stuff were woven from it, and submitted to the late Emperor of the French; they were described as stronger than cotton tissues, equal in fineness, and 60 per cent. cheaper. A company was formed to provide this substitute on a large scale, but nothing has since been heard of its progress and success.

At length, however, in the autumn of 1862, before the Exhibition had closed, pæans of triumph were heard far and wide, and a formidable rival was heralded, to dispute the rights of King Cotton to reign. A substitute was discovered which, it was fully believed, would not only answer all the purposes of cotton, but would prove to be superior to it in fineness and strength. An abundant supply, at a cost not greater than the price of American cotton in ordinary times, was at hand, so that an end could at once be put to the prevalent distress, and immediate employment be afforded to the industrious multitudes then dependent on doles of charity for the means of subsistence. A favourable verdict was pronounced by Liverpool experts, who reported that, for colour, length, and fineness, the material was all that could be desired, whilst competent judges in Manchester declared that the fibre was quite suitable for spinning purposes, as far as could be ascertained from the samples shown. Thus for a season the *Zostera marina* was hailed as the great and long-sought deliverer. Its popularity, however, soon began to wane; it was found to be no better than other pretenders, the expectations formed of it failed to be realised, and, sharing the fate of all previous efforts to find a substitute, it quickly sank into oblivion. Cotton still maintains its ascendency, and notwithstanding all revolutionary attempts to depose it, is as much king as ever.

During the Exhibition of 1862, representatives from all parts of the world where cotton could be grown met in council, to discuss the possibility of overthrowing the despotism which had so long been established. America then held the supreme sway; American cotton was king, but now the time seemed to have come when this should no longer be permitted, and measures were discussed and concerted to render the restoration of American supremacy impossible. Dependence upon one source of supply had long been contemplated with uneasiness, and the obvious disasters to be anticipated should that source from any cause become wholly or partially closed, produced an ever-increasing anxiety to obtain the raw material required by our manufacturers from other quarters. A great and important trade might at any moment be paralysed or lost through a capricious season, the outbreak of war, or some social or political convulsion. So great was the tyranny incident to this state of dependence, that more than once the taunt had been uttered that England would not dare to take any course which would involve the loss of the American supply of cotton, and throw more than two millions of people out of employment. To afford relief to the oppressed sons of Africa, and to procure free instead of slave-grown cotton, had long been an object of earnest desire, and had stimulated exertions in India and other territories under the dominion of the British Crown. An opportunity seemed now to be afforded of ascertaining the cotton-growing capabilities of almost every part of the globe. No fewer than 35 different countries had sent cotton to the Exhibition of 1862, representing Europe, Asia, Africa, America, and Australia. In the conference which was held to consider how the opportunity which had arisen could be best turned to account, it was demonstrated that, as regards soil and climate, there was no difficulty in producing cotton to any extent, and in districts almost without number; nevertheless, it was as conclusively shown that there were formidable and nearly insurmountable obstacles to be overcome before America could be superseded as the great source of supply. Want of labour, want of roads, want of capital, want of enterprise and skill, the immobility and stereotyped characteristics of Eastern and half-civilised races, with other causes, tended greatly to repress the sanguine expectations which at first were entertained. The terrible disorganisation and enormous burdens which were sure to be the results of the war then raging seemed to preclude the possibility that the cotton states of America should, for many years to come, if ever, regain their ascendancy. The field was relinquished to the rivals of the great cotton king, and nothing remained but for them to go in and conquer. A powerful stimulus was thus given to the growth of cotton in all directions; a degree of activity and enterprise never witnessed before was seen in India, Egypt, Turkey, Greece, Italy, Africa, the West Indies, Queensland, New South Wales, Peru, Brazil, and other districts of Central and South America, and, in short, wherever cotton could be produced; and there seemed no room to doubt that in a short time there would be abundance of cotton, even if America should cease to be a source of supply.

Ten years have since passed away, and the present Exhibition, in which cotton is made specially prominent, affords an opportunity to compute the results. Some of the thirty-five representatives of 1862 again appear, but for the most part it is only to bear witness to disappointment and failure. America has re-entered the field of competition, and is able to bid defiance to the world. Slave labour has disappeared, the prognostications of its abettors have been falsified, and American cotton is again supreme. No other can compete with it, and we are nearly as much dependent on this one great source of supply as we were before the cotton famine. Italy, Greece, Africa, the West Indies, and other numerous smaller contributories, not excepting even Turkey, do little or nothing more than they did ten years ago. Queensland and our other colonies still send mere driblets; the Brazils and Egypt are limited in their production by the sparseness of their population; and India, which has been so greatly enriched by cotton cultivation, upon which so much wealth, and exertion, and skill have been expended, with its model farms and cotton commissioners, and to which all eyes were directed as the cotton-field of the future, destined to take the place of America, still disappoints our expectations, and is only ancillary to the great ruling-power. True, the supply of cotton from India has been more than doubled during the last decade, and the adulteration once so rife has, by incessant vigilance and exertion, been greatly checked; whilst, owing to improved machinery for cleansing and preparing it for market, it comes forward in better condition than formerly, but it is still so inferior to the production of the United States, that it is only freely taken when the American supply becomes scarce. The Indian collection of cotton samples, cotton soils, cotton implements, cotton plants, and cotton seeds, which it does not devolve upon us to describe, is complete and extensive, and shows, in a striking manner, what has been done on a small scale, and what might be done more largely if adequate means were employed.

Leaving the Indian cases and samples, which will be found to be highly interesting, attention is naturally first arrested by the cotton-plant itself, of which there are not only numerous pressed and dried specimens to be seen, but also trees in actual growth, exhibiting the flowers and fruit of the different varieties (No. 4,471). The plant-house presents special attractions to those who have never visited cotton-growing countries, and have never had the opportunity of feasting their eyes upon the foliage, the blossoms, and the fleecy fruit of the tree which affords material for the clothing of all nations. Whether considered botanically or commercially, the cotton-plant is a highly-interesting and important subject of investigation; but to the great mass of the people, not excepting even those who derive their subsistence and wealth from the manipulation of cotton, the plant itself is almost entirely unknown. Even the great centres of the cotton industry do not contain any repertory of the plant; neither Liverpool nor Manchester possesses a conservatory appropriated to its growth; and any one wishing to study it must find his way into some private hot-house, or into the national establishment at Kew, and even here it only appears as a rare specimen amongst other tropical curiosities. Provision, however, has been made in connection with this year's Exhibition for showing the cotton-plant in the various stages of its growth. A handsome span-roofed structure, heated to the proper degree of temperature, has been prepared, and the whole arrangement was placed under the able direction of Major Trevor Clarke, who has so long made the rearing and study of the cotton-plant a speciality, and who, aided by competent assistants, has left nothing undone to ensure success. A rare collection of about 100 plants, produced under Major Clarke's own superintendence, has thus been exhibited, comprising all the varieties which supply the raw material required by our manufacturers, to which some curious and interesting sorts were added from time during the progress of the Exhibition. A complete botanical collection was originally intended, but this was subsequently abandoned by the Commissioners, who resolved to have merely well-grown specimens of the commercial sorts shown in flower and fruit. The sorts that can be cultivated with a view to show fruit and flower in a glasshouse in England are but few, to wit, New Orleans, Sea Island, Egyptian, and the native Indians; the Brazilian and Peruvian forms, with many other large-growing, shrubby, and arboreous sorts will not be coerced into fruit and flower here. There was, however, an almost perfect collection of the leading commercial kinds, including, besides the varieties already enumerated, Sea Island crossed with New Orleans (green seed), Borneo, Chinese, North-Western Provinces of India, Hingunghât, Juree, vine-cotton (Cuba), Assam, arboreum, and various hybrids raised by Major Clarke, who furnished the seed from which nearly all the plants were produced. An interesting set of plants was grown from seeds sent to Kew by the Cotton Commissioner from the experimental farms in the Berars, the Central and North-Western provinces. A remarkable collection of hybrids was shown amongst the dried specimens (No. 4,472), and the most valuable portion was to be seen in the quiet black butterfly cases which lined the window-sills in the machinery-room.

The plant has been, and still is, subject to much mystification, and considerable confusion exists as to the proper classification. The arboreum, or tree cotton, is an example. Botanically considered, the only species entitled to this specific designation is the purple-blossomed, green-seeded short-stapled, small cotton-tree of India, but this true Indian tree-cotton is confused with the tree-cottons of the west, which are themselves again confused with one another. Some give the name arboreum to the Brazilian kidney cotton, which, if allowed to stand, will form a stout, robust, small tree, as thick as a man's leg, with large, luxuriant leafage, and bearing a strong long-stapled cotton. Some of the more robust black seed cottons, if left unpruned, will probably attain like dimensions. Almost all parts of the world, Brazil, Peru, the West Indies, the islands of Polynesia, the continent of Africa, all have one sort or another of these tree-like species. The Bourbon makes a spreading small tree in the tropics, and there is an arboreous race in Brazil besides the kidney cotton tree. A remarkable species, brought by Sir Samuel Baker from Central Africa, said to bear red blossoms—quite a new feature in the occidental races, and which may be seen in the collection at Kew—seems inclined to be arboreous. Major Clarke would render an important service if he would give us a treatise on the different branches of the *Gossypium* family, and remove much of the confusion in which its genealogy is now involved. As there are duplicates and spare plants of all or most of the sorts in the collection at South Kensington, which might doubtless be procured by persons really interested in the subject, it is to be hoped that some permanent collections may grow out of this one at the Exhibition, which is the most complete that has ever been seen in this or any other country.

Whilst in its various manufactured forms cotton is not much of a novelty, but few comparatively have any idea of the full value of the wonderful plant by which it is produced. Every one knows that the wool is converted into various articles of clothing, some of which bear the somewhat cabalistic names of Madapollams, Tanjibs, Silesias, Dhooties, Mulls, drills, domestics, &c.; but besides this, everything else belonging to the plant is now utilised and turned to profitable account. Whilst not more than one-third of the produce of the plant consists of clean cotton, after passing through the process of "ginning," and is converted into yarn and cloth, the remaining two-thirds, being seed, not only supply the germ of future cotton harvests, but the surplus over and above what is required for sowing, comprising many thousands of tons, is converted into oil, some of which, when refined, is used to mix with olive oil; into cake for feeding cattle; into a valuable material for making paper; and the ultimate residuum or refuse into soap. Not only so, but the very stalks of the plant are made to answer a valuable purpose; and besides being used for thatch and baskets, some specimens of which were to be seen in the Exhibition (No. 4,485c.), they also supply a fibre that can be converted into gunny and other kinds of cloths equal to those manufactured from jute. The possibility of utilising this gossypium fibre has not only been tested by actual experiment in India, but has also attracted some attention in the United States, as likely to furnish a material that may be used in the manufacture of the common kinds of paper. There seems little doubt that it can be turned to useful purposes, even though the most sanguine expectations that have been formed should not be realised. Besides the living plants, an American tree, covered with bolls of the New Orleans variety, has been exhibited by the Cotton Supply Association (No. 4,480c.), together with some remarkably fine cotton pods obtained from different countries (No. 4,480AB). It would have been a great defect if an Exhibition giving special prominence to cotton, had not afforded the opportunity for making the plant itself, which supplies the raw material of so important a branch of our national industry, the subject of careful observation and study.

Next to the United States of America, the most important cotton-growing country is India, which retains a large proportion of its production for the various purposes of home consumption. The Indian collection is extensive and varied; it has been obtained from the different districts where the plant is cultivated, and it contains carefully selected specimens of the chief indigenous and exotic kinds. In the vicinity of the Indian collection are samples from Fiji, Tahiti, and Australia (Nos. 4,474, 4,485*), grown chiefly from Sea Island seed, with some specimens produced from Brazilian or kidney seed. That the Fiji Islands are capable of producing excellent long-stapled cotton has been sufficiently proved, Sea-Island cotton having been grown in considerable quantities, and in some cases by settlers from Lancashire. In the Exhibition of 1862, Fiji did not appear at all amongst the different countries which came forward to furnish the eagerly-coveted and much needed fibre. Indeed, at that period cotton, as a cultivated crop, hardly had an existence in Fiji, but now the islands are becoming every year of increasing importance as a source of supply. The plant is perennial, producing two and sometimes three crops in the year. The value of the cotton exported in 1865 was under £10,000, but last year it had reached £100,000. The chief difficulty has been to find sufficient labour, but as this becomes diminished there is little doubt that the cultivation will extend, and the present area of 10,000 acres will be greatly exceeded. Some of the cotton from Mango Island, which was purchased a few years ago by several brothers who emigrated from England, and have ever since continued persistent and successful cotton growers, has realised since the American war as much as 5s. per lb. Great improvement has been effected by the careful selection of seed, and by due attention to the cultivation. The number of emigrants pouring in from the Australias and elsewhere justifies the expectation of further and rapid progress, especially should a more settled government be established. Tahiti is also a new cotton-producing country, which did not appear amongst those that furnished samples to the 1862 Exhibition. The Tahiti Cotton and Coffee Plantation Company has now been in operation for several years, and has sent forward some fine samples grown from Sea Island seed. Considerable consignments have been made, from time to time, both to London and Liverpool, and the advantages accruing to the island from the successful attempt to establish cotton cultivation were fully recognised and described in a report of the Imperial French Commission, as well as in repeated communications from her Majesty's consuls. The land thus planted with cotton, consisting of many thousands of acres, had previously been lying waste, but a large emigration of Chinese furnished an industrious and intelligent race of labourers for its cultivation; efficient steam-engines, roller-gins, and hydraulic presses have been brought into use, and there seems no reason why the growth of cotton in Tahiti should not be greatly extended.

The samples of cotton exhibited from the Australian colonies (Nos. 4,454, 4,480, 4,485a, 4,485*) are sufficient to confirm the conviction long entertained, that those dependencies of the British Crown are fully capable of furnishing our manufacturers with large quantities of the raw material which they require, and that, too, of a superior quality. With millions of acres of untouched virgin soil, many feet deep, and in the very zone where cotton grows to perfection, it is natural to ask why should not the precious material be produced in abundance, and why should we continue to be so largely dependent upon sources of supply which must always be more precarious than those under the control of our own government? The colonies and dependencies of Great Britain, including India, seem well able to grow all the cotton that we need, but they have hitherto failed to realise our expectations; and notwithstanding the bitter experiences of the past, we are still without any effectual security against the recurrence of a cotton famine, if from any cause we should again lose our American supplies. The great and almost exclusive difficulty encountered in Australia arises from the scarcity and costliness of labour. Other discouragements occasioned by floods and the inclemency of exceptional seasons, long droughts or heavy inundations, have also severely tried the constancy and perseverance of new settlers, but in these cases cotton has upon the whole suffered less than many other crops. Though, however, the climate is somewhat capricious, there is every reason to hope that, as the population increases, and the resources of the colonies become more fully developed, cotton will be more largely produced, and will be supplied to us in greater abundance. Its quality is such as to ensure for it a ready and cordial welcome in the English market, and it is to be hoped, for the sake of the Australias themselves, that their pre-eminent cotton growing capabilities will not be allowed to lie dormant, but will become increasingly a source of wealth and prosperity.

The Santos cotton (Nos. 4480—4485*), the growth of the province of Saô Paulo, which did not appear in the Exhibition of 1862, affords a remarkable example of the success which has attended some of the efforts made to open up new sources of supply. About ten years ago, a small quantity of seed was sent from Manchester by the Cotton Supply Association for an experiment, and was freely distributed to any one disposed to attempt the cultivation of cotton. It was generally and eagerly taken, and so great was the interest excited by the results, that when the following year a still larger quantity of seed was sent, it was found to be insufficient to meet the demand for it which had arisen. The success of the experiment far exceeded the most sanguine expectations that were formed. Though cotton had previously had no place in the Saô Paulo tables of exports, yet in the first year after the seed had been supplied, 87 arrobas, of 32lbs. each, were shipped to Europe; in the second year, 886 arrobas, and thus the increase continued until the supply from this entirely new source became nearly one million of arrobas, or about 100,000 bales of 300lbs. each, a quantity as large as had ever been obtained from the whole of the Brazils in any one year previous to the American War. Her Majesty's consul at Santos, in a despatch to the Foreign-office, describing the progress of cotton cultivation, stated that the province of Saô Paulo, which contains not less than 72,000 square miles, is well adapted to the growth of cotton, and that the people, formerly so poor, were, in consequence of this new branch of industry, becoming rapidly wealthy. The cotton thus produced being grown from New Orleans seed is of the kind most wanted, and experienced Southern planters have pronounced it to be fully equal in quality to that of the United States. The province seems to possess an extraordinary capacity for the production of cotton, the cultivation of which can scarcely fail to be maintained and extended.

The South American Republic of Venezuela, which sent some specimens of excellent cotton to the Exhibition of 1862, which attracted special attention, again appears with representative samples, showing that considerable progress has since been made (Nos. 4,475, 4,480). The inquiries prosecuted in every direction during the cotton famine, tended to show that immense districts in Venezuela were well adapted to the growth of the staple, and that the small quantity then produced was fully equal in quality, if not superior, to that of the United States. Some cotton from Maracaibo, in 1862, was sold in Liverpool at 2s. 5d. per lb., when Orleans cotton was selling at 1s. 1d. per lb., and sanguine hopes were entertained that large supplies would be procured from this source. There were thousands of acres that could be brought into early cultivation; the government appointed a commission to encourage and assist the growth of cotton which could be brought as quickly to Liverpool as from the United States; and there seemed to be every assurance that the exertions to supply cotton from that quarter would be continued and speedily rewarded. These expectations, however, have not been fulfilled, although the samples now exhibited fully demonstrate that excellent cotton can be produced in Venezuela. One of the samples exhibited is described as "wild" cotton; but "uncultivated" would have been a better designation, as what is meant is, that the trees formerly cultivated have now for some years been allowed to run wild.

A large and interesting collection of Italian cotton (Nos. 4,485a—4,490) demands special notice. It has been prepared by the Cavalier W. P. Jervis, Conservator of the Royal Industrial Museum at Turin, and comprises 114 specimens from some 80 different localities or communal territories, and which are arranged geographically and according to species. A map of Italy is supplied, showing the means of communication with the various places from which cotton is obtained, and marking all the lines of the regular postal steamers. On each sample is also marked the means of communication from the port whence steamers sail nearest to the place of its growth, showing the distance by road or railway. The collection is accompanied with a memorandum, tracing the rise and progress of the cotton industry in Italy, with important details of the past and present condition of cotton cultivation. Cotton had been grown in Sicily long anterior to its manufacture in Manchester, and long before the existence of any European colony on the continent of America, while the Red Indians had undisturbed possession of its boundless plains, and was then, as now, cleaned by a primitive wood apparatus, called "manganello," identical with the "churka," still so extensively used in India.

In the Exhibition of 1862, Italy appeared to be one of the most promising countries to which attention was directed for the production of cotton. A complete illustration of what the country could supply was then afforded, and a careful examination of the samples, exhibited by skilled experts, showed that whilst some of the cotton was of excellent quality, but badly grown, gathered without regard to the proper time, and greatly injured by the imperfect machines employed in cleaning it, a large proportion was the produce of an inferior kind of plant, cultivated without care or attention. The result was a determination to induce the growers to abandon the weak-fibred, short-stapled species, of a fawn or reddish yellow colour, which had been commonly grown by the peasants of Calabria and Sicily, and to introduce New Orleans American seed, as likely to prove more serviceable and profitable. The improvement of cotton cultivation was accordingly taken up with earnestnes by the Italian government, and a Royal Commission was appointed, with Commendatore De Vincenzi, the present Minister of Public Works, at its head. Organisations, comprising the leading men in the several districts adapted to the growth of cotton, were formed, for the purpose of corresponding and co-operating with the Commission. Information respecting seed and machinery was thus widely distributed, and practical directions, of the highest importance to the cultivator, were at once supplied. A complete set of samples of cotton, from every part of the world, was procured, and experiments with different descriptions of seed were tried in the various cotton-growing regions of Italy; whilst, at the same time, the services of Professor Parlatore and other eminent botanists were secured, in order that no means might be left untried to ensure success. At an Exhibition held in the Industrial Museum at Turin, in 1864, some 300 cultivators offered samples of their cotton, at which also the principal gins made in England, France, and America were entered for trial, and were daily worked under the superintendence of the makers, or their representatives, for a period of two months. Ploughs, hoes, cultivators, spades, and other agricultural implements in use in England, France, Switzerland, and America were also exhibited, so that everything calculated to be of service to the cotton-grower might be brought under his notice. The utmost enthusiasm was everywhere manifested, and confident hopes were entertained that cotton cultivation was about to prove highly conducive to the wealth and prosperity of the country. The investigations of Professor Parlatore led him to the conclusion, after careful experiments in planting, that there are only seven species of cotton, the rest being merely varieties. These are:—

1. *Gossypium arboreum*, Linn., found in Ceylon, the Moluccas, Arabia, Abyssinia, Senegal, &c.
2. *G. herbaceum*, Linn., growing in Siam, China, India, Italy, &c.
3. *G. Sandwichense*, Parl., indigenous to the Sandwich Islands.
4. *G. hirsutum*, Linn., including Siamese, Bourbon, Upland, Georgia, and Louisiana cotton. Sometimes it produces nankeen-coloured cotton.
5. *G. Barbadense*, Linn., including Sea Island and Barbadoes cotton, with long staple.
6. *G. Tahitense*, from the Society Islands, Tahiti, &c., in the Pacific.
7. *G. religiosum*, Linn., comprising Peruvian and other cottons, principally with seeds in adherent files.

The improvement effected by these efforts was seen in the samples sent to the Dublin Exhibition, in 1865, the Naples Cotton Exhibition in 1866, the Paris Exhibition of 1867, and is manifest in the samples in this year's Exhibition at South Kensington. It is matter for regret that, so soon as the government ceased to accord a subsidy to the Royal Commission for promoting the cultivation of cotton, the landed proprietors generally abandoned their experiments, before their labourers had been able to acquire the requisite knowledge and skill, under the pretext that, the American war being over, cotton would return to its normal value. The present great centres of cotton cultivation are around Bari and Barletta, on the Adriatic coast; in the vicinity of Salerno, Sarno, and Castellamare, south of Naples; in the region stretching south of Etna, as far as Catania, on the southern shores of Sicily, facing Malta, in the provinces of Caltanissetta and Girgenti. The cotton of these four districts is known in commerce by the several names of Pugliar, Castellamare, Biancavilla, and Terranova cotton. In the island of Sardinia, and elsewhere cotton is grown, but the quantity is too insignificant to demand notice. Since 1862, railways have been constructed, and are now working in most of the cotton districts; excellent roads, too, have been so generally provided during the last ten years, that it is rare to find a town of any size without ready means of communication with the rest of the world. Postal and other steamers call at the principal towns all round the coast on fixed days, weekly, bi-weekly, or fortnightly, so that the cost of carriage is not a tithe of what it used to be. A regular cotton-market, during the season, at Catania, Palermo, Bari, Brindisi, Naples, and Cagliari, would, it is thought, be of great service. The cotton is too frequently put into bales without being properly pressed; and it is suggested that presses might be hired out to cotton-growers in some of the districts. Accompanying the samples of raw cotton are specimens of several kinds of yarn, some made entirely of Italian cotton, and others of American and other kinds mixed with Italian.

Since the opening of the Suez Canal, Indian cotton finds a large and ready sale at Genoa and elsewhere. Regular steamers, both English and Italian, sail as often as once a week from Brindisi for Alexandria, some of them proceeding further east, while the Italian line continues northwards to Ancona and Venice. Rubattino and Co., of Genoa, have lately established a monthly line to Alexandria and Bombay, touching on the way at Leghorn, Naples, and Messina. Cotton can thus be brought at cheap rates direct to Genoa, filling up the cargo when other merchandise is not forthcoming, in India. Indian cotton is sold in Turin pretty generally, now the spinners are not obliged to have recourse to Liverpool; indeed, it costs but little more to get it direct from India than from England, as the steamers are compelled to go round by the Straits of Gibraltar, and this voyage lasts at least ten days. Spinning mills exist near Naples, in the province of Umbria, and elsewhere in the central part of the kingdom; but by far the most important centre is Northern Italy, in the provinces of Genoa, Cuneo, Turin, Novara, Como, Milan, &c., all skirting the Alps, which furnish an unlimited supply of water-power during many months of the year. The mills are provided with excellent turbines and other wheels, and have mostly an auxiliary steam-engine, which, owing to the high price which coal still maintains, and will do until the Mont Cenis Tunnel brings it from the basin of the Loire, St. Etienne, Rive-de-Gier, &c., is only employed when absolutely necessary. The price of coal in the interior frequently amounts to £3 per ton at a railway station, and where the mills are in the mountain valleys, at a distance from the railway, the cost is fabulous. In many localities lignite is sold at 12s. per ton at the mine, elsewhere turf, but the quantity does not suffice for general consumption. The cotton mills are often fitted up with the best machinery, and managed with great skill, producing yarns for weaving common goods, for hosiery, and other knitted manufactures, and for hand knitting. Up to No. 18 is commonly made, but the higher numbers, up to 60 and even more, are spun when required. The samples sent are few, and such as every one can daily purchase in wholesale houses, and in nowise made for exhibition. Those of Terranova cotton may be compared with others made entirely of American cotton, and others partly of India cotton. A few commercial samples of dyed yarns show what is employed for the common—largely manufactured—goods for the less wealthy part of the population, and for purposes not requiring great brilliancy of colour, but rather fastness and good use. Competent persons, in examining the specimens, should bear this consideration in mind. Had it been requisite, a series of specimens of the most varied cotton goods, from the commonest to the most perfect, might have been added, but time was wanting, and it would have given a false idea of the state of manufactures in the country, had it not served to prove the incalculable benefits of good laws, constitutional government, social improvement, especially among the lower classes—so wonderful that, in twenty-four years, since the impregnable citadels of despotism and superstition began to crumble into dust before education and enlightenment, Italy has made more progress than she had accomplished in the fifteen centuries, during which she had been under a mesmeric spell, since the time of the Emperor Constantine. But more startling progress awaits the future.

The specimens of cotton exhibited from Egypt, Syria, Smyrna, and other parts of the Ottoman Empire afford abundant evidence that the soil and climate of those territories are admirably adapted to the production of cotton. Egypt (Nos. 4,485A—4,485*) is perhaps the finest cotton-growing country in the world. It is not surpassed in productiveness even by the Southern States; not only is the yield larger than in America, but for quality and length of staple Egyptian cotton holds a high rank, and comes next after Sea Island. So firmly is the growth of cotton established in Egypt, and so fully are both the government and the people alive to its importance and advantages, that there is no reason to apprehend that it will be allowed to decline. It would be matter for rejoicing if the same could be said of Turkey, where, under a better government, and with due encouragement, cotton cultivation would prove a source of incalculable wealth and prosperity. No country in 1862 held out greater promise of supplying the want created by the American war; and though strenuous and successful efforts were made for a time, these have not been maintained, and the hopes then excited have not been realised. Turkey, Egypt, and India, should be well able to prevent any serious inconvenience from being experienced, even should America again fail us. The samples from Turkey (Nos. 4,480, 4,485) show that cotton of excellent quality can be produced. The samples from the West Indies (Nos. 4,485A, 4,485*) from Natal and other districts in Africa (Nos. 4,480, 4,485*) exhibit a description of cotton which would be most acceptable if it could be obtained in quantity. It is earnestly to be hoped that this years Exhibition will have the effect of reviving the growth of cotton where it has been allowed to languish, and thus contribute to diminish that dependence upon one source of supply which must, ever more or less, be an occasion of uneasiness and anxiety. There is reason for sincere congratulation that the raw material supplied by our manufacturers is no longer associated with the accursed system of slavery, but is now the product of free labour, with the simple exception of Brazil, where a mild species of slavery still lingers, and that the wail of the oppressed no longer mingles with the whirl of the spindle. The sufferings of the cotton famine are forgotten in the joy produced by the fact that cotton and slavery are for ever divorced.

The number of visitors to the Exhibition and Horticultural Gardens during the period the Exhibition of 1872 was open was 742,820.

THE EXHIBITION OF 1873.

Silk forms one of the industries selected for next year's Exhibition. It is proposed, in order that the class may be completely represented, to admit specimens of sewing and embroidering machines which possess special features of novelty and excellence in the working of sewing silks upon different materials.

Ancient silk and embroideries manufactured before 1800 will also be admitted for comparison with similar modern manufactures. Possessors willing to lend them to her Majesty's Commissioners are requested to communicate with the Secretary.

The food section is being worked under the auspices of the Society of Arts, and from the returns that have been received a very good exhibition is anticipated as the result of its action. The section embraces a very wide area, as will be seen by the following programme:—

Substances used as Food. (Class 8.)

(*a.*) Agricultural products and manurial substances used in their cultivation.

(*b.*) Grocery, drysaltery, and preparations of food.

(*c.*) Wines, spirits, beer, and other drinks, and tobacco.

(*d.*) Implements of all kinds for drinking (exhibited for peculiarity of shape or for novelty), and for the use of tobacco.

Regulations.

1. Applications to submit objects proposed for exhibition to the Committee of Selection, should be made upon the printed form No. 10 (to be obtained at the offices, Upper Kensington Gore, London, S.W.), and forwarded to the secretary before the 31st January, 1873.

2. Specimens included in the above subdivisions will be exhibited, as well as the material, machinery, and processes used in their preparation and production. Special arrangements will be made for showing agricultural products under cultivation.

3. Class 12 is divided into the following sections; and producers of substances used as food, or of machinery connected with its production, may submit specimens for exhibition, or exhibit processes in operation:—

Section a.—Agricultural Products.

Including seeds and materials for manures; grain, roots, fungi, &c., used as food; fruits and vegetables, fresh and dried; hops; linseed and other cake and meal; butter; artificial food, &c.

Section b.—Grocery, Drysaltery, and Preparations of Food.

Including arrowroot, bacon, baking powder, biscuits, cheese, chocolate, cochineal, cocoa, coffee, confectionery, corn-flour, fish (cured), ginger, groats, hams and tongues, isinglass, macaroni, mustard, pearl barley, pickles, preserved provisions, rice, sauces, soda, spices, sugar, tea, vinegar, &c., together with the machinery and processes employed in their production or preparation.

Section c.—Wine, Spirits, Beer, and other Drinks, and Tobacco, &c.

Potable liquors of all kinds; malt, finings, corks, capsules, syrups, spruce, &c.; tobacco, cigars, snuffs, with machinery, utensils, and processes employed.

Section d.—Implements of all kinds for Drinking[*] [*These will be limited to specimens exhibited for peculiarity of shape or suitability to different kinds of drinks. As mere glass or metal manufactures, they do not come under this Section, but will form Classes in* 1874, 1876, *and* 1878] *and Implements for the use of Tobacco.*

Articles in gold, silver, plated ware, pewter, china, and glass. Tobacco pipes, snuff boxes, cigar cases and boxes, &c.

4. The Exhibition will be limited to such specimens as are necessary for satisfactory illustration, and no mere duplicate specimens can be admitted.

5. To each specimen should be securely attached a written label, containing, 1, its name; 2, the name and address of the manufacturer; 3, the average retail price.

Ancient drinking cups, salt cellars, spoons, knives and forks, cruet stands, and other utensils for the table, tobacco pipes and graters, snuff-boxes, &c., made before 1800, will be admitted for comparison with similar modern utensils, and possessors of such articles, who may be willing to lend them for exhibition, are asked to put themselves in communication with Her Majesty's Commissioners.

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[*] These are limited to vessels which are put to the mouth, and do not include jugs, decanters, bottles, &c.

6. In the case of objects which are very bulky or heavy, it is advisable that photographs or drawings, with some description, should accompany the application form, No. 10.

7. In the case of processes, application should be made for any special arrangements which may be required, in respect of space, fire, gas, steam, or water, etc., but her Majesty's Commissioners can undertake to consider those applications only which shall have been notified before January 31st, 1873.

8. Her Majesty's Commissioners will provide foundations, railings, general shafting, steam, water, and gas, to all exhibitors of machinery whose requirements in these respects have been notified to them before the 31st January, 1873, and whose machines have been accepted for exhibition by the Committee of Selection. Exhibitors must, however, make their own connections for gas, water, and steam.

9. Exhibitors of accepted machinery must provide their own driving belts and driving pulleys, which are to be in halves, and bored to the proper diameter of the main shafting, as notified to them by her Majesty's Commissioners. They must also supply and erect, at their own expense, any counter shafting (including the necessary foundations) which they may consider requisite to increase or reduce the speed to suit their own particular machines.

10. The following information should be supplied to her Majesty's Commissioners with the Preliminary Application (Form No. 10) by proposing exhibitors of machinery:—

(*a.*) A plan of each machine, showing the position of driving pulleys, the minimum space required for attendants, and indicating the parts of the machine which should be placed most prominently for inspection by the public. An elevation also would be of use, if it can be supplied without inconvenience.

(*b.*) A plan and section of foundations are required.

(*c.*) The weight of the machine.

(*d.*) The amount of motive-power in actual horse-power required from main shafting.

(*e.*) Should water, steam, or gas, be required, all necessary information as to the quantity of the requisite supplies.

11. Objects produced in the United Kingdom, as well as those objects produced in foreign countries, for which space has not been guaranteed, must be sent direct to the Exhibition building for the inspection and approval of judges appointed for the purpose. All objects must be delivered at the proper places in the building, which will be hereafter advertised, and into the care of the appointed officers, free of all charges for carriage, &c., unpacked, labelled, and ready for immediate exhibition.

12. All specimens under the class of food must be delivered on the 6th and 7th March, 1873.

Cooking and its Science. (Class 13.)

This class is specially for the illustration of cooking processes. Raw materials, and the less perishable products of cooking, will be exhibited in Class 12 (Food). Cooking of all kinds will be represented, together with the mechanical appliances connected with it as used in all parts of the world.

Besides the apparatus and utensils used in actual cookery of all kinds, this class includes all descriptions of domestic machinery and utensils, hot water apparatus, ice machines, &c.; hydrometers, saccharometers, &c.

The general regulations applying to this class are similar to those relating to substances used as food (Class 12); and strict punctuality will be required in the delivery of all objects for exhibition.

EXHIBITIONS.

VIENNA EXHIBITION.

Germany.—The Vienna Exhibition promises to be as large and complete as any of its predecessors. The Germans are entering into it with great vigonr. From returns received, it appears that the total number of the German exhibitors is 7,861. In this number are included, as one person only, all those exhibitors who have combined in making what is called "collective exhibitions," and the number of these, for some branches of industry, is considerable. As regards the special groups, the chemical industry of Germany, Group 3, will be represented by 107 exhibitors of chemico-technical products (acids, salts, &c.); of exhibitors of pharmaceutical preparations there are 21; of fats and their products (soap, wax, oils, glycerine, &c.), 64; of products of dry distillation (as paraffin, benzine, aniline, &c., 18; of ethereal oils and perfumes, &c., 44; of matches, &c., 10; of dye-stuffs, 105; of starches, 26; of glues, 33; of resins, varnish, &c., 47; and of different other products of this Group, 32. In Group 5, textile industry and clothing, which is a prominent branch of German industry, the contribution of Germany will be as follows:—Wool industry is represented by 29 firms for woollen yarns; 142 firms (among these collective exhibitions of whole towns) for cloths, plush, &c.; 62 firms for other woollen fabrics; 30 firms for carpets, &c.; 30 firms for woollen cloths, shawls, ribbons; 43 firms for mixed fabrics. The cotton industry will be represented by 29 firms, with yarns; 62 with textile fabrics; 12 with printed and dyed goods. The linen industry will be represented by 21 firms with yarns, 69 (among which collective exhibitions of the chief centres of this industry) with textile fabrics, and 33 with mixed articles. The silk industry is represented by 35 firms, besides collective exhibitions of the principal places of manufacture. For different other textile fabrics and manufactures there are 52 firms; for lace, fringe, and embroidery goods, 73; for artificial flowers, and similar articles, 30 firms. Woven and worsted articles of clothing will be exhibited by 41 firms; ready-made clothes, 44; gloves, and other small articles of attire, by 90; shoes and boots by 48 firms. In addition, there are 34 more firms, with various sorts of articles, classed in this group. A particularly conspicuous part of the German Section will be the machinery exhibits, Group 13. The German machinery will, without doubt, surpass that of all other exhibiting nations, and as by far the greatest number of large and renowned firms is among this class of exhibitors, it is to be hoped that the quality will likewise correspond to the extent of the exhibition in this group. The following figures will show in what branches this industry is most active at present. There will be 58 firms exhibiting prime movers, steam generators, boilers, steam-engines, turbines, &c.; of transmission machines, &c., 24; machinery for metallurgy and metal work, 68; wood-working machinery, 17; machines for spinning, weaving, knitting, and embroidering, &c., 78; for the manufacture of paper and printing machines, 60; machines and apparatus for sugar-making, 26; distillery and brewery machines, &c., 60; machines for mining, &c., in particular, 24; exhibitors of sewing machines, &c., 55; of agricultural machines, 125; machines for army purposes, pumps, &c., will be exhibited by 50 firms; other kinds of machinery and apparatus, which cannot be specially classified, will be represented by 45 firms. The exhibition of fire-engines, &c., embraces 42 exhibitors, and street locomotives, 39 firms. Lastly, there will be 42 firms exhibiting railway material, such as locomotives, waggons, trucks, &c. The total number of German exhibitors in Group 13 is 763.

Italy.—The municipality of Turin have voted the sum of 5,000 francs towards the expenses of the committee appointed by the Royal Chamber of Commerce and Art to represent that city at the Vienna Universal Exhibition. An album, containing photographs of all the principal buildings that have been erected or restored since 1860 in Turin, will be exhibited by the municipality, and will contain, amongst other views of the town, the Palazzo Carignano, the new general magazines, various statues and other monuments, including tombs, views of new streets and public walks, private palaces, houses, and villas, that are remarkable for their architectural design or internal decoration. Should other towns follow the example set by Turin, a most interesting exhibition of town architecture might be formed at Vienna, and we trust that this hint will not be thrown away, and that the authorities will avail themselves of it, and contribute a complete collection of photographs of all recent improvements that have been carried out, not only in London, but in all the principal towns throughout the kingdom.

Dwelling Houses.—A collection of examples of private dwelling-houses, represented by models, drawings, and full-sized examples of thoroughly furnished apartments, will be one of the features of the Exhibition. The object specially held in view in making this collection is, not to give examples of how dwellings are now constructed and fitted up in various countries, but rather to illustrate how such dwellings ought to be arranged and constructed. The apartments will include kitchens with cooking ranges and other fittings, cellars, &c., and various housekeeping appliances. The architectural features of the various habitations will also receive proper attention, and full opportunity for illustrating them will be afforded by the drawings and models, while constructive details will also be shown. A section will be devoted to examples of working men's houses. The special attention of the manufacturers of iron houses should be drawn to the fact that such houses are almost unknown in Austria, and that rents are enormously high, while there exists no suitable accommodation for the poorer classes, who are compelled to live under disadvantageous conditions in the city, or occupy dwellings far out in the suburbs. Ordinary building materials are extremely dear (bricks cost from 50s. to 60s. per 1,000), and there appears no inclination to construct artisans' dwellings for the benefit of that numerous class. Under these circumstances, it is probable that, not only would English manufacturers be doing a good service to Austria by sending for exhibition a number of good types of iron buildings, but that they would also create for themselves a large and lucrative trade in the export of such buildings; for, on account of the price of material, iron would compete easily with brick or stone structures. There exists at present a deficiency of house accommodation in Vienna, and without doubt a great difficulty will be found, during the time of the Exhibition, in providing for the crowds of visitors who will be attracted thither. If, therefore, there were erected a number of iron houses previous to the opening of the Exhibition, the rents that could be collected from them would more than cover the first outlay, while Austrian capitalists and building societies would be thoroughly convinced of the suitability of such buildings for dwelling houses. It must be borne in mind, however, that the structures chiefly required are not large, but small buildings, with two or four rooms, adapted to the requirements of the artisan, which shall be easily transportable, and afford a better and cheaper accommodation than the Austrian workman is now able to command. It would be of considerable service to the whole world if some buildings were erected, showing the proper appliances for economical warming and perfect ventilation.

CORRESPONDENCE.

REPORT ON MUSICAL INSTRUMENTS IN THE INTERNATIONAL EXHIBITION OF 1872.

Sir,—I beg you will have the goodness to permit me to state that, on my return to England, I find the report on musical instruments has been, so far as I am concerned, prematurely printed. By a mishap, the last proof did not reach me until it had wandered from London to Paris, Paris back to London, and thence to Vienna.

I understand that a special issue of the reports on the International Exhibition of 1872 will be made by the Society of Arts, and that my latest corrections will be then adopted. In these circumstances, it is unnecessary for me to enumerate at the present time the various printer's and other errors in the published report and their corrections.—I am, &c.,

The Reporter on Musical Instruments.

October 21st, 1872.

THE THROUGH ROUTE TO INDIA.

Sir,—Mr. Humann, in his letter to the *Journal of the Society of Arts* of 18th October, has made some most important observations on the question of the "through route to India," which has so long been advocated by Mr. Hyde Clarke and other competent authorities, and which the governments of England and India (greatly against their own interest) have never thoroughly appreciated.

Now, although the Ottoman government may be greatly interested in such a line crossing its territory from one extreme to the other, and also most anxious to promote it, it must be borne in mind that Turkey has already her hands full, and her exchequer is over-burdened, with the Roumelia and other lines of more immediate importance to herself, for strategic and governmental purposes, to feel disposed to devote all her energies to favour a line which, after all, would be one of secondary importance to Turkey. If such a line is to be made to suit the convenience of England and other European countries, to put them in communication with India, it is but fair that they should contribute towards the cost of its construction, in the same way that Italy and Germany contribute towards the making of the St. Gothard railway in Swiss territory. Active steps should be taken by our government in promoting the through route to India, and in lending its support by guaranteeing part of the required capital.

It is a disgrace to our boasted civilisation that railway communication with India has not long since been established, and I am inclined to think that "Mejlisses" are to be found in other countries besides Turkey. I have long held the same opinion as Mr. Humann as to the advisability of making railways, in the first instance, as cheaply as possible in all new countries, and, as the traffic increases, to change the temporary into permanent works. Let England and India but put their shoulders to the wheel, and there is no reason to doubt the possibility of opening a through route to India in less than five years from the present time.—I am, &c.,

P. Le Neve Foster, Jun., C.E.

Mortara, Lomellina, Italy.

THE MALT DUTIES AND THE MEAT SUPPLY.

Sir,—At the present time, when the price of meat is so high, and the difficulty of obtaining a sufficient supply is getting greater every day, I venture to put before the members of our Society a few facts, to which I ask their attention.

I take first the following extract from the *Royal Agricultural Society's Journal*, vol. viii., part 1, No. 15, 1872, as *apropos;* page 74, Mr. R. O. Pringle, editor of the *Irish Farmers' Gazette*, writes:—

"Mr. Colman said that it is all very well to tell a farmer to keep four bullocks where before he had only three, but let him, before he thinks of increasing his stock, direct his attention to the production of food for them. This Mr. Colman showed could only be done by increasing both the acreage and the quantity per acre of his root and green crops." What prevents him doing this? The malt duty. How? Why, because in order to do with economy he must follow the four-course shift or system of agriculture, in which barley will take its legitimate place, and a crop of barley is an abomination to the Irish agriculturist. Why? Because the exciseman won't allow him to malt it for feeding his stock without taking from him £70 out of every £100 worth of barley he malts."

The author of the "People's Blue Book," page 929, says:—"In other countries—in Holstein, in Holland, in Denmark, and Germany, great profits are made by feeding stock, with the aid of malt, for the London market; but if you (in Ireland) do so (says government) you must pay us £70 on every £100 worth of barley grown on your farms."

"Why should not the farmers in Ireland feed as well as breed stock, and have the profits now pocketed by Holland, Denmark, and Germany? At all events, there can be no justice in preventing their being put on an equal footing in the trade with their continental rivals. It is only the malt-tax that prevents it. The climate of Ireland, from too much moisture and too little summer sun, is not suitable for growing wheat with profit, and the best paying crop, barley, for which the climate is better suited, is taxed 70 per cent.; and the pernicious operation of the tax is aggravated by levying it at the point of production, so that consumers pay more than 200 per cent. prime cost."

Again, a very eminent agriculturist, H. Neild, Esq., of Wortley, Lancashire, writes in the *Manchester Courier*, August 21st, 1872, under the head "Butchers' Meat: How Farmers can Increase Supplies:"—"I, together with many of the breeders and feeders of stock, believe the present 'comparatively' high prices of meat affect ourselves as consumers equally with the general public, and the agitation upon so important a question is by no means an unreasonable one." It is a great mistake to conclude that high prices result in large profits to producers. The true source of profit to a farmer is abundant supplies with moderate prices. I venture a confident opinion, confirmed by practical experience, that one grievous obstacle to a more abundant and cheaper supply of beef, mutton, and dairy produce is the impolitic and unjust tax upon malt, which in fact is a tax upon labour, for the tax is levied during the operation it undergoes.

Myself and others know, by practical experience, that beef, mutton, milk, &c., can be produced more abundantly by a liberal use of malt as a condiment with other food than by anything else. In confirmation of this I refer to the appendix to the Parliamentary Committee's Report on the Malt-tax, 1868, a most valuable document, and to a tabular statement of a carefully-carried-out experiment by that eminent farmer, the late John Claydon. His experiment was with 23 bullocks, and extended over half a year, say 26 weeks. They were divided on the same day into two lots. Their food was daily and regularly weighed and measured; one lot was fed in the ordinary way, the other had non-dried malt, about 14lbs. daily for 13 weeks, in place of cake, bean-meal, &c. They were sold at the same time. The comparison showed that the beasts fed with malt (of course apart from the duty) cost in feeding per head £7 16s.; those fed with cake, bean-meal, &c., cost in food per head £16 1s. 6d.

Both lots went to the butcher at the same time. The bullocks, which cost in feeding £7 16s. per head, realised an average per head of £26 2s. 2d. The others, whose feeding cost £16 1s. 6d., realised an average per head of £29 10s. 9d.

The beasts fed with the malt left a good profit, and the others a large loss. Equally convincing facts with reference to sheep, &c., can be adduced. I venture to state that when we can have fair free trade in untaxed malt, many thousands of pounds now annually wasted by farmers on spurious compounds—cake and feeding stuffs—will be saved, and go to augment the meat supply of the country; and give, in addition, security to the farmer for the capital he has embarked, and freedom in his cultivation. Only let him have fair-play in his race of competition with the untaxed foreigner, and then we shall have found the true way of making meat cheaper, and producers and consumers contented.

The above are startling figures, and if true it is high time for the people of this country, and, in fact, all countries, to begin to think on such matters.—I am, &c.,

Thomas Briggs.

Richmond.

THE METTRAY COLLEGE.

Sir,—During a recent visit to Western France, I endeavoured to see this well-known juvenile establishment, which is within a mile and a-half of the railway station nine miles north of Tours. It is, I ascertained, only shown to the public on Thursday and Sunday in each week, and as the day of my visit happened to be Tuesday, I could only see the exterior of the college, from which view I gained a general idea of the interior arrangement, including a church, ship with masts, tasteful edifices, agricultural enclosures, and neatly-constructed walks. At the time of my visit, a fire, which consumed five or six large stacks of forage, was raging, so I had a fair opportunity of inspecting the whole rank and file of the establishment, besides the military and firemen, who succeeded in saving the wheat stacks. I should be glad of information from one of your readers respecting any reliable work, in French or English, upon Mettray. Neither at Tours nor Le Mans could I learn anything about it.—I am, &c.,

Chr. Cooke.

London, October 18th, 1872.

INDIAN RESINS AND GUMS.

The progress of our manufactures and chemical industries leads to increased demand for gums and resins, which are only received in any quantity from two quarters, India and Africa, where these are abundant and labour is cheap. In soluble gums, Arabic, &c., there has been a small increase in the imports in the last few years; but notwithstanding the large employ of dextrine and gum substitutes, the natural gums, at moderate prices, are still much wanted; of the various lac products, for which we are solely dependent on India, the supply is decreasing; and of the resins for varnish, copal and kowrie are the only ones of which steady supplies are maintained; animi has fallen off considerably. In view of the growing deficiency in the supply of gums and resins for commerce, the government of India has set on foot, through its officials, inquiries as to the yearly amount that could be obtained of the more easily procurable kind of gums and resins, and the price per ton at which they could be put down at the provincial commercial centre most convenient for export to Europe, or for transmission to a suitable port. The exportation of these products, and especially of gums proper, has only to a very small extent engaged the attention of traders. They are now generally gathered for local consumption merely. A large foreign demand would develop the trade in each kind to an immense extent, as gum-producing trees are abundant all over the provinces. We have not all the replies before us, but from the report of the commissioners of the Central Provinces, some useful facts may be gleaned.

About 180 tons of dammar or *ral*, at from 160 to 190 rupees per ton, could be put down yearly at Nagpur or Jabalpur. This would come from the district of Mandla, Balaghat, Raipur, and Bilaspur. Formerly, a good deal of ral was procurable. It is easy to get. The hillman selects the finest trees, hacks a circle on the bark round each, and removes the ral when formed. This process, though, kills the tree, and entire forests have been destroyed by it. Of late years a stop has been put to the practice in the government jungles, and but little ral now finds its way into the market, and that is procured from the Malguzari jungles. In addition to the above, a large quantity could be exported yearly from Sambulpur, and put down at the port of False Point, at 135 rupees a ton. The vast extent of sal forests (*Shorea robusta*), government and zemindari, in these eastern districts, would admit of enormous quantities of ral being produced, were there a call for it, at a fairly remunerative price. The hill tribes would readily carry on the industry, and, could they be induced to tap the trees judiciously, the timber would not suffer. These provinces, at a rough guess, could readily supply 25,000 tons of stick lac. The price at which it could be put down on the railway, and a part of it at False Point, is from 280 to 500 rupees per ton. All districts produce lac, but it is particularly abundant in the eastern ones. Large quantities of it are consumed in the different towns in the making of bracelets, &c.; but most districts also export it, to a greater or lesser extent.

In Jabalpur there is a European lac factory that consumes most of the lac produced in the district. It comes, too, to Jabalpur and Mirzapore in large quantities from Raipur, Bilaspur, Sagar, and Mandla. In the last-named district, the Jabalpur lac firm has bought the right, for the next three years, of collecting lac in the government jungles, for 950 rupees a year. In the Sambalpur district, a European firm, from Mirzapore, has, for a long time, held pratically the monopoly of the lac collection. Burhampur and Bombay receive supplies, though of less quantity, from the Narbada and Nagpur divisions. The whole exports of the Central Provinces for the year 1868-69 amounted to 1,492 tons, and for 1869-70 to 1,348. Of this amount, in the two years respectively, 1,417 tons, valued at 386 rupees a ton, and 1,290 tons, at 269 rupees a ton, were exported to Mirzapore and Central India; 66 tons, at 540 rupees, and 53 tons, at 350 rupees, were exported towards Bombay; and nine tons, at 205 rupees, and five tons, at 252 rupees a ton, were sent down to the eastern coast.

Stick-lac is procurable in immense quantities all over the provinces. In years of excessive heat the out-turn is said to be less. The low price at present paid for it hardly repays, it is said, the cost of collection, and, in consequence, much that is in existence is not gathered. A large demand at a good price—and this it is confidently expected will not be long in coming—would call all this at once into the market. Moreover, by inducing better methods of cultivation, collection, and cleansing, it would vastly increase the supply, which would be limited only by the extent of the demand and the size of the forests. The valuable industry, too, that it would establish would tend to develop the resources of the most backward parts of the Central Provinces. The increase of the supply by artificial propagation thus becomes a subject of much interest. Major Lucie Smith reports that lac is found abundantly in the zemindaries to the east of the district of Chanda. The incrusted twigs are broken off and sold by the Gonds to the dealers in lac. The people believe that the lac insects are born of the morning mist, and no efforts are made to propagate them artificially. But were there a large demand, the rearing of the insect would be systematically carried on, and result in a very great increase of the product. Mr. Grant, the Commissioner of the Jabalpur division, states that in two places only is the production of lac assisted by human agency in propagating the insect from tree to tree. The great bulk of the lac is produced without any artificial assistance, and left entirely to the unaided exertions of the insect, and its migration from tree to tree. The question whether it would pay the government to undertake the establishment of lac-producing tracts of forests is one which naturally suggests itself in any discussion of an increased supply of resins. On the practicability of a scheme of this nature, the Deputy-Commissioner quotes a passage from a letter received by him from Mr. Michia, a French gentleman of some scientific attainments, who possesses a very intimate knowledge of the forests of the Jabalpur and Mandla districts, and who is himself the proprietor of a large tract of productive forest land in the latter district. Mr. Michia says the production of stick-lac might be indefinitely increased in the Central Provinces, if more attention were paid to the rearing of the cocoons. If, instead of trusting to chance for the annual propagation of this valuable insect, and relying altogether on the agency of birds in transferring young broods from tree to tree, without which lac would altogether disappear from our forests, we were to establish in the wilds of Balaghat and and Mandla lac plantations for rearing the cocoons, the supply would be enormously increased. Palas (*Butea frondosa*) and cusam (*Schleichera trijuga*), the only necessary trees, are found in great abundance all along the whole of that line of country. The plan suggested by Mr. Michia appears feasible, and worthy of a trial.

The Beejasal (*Butea frondosa*) and dhak (*Pterocarpus marsupium*) that yield kino are fairly plentiful in these provinces. At present there is no demand for kino, except to a small extent for medicine. Large quantities could, if required, be supplied for export. The Deputy-Commissioner of Chanda considers that 100 tons could easily be raised in his district, and put down at the Wurdha railway stations for 120 rupees a ton. But the valuable timber of the Beejasal would suffer by the process of tapping that is necessary for the production of the resin. The Salai tree (*Boswellia thurifera*), from which *gunda fereza* is produced, is as abundant as any tree in the Central Provinces. At present but little of the gum is brought into market, and that for local use, but very large quantities could be readily supplied. The tree yields the gum abundantly. The value of its timber is very little, nor is it injuriously affected by tapping. From the Chanda district, it is estimated that 10,000 tons could be put down yearly at the Wurdha railway station for 100 rupees a-ton. In the Narbada valley, it could be brought to the railway for 160 rupees (£16). Of the Dikamali resin (obtained from the *Gardenia lucida*) it is conjectured that 200 to 300 tons could be brought to the railway from the Chanda and Bhandara districts for about 100 rupees a-ton.

Some 4,500 tons of the better kinds of gums could readily be supplied on the Great Indian Peninsula Railway at from 100 to 200 rupees per ton. The dhoura (*Shorea robusta*) and babul (*Acacia arabica*) are said to yield the best gum. Good gum is also procured from the char, ber, palas (*Butea frondosa*), saj, ain (*Dipterocarpus* sp.), tendoo (*Diospyros melanoxylon*), khair (*Acacia catechu*), &c. There are numberless other gum-yielding trees, the gum of most of which is not of any market value. All these gums are readily procurable in most districts in large quantities. But the different kinds are brought to market so mixed up together that it is impossible to distinguish between them, or to make a guess at the amounts of the different sorts that could be supplied. Gums are generally collected for mere local consumption. Small quantities are, however, exported into the Berars, from Sagar to the north, and from the Narbada division towards Bombay. During the last year or so, two Bombay European firms have sent agents into the interior of the Nimar district, to make arrangements for a permanent supply. They have not as yet been very successful. In some parts the Gonds gain a livelihood by gathering gum, but the price is so low that in most districts men find the cutting of grass and sticks much more profitable. As a rule, women and children are employed on the work. In Nimar, their wages are the weight of the gum collected in wheat, or double its weight in *jowari* (sorghum). A large demand at higher prices than those now offered would not only greatly increase the outturn, but bring into the market a far superior article. At present, as has been stated, all kinds are gathered promiscuously, and offered for sale as gum, not as the product of any particular tree, exceept, indeed, occasionally, when the gatherers are under contract to supply the dhoura or some other gum for medicine. But these pure gums are procurable in very small quantities. Not only this, but the gum offered for sale always contains a quantity of sand, leaves, and bark. No attempt is made to keep it clean. It is gathered carelessly before it is sufficiently dry to come away of itself, and in consequence pieces of bark are torn off with it. But it may well be questioned whether this industry would ever become a remunerative one in these provinces, so far removed from the sea. Gum-bearing trees grow as extensively on the sea-board, where facilities for export are much greater.

SILK AND THE SILK TRADE.

The *Warehousemen and Drapers' Trade Journal*, in an article on "Silk and the Silk Trade," says:—

If regard be had to the amount of capital invested in the silk trade, to the variety of articles and patterns made from silk, and to artistic merit in manufacture, France unquestionably takes the lead of all nations. One special advantage pertaining to the production of silk goods in France is that a large proportion of the material employed is supplied by the country itself, though this advantage has been curtailed for many years by the silkworm disease, which has led to a large importation of the silk produce of China and various other Asiatic countries. The leading French spinners, who necessarily require a large quantity of cocoons to supply their factories, have profited by the active and intelligent agents (*graineurs*) they sent abroad at the outbreak of the disease to obtain eggs of all varieties of the *Bombyx* from countries not yet visited by the disease. The silk crop of France has been so far brought up by importations, and the elements of disease so eliminated, that, with favourable seasons, the French silk crop may be expected to reach more than its former proportions. The value of the raw silk produced in France may be set down at £8,000,000 per annum, or nearly half the amount supplied for home manufacture and export by the Chinese silk rearers. Italy is on a par with her in the aggregate value of silk production. Algeria has of late years rendered very considerable service to France in the supply of silk. Whilst the cost of producing silk goods in France has been reduced by mechanical inventions, the tendency of the raw material itself is to higher values. The truth is, that for the French manufacturer no silk in the world will suit them so well as that produced in the departments. The soft, lustrous beauty of the best descriptions, the combined strength and suppleness of the thread, the careful assortment secured, the skilfully-conducted processes of throwing, spinning, &c., to which it is subjected, the effect in appearance of a small quantity in combination with inferior silks, according to processes that have been thoroughly mastered, combine to give to these a special value for all purposes of utility and fashion. In the making of organzine, the artisans of Ardèche, Drôme, and Vaucluse are unrivalled. The ribbons of St. Etienne are not less noted for their workmanship and bright and attractive patterns than their quality of texture, due to the large proportion of French silk entering into them. Lyons owes much of her present prosperity to the extraordinary efforts that have been put forth to augment the supply of native silk. Turning to Italy, we find that there, as elsewhere, the Jacquard loom has effected quite a revolution in the supply of silk goods. The introduction of this loom, with other approved inventions bearing on the silk industry, gave the sign for the inflow of foreign capital into Italy for the production of fancy silks. Italy produces silk fabrics of superb quality, and infinite talent is displayed in working up foreign with native silks. With France, Switzerland, and England for rivals, Italy must depend on relative cheapness and taste of design in foreign markets, due regard being had to quality. Genoa and Turin, Venice and Florence, worthily maintain their ancient reputation in various branches of silk manufacture. We know no more profitable field for enterprise than in the extension of the silk culture in Italy, looking to present advanced prices, and the almost absolute certainty that, whatever the recurring fluctuations incident to the silk trade, these are likely to be maintained for years to come. High prices in Europe would seem to have no effect in stimulating Chinese production, though a corresponding advance is made to buyers. So also with Japan. The silk produced by Spain and Portugal is of the annual value of about £900,000. For the full development of the silk-piece goods manufacture in Spain, her stringent tariff must be relaxed at once, to admit a larger supply both of raw material and foreign goods of various descriptions, so as to enlarge the basis of exchange, and to relieve Spanish silk goods from the export duty which prevents many descriptions well suited for foreign markets finding a place in competition with the productions of other nations. Switzerland, in her silk trade, continues to be distinguished by economical workmanship, and by careful, though, perhaps, too little varied application of her patterns for the requirements of the special markets for which her goods are destined. She makes no figure in the production of the raw material, taking her supplies from all quarters; but its free admission places the Swiss manufacturers on a close equality in this respect with those of France and Italy. In view of the success of the Viennese manufacturers, especially in the production of ribbons, and their very tasteful appreciation of what is excellent in design, it is strange that silk itself should not be more extensively cultivated. The whole annual product of the empire does not exceed in value £500.

In Germany the industry of silk is manifestly increasing. Besides a large home trade, her products in velvets and velvet ribbons, and other silk articles of large consumption, find profitable markets in this country, France, and the United States. Great care is exercised by the Prussian manufacturers in the selection of suitable silks for their goods. But for certain fiscal restrictions the production would be still greater. Belgium, paying more attention to other branches of manufacture, still produces a smaller amount of silk for the home trade.

Turning from Europe to the East, we have to remark that, of the numerous varieties of silks in Japan, the larger proportion have never been permitted to reach European countries. This restriction on the export of the better qualities of rare silk no doubt arises from the action of the government of Japan, always most jealous of foreigners and of any increase to the foreign trade; but it is most gratifying to find that the supply of these better qualities, although at present limited, could, under more liberal government in trade, be indefinitely increased. Twenty-one Japanese provinces produce silk, chiefly sent for sale at Osaka and Mako. The approximate annual production amounts to 67,500 piculs, equal to 135,000 bales.

China will probably continue to be for ages our chief source of supply. Throughout the length and breadth of that vast empire the culture of silk is a domestic occupation. The large supply arises from the multitude of individuals thus engaged.

SOCIETY FOR PROMOTING SCIENTIFIC INDUSTRY.

The formation in Manchester of a Society for Promoting Scientific Industry is advocated by Mr. Frank Spence, of the Pendleton Alum Works. In a letter to the *Manchester Guardian*, he says of the proposed society :—

"It will deal only with science in its practical applications—in the selection and perfection of all the instruments of production, not excluding the most important, and, just now to many a manufacturer, most embarassing of them all—the worker. Its gatherings will be a reunion, where mutual instruction and benefit will be derived from the free interchange of ideas, where individual difficulties will be solved by the experience of others, and where the latest suggestions of industrial ingenuity will be subjected to the valuable test of free criticism and discussion. The advantages of communication between workers in the different fields of pure science are too well-known to be insisted on; the achievements of the British Association will at once suggest themselves to every reader. In like manner, a society of the kind proposed will concentrate upon industrial problems, and bring within the reach of all its members, the technical knowledge of the engineer, the chemist, the merchant, the political economist—in short, of the experts in every branch of science and art. The wide variety of the industrial pursuits of this neighbourhood is of itself almost a guarantee for the success of the new society. A moment's reflection will show how important to every steam-user in every section of the association will be the discussions in the engineering section upon the relative efficiencies of different kinds of coal, upon firing, consumption of smoke, mechanical use of 'slack,' feedwater heating, prevention of corrosion and explosion, variety of boiler (Galloway, Howard, Root, Fairbairn, Field, French, multitubular, Cornish, &c.), economy of high-pressure steam, 'cut off,' &c. The simple fact that some manufacturers are getting twice to thrice as much power as others out of a pound of coal speaks volumes as to the wasteful and utterly unscientific character of the arrangements in many establishments; and it is little exaggeration to say that such a state of matters would not outlive the discussions and exact statements of results, which the society would exist to promote and present in a printed form to its members, a single day.

"The discussions in the chemical section will in like manner be of immense value to the engineers, to ironfounders, colliery proprietors, cotton spinners, and manufacturers, silk manufacturers, dyers and dye manufacturers, bleachers, calico printers, and their numberless subsidiary trades, glass manufacturers, lime burners, tanners, waterproofing manufacturers, glue and size makers, soap-makers, oilcloth manufacturers, agricultural manure makers, &c., all of which have a very extensive development in this district. Other sections, representing (in the case of the leading manufactures) single industries, will doubtless be formed, as the necessity for them arises, and the other sections prove too crowded with work to do them justice. As enough has now, I think, been said to indicate the province and work of the new society, I will now only allude to one or two questions which are most likely to occupy an early and prominent place in its discussions, and upon which it is becoming absolutely imperative that the voice of Manchester should be heard by the House of Commons. Anything more pregnant with ominous meaning as to the future of inventive progress in Britain than the following facts it would be difficult to conceive. I take the figures for 1868, the latest year accessible to me while I write. In the United States, where the total government charges for a 17 years' patent are £7 4s. (the fees charged being 'intended solely to pay the necessary expenses' of the large staff of scientific examiners and clerks), there were, in 1868, 13,378 examined and certified patents sealed. In Great Britain, where the total government charges for a 14 years' patent are £175, the number sealed during the same year (every one of them unexamined and uncertified) was 2,490. Under the respective systems, during the ten preceding years, the number of American patents had increased 360 per cent.; the British only 27 per cent. A kindred question, and one upon which many Lancashire inventors would like to see speedy action taken, is that of German patents. It is virtually impossible to patent anything in Germany, but Germany is importing English inventions *ad libitum*, 'without money and without price.' This was made very clear by Mr. Bessemer, in his recent evidence before the Select Committee on Patents; and the practical result of it all is, that Germans are beginning to be excluded as visitors from English manufactories. This, of course, is revenge rather than remedy, and it will be for the new society to consider whether, in view of the great importance of Germany as a market for inventions, some steps should not be taken to convince Prince Bismark that, in the end, 'honesty is the best policy,' and that it might be wise, if nothing else, to alter the German law.

"As precedents have always great weight with English minds, a word or two in conclusion about an association which has raised the character of the manufactures of its district to a pitch of excellence that has given them a world-wide reputation, may not be out of place. The Société Industrielle de Mulhouse—the Manchester of Alsace—was organised in 1825, and its object was declared to be 'the advancement and propagation of industry, by the assemblage in a central situation of a great number of the elements of instruction, by the communication of discoveries and of remarkable facts, as well as by the initiation of original investigations, and by all the means which shall suggest themselves to the members in order to ensure its prosperity and the happy results to which it may give rise.' In carrying out this programme the society holds regular meetings, at which papers are read, and, after being discussed, published in the *Bulletin* of the society. No hard-and-fast line has been taken, but the genius of utility is conspicuous throughout the yearly volumes of its publications. The subjects on which papers are read are singularly diversified, and include essays upon mordants, cotton, fuel, motive power, railways, gas, prevention of accidents, average length of life at Mulhouse, hours of labour, workmen's homes, &c. The Society has aided in the establishment of a workmen's club, founded a school of art, instituted lectures, and offers no less than 141 prizes, some of them of considerable money value, for the solution of various industrial problems. This prize system, by the way, seems one not altogether unadapted to English modes of working. At all events, premiums appear to be a very powerful incentive to progress in matters agricultural. It may be that in this the counties are simply in advance of the towns. If the plan were adopted here, and a mere tithe of the public spirit shown in its support which distinguished Sir Joseph Whitworth's endowment of technical scholarships, there would be little fear of any difficulty as to the 'ways and means.' Another thing to which the Mulhouse Society early directed its attention was the formation of a technological library, and this, of course, will be a very important feature of the Manchester Society, the generally expressed want of such a collection being, in fact, one of the first matters that are to receive its consideration.

"Amongst other institutions, the Mulhouse Society has also established a cabinet of natural history and an industrial museum. But it is unnecessary to enter into further details; suffice it to say that the Société Industrielle de Mulhouse is universally acknowledged to have been of immense service to the manufacturers of Alsace; and any Lancashire calico printer will bear me out in adding that their specialties in printing are of unequalled quality, and famed throughout the world. It remains for Lancashire to learn in time the lesson which has been taught by this society. Evidence is pouring in from all quarters that the manufacturers of the Continent are rapidly making up the vantage ground we had gained, and every day makes it clearer that we are heavily handicapped in the race. Opposed by their cheaper labour (far too cheap to admit of the huge expenditure on narcotics which is demoralising so many of our own workers); by their rapidly-increasing output of coal, the fuel being now in many cases cheaper than our own; and, lastly, by their carefully-educated working class (so well schooled in the case of Saxony that every man in the country can read and write),—opposed by such elements in the struggle, Lancashire, if she is to hold her own during the next ten years, will now have to put forth a supreme effort to foster and stimulate what is, after all, her only real and lasting source of material prosperity—industrial science."

LABOUR IN BELGIUM.

In consequence of a circular addressed by Earl Granville to her Majesty's Secretaries of Embassy and Legation, and to her Majesty's Consuls from whom reports on the condition of the working classes had been received, a further volume, containing additional particulars have been presented to Parliament. The concentration in a convenient focus of such informing comparisons, for the use of the emigrant, operative, and the political geographer, is no less than an event in the history of social science. Amongst the sum of experiences and inquiries thus gained, Mr. Consul Grattan, in his review of the condition of the working classes of Belgium, speaks more particularly of certain circumstances affecting the interests both of capital and labour which had occurred in Antwerp. Up to a very recent period, the industrial movement had produced only isolated and partial strikes, resulting either from a diminution of wages or from a stoppage of work in factories and workshops. The fault lay, to a certain extent, with the employers of labour themselves. The Belgium manufacturers, having the powerful competition of England and Germany to contend with, and being sometimes burthened by an accumulated stock of unsold fabrics, were occasionally compelled to have recourse to the expedient of reducing wages or of stopping work, to the great detriment and ruin of the working population. Strikes and disturbances were the result, and these formed the origin of the subversive movement which culminated in the subsequent agitations of the International. The Belgian manufacturers, to their credit it may be said, have in general always endeavoured to conciliate the interest of the working class with the exigencies of the time; and it may be affirmed that, within a few years past, there has been a rise in wages of about 25 or 30 per cent. Nevertheless, the operatives are far from being satisfied, and their demands, on the contrary, are increasing day to day. Strikes have taken place in the different industrial centres. The movement has become an organised one. The social question has assumed a visible shape and form, and has asserted itself distinctly and categorically, and the situation has become all the more serious, that at this moment thousands of artisans are enrolled into unions which are believed to be affiliated to the International, and blindly obey the orders they receive from leaders who are for the most part unknown to them. The most notable strike has taken place amongst the cigar-makers. There are, it appears, in Antwerp about 45 to 50 establishments exclusively devoted to the manufacture of cigars, and employing altogether about 10,000 workmen and apprentices. The wages of a workmen amount from 25 to 35 fr. a week, and those of the apprentices 5 fr., which are deducted from the wages of the workmen. These apprentices, termed *poupetiers*, are children from ten to fourteen years of age, whose business it is to prepare the cigars, that is to say, to make the inner roll, the workman's task being the more difficult and complicated one of completing the cigar by means of the exterior leaves. The preparatory labour thus performed by these *poupetiers* tends very considerably to diminish and simplify the work done by the men, and leads to a proportionate increase in the productive power of the factory, and hence it follows that the manufacturers attach great importance to having this preliminary work performed by children or apprentices, who, by this means, also acquire a knowledge of the trade, and become ultimately available workmen. The artisans required, independently of a reduction of the hours of labour, that the wages of the *poupetiers* should be paid by the manufacturers, without deduction from their own wages, and that the *poupetier* should, in fact, be employed by the manufacturers, whereas, according to the system hitherto prevailing, every workman brought his own *poupetier*, for whose work he was responsible. They at last went further, and their demands embraced the eventual dismissal of the *poupetiers*. The masters were obliged to yield, so that in some of the principal establishments the *poupetiers* have almost entirely disappeared, and will not, it is said, be replaced, and the hours of labour have been reduced from eleven to nine and a-half hours a day. Work has been resumed in all the factories, but the Antwerp cigar trade has received a serious blow, and, as far as cigars of ordinary quality are concerned, it would appear that the native manufacturers are no longer able to make head against foreign competition.

Amongst the causes that militate against the well-being of the working classes of Belgium are low wages, want of prudence, habits of intemperance, unsatisfactory relations between masters and workmen, insalubrious dwellings, and absence of home life. Their case is forcing itself upon the attention not only of the philanthropist, but of the politician, and efforts are being made to influence the opinions of the industrial classes by educational agencies. Lectures, intended especially for the benefit of the artisan class, in which the questions treated were handled with all the freedom of modern philosophical thought, were sought to be counterbalanced by institutions founded under conservative influences, and actively patronised by the clergy. Various establishments of this kind spring up in different parts of Belgium, chiefly in the leading industrial districts, and have led to the formation of a league termed "La Federation des Sociétés Ouvriers Catholiques Belges," having its principal seat and centre in the town of Louvain. The Antwerp working men's school (*Ecole d'Ouvriers*) which represents the views of the league, was founded in 1864. Its organisation is the following:—An administrative council, consisting of six members, viz., the president, treasurer, director, secretary, and two inspectors, is charged with the supervision and direction of the establishment. Instruction in the various branches is given in Flemish. The classes assemble every evening from 8.30 to 9.30 p.m., and are thus sub-divided:—Two classes of Flemish, five classes French, two classes English, one class German, three classes mathematics, and one class industrial drawing. Each course embraces two hours of study per week, with an interval of some days between each, so that the pupils may have time to prepare their tasks at home. The experience acquired in this school has hitherto demonstrated that mathematics, including in that term arithmetic, form the most useful branch of study for working men, inasmuch as their principal deficiency lies rather in the want of calculating power than in quickness of apprehension. At certain periods of the year games are set on foot, prizes being awarded to the successful competitors. A savings bank, under the control of the workmen themselves, is also attached to the institution, by which means the men acquire experience in the management of their own affairs, and a salutary influence is thus established among them.

Amongst the praiseworthy efforts made of late years at Antwerp to ameliorate the condition of the industrial classes may be named an association, termed in the Flemish language "Volkskring," or society for the promotion of gymnastics and other athletic exercises amongst the people. The instruction given is based upon the most approved modern principles, and embraces, in addition to the various athletic exercises, elementary anatomy, studied from the skeleton, and from large coloured drawings, which convey a clear and distinct idea of the parts lectured upon, as well as physiology. Various public exhibitions take place during the year, and in the summer months excursions are made into the country, and to the various small towns within the provinces, where opportunities are afforded to the members, who carry with them the necessary gymnastic apparatus, to display their proficiency and skill. Conformably to the scientific system of instruction pursued, the exercises are varied, so as to suit the physical requirements of persons exercising each particular trade or occupation.

NOTES ON COMMERCE AND TRADE.

Germany, France, and England compete for the supply of carpets to Chili, Peru, and other of the Spanish American States. Those most in demand are small fringed carpets, of a yard or a yard and a-half square, which the females take with them to church to kneel on. The patterns preferred are lively colours for the designs, and green and red for the ground. The value of those imported into Chili averages £60,000 a year. Last year (1871) the value reached more than £80,000.

The discovery of the argentiferous strata of Caracoles in the last year or two, has given a great impetus to mining industry in Chili, insomuch that, in August last year, the population at this new centre reached 3,000. According to scientific reports, the mines situated on the provincial department of the littoral on the northern frontier of Chili, near the territory of Bolivia, is of an extent of more than twelve leagues, and is the most important argentiferous discovery made in the last three centuries. The rich mines, so well known in Chili and Peru, of Chanarcillo, Tres Printas, and others, are but small ramifications from Caracoles, which is their central point. The working of the numerous mines of Caracoles, imperfectly as they have been yet explored, have yielded, up to the 1st of August, 1871, 220,000 marcs, which, at £2 the marc, gives a total value of £440,000. Chili, besides this, contains deposits of gold, copper, cobalt, nickel, lead, and coal. The exports of nitrate of soda, which, from 1830 to 1855, had only reached to 406,602 tons, has attained to enormous proportions. In the six months ending 1st July, 1871, 1,859,493 cwts. were shipped, and the quantity will attain still larger proportions with the facilities of transport which the railway from Iquiqua to Norea will furnish when completed.

The history of the coal trade of the United States furnishes the most striking evidence of its rapid progress. Previous to 1820, the year in which coal mining commenced, there were very few factories and workshops, no railroads, and almost no steam vessels in the United States. Since that date manufacturing establishments have sprung up in all directions with amazing rapidity, thus creating a demand for fuel. The following shows the progress of anthracite coal mining in Pennsylvania. The total production of coal during 1820 was 365 tons; 1830, 174,734 tons; 1840, 864,479 tons; 1850, 3,358,899 tons; 1860, 8,513,123 tons; 1870, 15,849,899; 1871, 15,113,407 tons. The production in 1872 promises to be larger than in any previous year—the total production for the year up to September 21, being 14,133,173 tons, against 10,120,784 for the corresponding period of last year, being an increase of 4,012,389 tons.

The export of alfa, or esparto, for paper-making, from Algeria, which commenced with 450 tons in 1862, reached 46,000 tons in 1871, this, at an average of 14 francs the 100 kilogrammes, gave a total value of £240,000. Owing to the high price which esparto has attained, efforts have been made to bring the leaves of the dwarf palm, which is abundant in North Africa, into use for paper-making; but the greater quantity of chemicals required and the larger amount of waste, are insuperable difficulties at present to its extension.

Although there has been a gradual decline in the exports of the precious metals from San Francisco in the last few years, the production of gold seems to be fairly sustained. The mint and treasury of the mines of the north and south received, in 1870, £8,712,611 sterling, made up of £2,830,597 in ingots of silver, £4,308,571 in bars and gold-dust, and £1,572,897 in coin. The total exports of coin and specie from San Francisco in 1870 amounted to £6,596,630, and there has been a gradual decline since 1866, when £8,872,830 was shipped. About £2,000,000 came to England, £1,000,000 was sent to China, and £2,688,000 went to the eastern ports of the Union. The total value of the exports, by sea and land, of the State was £4,569,630.

Besides other silk manufactures, Irish poplins are largely in favour in California, and English poplins, of agreeable patterns and colours, are finding their way extensively into favour.

The following important letter, bearing on the future of the French treaty, has been addressed to the Foreign Office by the Manchester Chamber of Commerce, in reply to a letter of Lord Enfield, asking the opinion of the Chamber on the proposals of the French Government:—

"Chamber of Commerce, Manchester, Oct. 15, 1872.

"My Lord,—In reply to your lordship's communication of the 7th instant, the directors of this Chamber beg again to record their unqualified objection to the imposition of any increased duties of a protective character on cotton fabrics. In 1870, a deputation of this Chamber stated before the Enquète Parlementaire, then sitting in Paris, that the existing duties under the tariff of 1860 were already so high as to preclude the possibility of any but the most insignificant exports being made in cotton staples from this country; and that, in fact, our producers were actually subject to French competition. Though an unusual amount of trade was stimulated in the year 1871, owing to the complete exhaustion of stocks in France during the war, the normal condition of the trade has again asserted itself, and this Chamber cannot accord support to a scheme which, under whatever pretence, imposes additional burdens on a trade already taxed out of existence. The directors consider that it is impossible to estimate the amount of cotton which enters into various fabrics with an accuracy sufficient to form the basis of a consistent and trustworthy tariff, and in endeavouring to compass this difficulty the framers of the proposed new treaty have naturally erred on the side of protection. Many instances could be cited of this tendency, but it may be sufficient to refer to the case of 32's twist, the compensatory duty on which would amount to 9-16d. per lb., while the tax sought to be imposed on the uncleaned cotton is 5-16d. per lb. As 100 lb. of cotton are required for the production of 80 lb. of this yarn, it is apparent that the proposed mode of levying the duty would, in this instance, still further increase the protection already accorded to the French producer. The attempt also made to impose a special tax, in addition to that called "compensatory," on Turkey red goods, can have no other aim but the protection of a certain department of French industry.

"One of the strongest objections entertained to the tariff on cotton goods under the treaty of 1860 has been its complicated method of application; and it is to be regretted that the new scheme presents a further addition to the already too numerous classifications. The directors would have attached little value, as far as the industry of this district is concerned, to a renewal of the old tariff on cotton goods. They cannot, therefore, concur in the imposition of still higher duties, accompanied by a loss of the commercial and fiscal freedom of this country. Finally, the directors object to the sacrifice of principle involved in endorsing the commercial policy of M. Thiers, and they share the conviction entertained by a large majority of the French Chambers of Commerce and the French commercial public, that the tax on raw materials will do little or nothing to relieve, even temporarily, the financial embarrassments of France; and that, by lending countenance and support to its imposition, the government of this country would violate those principles of free trade and sound commercial policy, by the observance of which alone they believe the true and ultimate prosperity of nations can be secured.—I have the honour to be, my lord, your lordship's obedient, humble servant,

"Hugh Mason, President.

"Manchester Royal Exchange."

A letter has also been received from M. Michel Chevalier by the chamber, on the same subject, in which he says that the chamber had not yet replied to the inquiries which he had made, which he interpreted to arise from the difficulty they experienced in presence of the strongly-expressed resolution of the chamber, and the opinion so suddenly adopted by the government in giving its support to the protectionist policy of M. Thiers, after having opposed his views in the remarkable despatches and notes of Lord Granville on the subject. In 1859 the government of Great Britain, by its extremely liberal offer, decided the policy of France, which then shook off the yoke of extreme protection, and accepted the principles of free trade, in the belief that her example would be followed by the whole of Europe. Having been present at the conference with Mr. Gladstone, which was arranged by Mr. Cobden, he could say that Mr. Gladstone gave him authority to bear to Napoleon III. the extremely liberal proposals which were then adopted. Mr. Gladstone now thought it right to approve of that which was opposed to his policy of 1859, and facilitated the carrying out of plans which were calculated to throw back France under her protectionist policy. He was entirely ignorant of the motives that had worked this sudden change in the opinions and policy of the Prime Minister. He desired to know whether the chamber adhered to the adverse resolution which it had passed in September last.

GENERAL NOTES.

Indemnity to Acquitted Prisoners.—A novel proposal has been made by a member of the General Council of the Seine, M. Lesage, to the effect that all persons who shall have been charged with any offence, and imprisoned, and who shall be acquitted on trial, shall be entitled to damages for the unfounded charge and false imprisonment!

The Lucifer Monopoly of France.—The government has granted a monopoly in the manufacture of lucifer matches to a society, of which M. Jules Vignal is the representative, and which has raised a capital of £1,600,000 for the purpose. The company is to pay the government annually the enormous sum of 16,300,000 francs (£652,000), besides a portion of the profits, which is given in terms too ambiguous for quotation. The retail prices are all, as a matter of course, fixed by the terms of the contract, and, as these are much higher than previously, the sums in question become naturally a tax on the public. Another and serious feature in this arrangement is the revolution of the whole trade, and the displacement of the whole of the capital now employed by hundreds of small and large makers.

New French Mail Contract.—The following is the account given of the new contract for the conveyance of the French mail between Dover and Calais. MM. Clebsattel and Churchward, whose contract has expired, received a subvention of £7,600 per annum from the French Post-office. When tenders for the new contract were invited only three contractors presented themselves, Messrs. Clebsattel and Co. demanding an annual subvention of £4,960; M. Worms, £6,798, and M. Eugène Lecompte, £6,980. These three proposals all exceeding the maximum fixed by the government, there was no result, and an agreement was finally entered into with Messrs. Magnier and Mulard, who offered to undertake the service with a grant of £4,000 per annum, the late contractors declining to accept a lower sum than that set down in their tender. The contractors have to deposit the sum of £8,000 by way of security. Of course these arrangements only affect the morning or French mail.

French Naval School of Application.—It has long been the practice in the French navy to send out the young aspirants on voyages of instruction in a vessel, or, rather in vessels, which have successively borne the time-honoured name of *Jean Bart.* Two years since, it was proposed to discontinue this practice, but the suggestion was overruled, and the present government has continued the old practice. The *Jean Bart* is announced to start from Brest, with its complement of young aspirants, between the 5th and 10th of this month. The route selected for the present year is by the Canary Islands to Teneriffe, thence to Dakar, in Senegal, Bahia, Rio Janeiro, and the Cape of Good Hope, returning to Lisbon about the 20th of April; thus the future officers of the navy will make a voyage of six months' duration, and visit some of the most remarkable points of the globe.

System of Embalming.—M. Gaunal's system of embalming by injection, described in *Les Univers* as simple, easy, and inexpensive, an improvement on the ancient and costly system, neither producing fear nor repugnance, chanced to be seen in that paper by M. de Quélen, inducing him to leave directions that after his death his body should be embalmed by injection. His body, which was admirably preserved, was visited by all Paris, and the method adopted for embalming it by M. Audigier, at once became popular. M. Gaunal's plan was to open the jugular or carotid artery; his successor, M. Audigier, neither opens artery nor vein. He introduces his preserving liquid through the mouth into the larynx, pouring it through a funnel, and when he has made about two glasses full (a half-litre) penetrate into the organism, the corpse is surrounded with a vegetable powder, impregnated with the same liquid, in the midst of the tomb. Not only is the preservation complete, but the body becomes completely mummified, and acquires a hardness which may be compared to wood or stone; the skin retains the colour it had at the time of death, and the features preserve their natural expression. But what is most astonishing, this wonderful preservation is produced in deal coffins, badly fitted, badly joined, placed in a damp situation, in contact with atmospheric influences of all kinds. These facts are stated in the official reports of very competent and very conscientious medical men. In all experiments which have been tried, bodies preserved on M. Audigier's plan have remained preserved for one or several years, and the official reports are unanimous in acknowledging that such an easy method of embalming is of great utility to the public; families may like to have the bodies of their relations brought from foreign lands; the bodies of unknown persons can thus be preserved for identification; bodies destined for dissection can be kept from decomposition. Audigier's method of embalming is exclusively carried on in Paris by M. Bayle, Rue Caumartin, who, out of respect to religious societies, offers to embalm gratuitously all priests or members of religious orders, either male or female, who die in Paris.

Effects of the War on the Commerce, &c., of France.—Official returns and statistical works are beginning to throw light upon the hitherto conjectural statements relative to the real effects of the late war. According to official returns, the revenue produced by the Customs duties and indirect taxes during the first eight months of the present year has been 549,000,000 francs, against 489,000,000 francs in the corresponding period of 1869. The total value of goods imported into France during the same period has been 2,329,000,000 francs, against 1,965,000,000 francs in 1869. The total amount of precious metals imported has been 305,000,000 francs, against 434,000,000 francs in 1869. The total value of exported goods has been 2,339,000,000 francs, against 1,940,000,000 francs, and of precious metals, 1,480,000,000 francs, against 204,000,000 francs in 1869. The increase in the amount of goods imported is attributed, in part, to the impending increase in the rates of duties. The *Annuaire de l'Economie Politique et de la Statistique*,* by M. Block, aided by several other well-known economists, presents us with all the known facts carefully arranged. In the first place, France has lost by the war more than 3,000,000 acres of land, and 1,597,228 of its former people, the numbers being derived from the census returns of 1866. To this have to be added 89,000 officers and men killed on the battle field, or who died in the hospitals, and an equal number estimated to have succumbed to the effects of cold and privation. The mere monetary loss in this case, says a journalist, cannot be estimated at less than £400 per head for each trained soldier, for the negroes of Louisiana cost more than that before the emancipation. This, however, is rather a fanciful calculation. The above sad total of slaughter is made up as follows:—26,000 perished at Forbach, Reischoffen, Borny, Gravelotte, St. Prevat, and around Metz in September and October; 10,000 fell around Sedan; the army of the Loire lost 22,000 men; that of Bourbaki, 7,000; General Faidherbe, 3,500; and Garibaldi, 1,600; the sieges of Strasbourg, Belfort, Phalsbourg, &c., cost the lives of 2,000 only; that of Paris, 17,000. The monetary losses are set down as follows:—

Contributions paid by the various departments, in round numbers and in francs..	39,000,000
Taxes imposed or collected by the enemy	52,000,000
Value of other requisitions made by ditto	327,000,000
Estimated losses by fire and other causes	141,000,000
Value of papers, furniture, &c., taken without requisition	246,000,000
The total being set down at	822,000,000

To the above are to be added the losses to Paris, which are set down as follows:—

Losses caused by the war, about	2,000,000
,, caused by the communal insurrection	6,000,000
,, by fire and pillage................	60,000,000
Damage done to municipal buildings	20,000,000
Total	88,000,000

Larger totals than this have been given for Paris, but this has arisen from the fact that the word Paris has been used carelessly for the whole department of the Seine. In this account the two are kept separate. The total money losses stand as follows:—

	Francs.
Department as above	822,000,000
Paris	88,000,000
Cost of the war proper, about............	3,000,000,000
Indemnity.............................	5,000,000,000
Total .... (£356,400,000)	8,910,000,000

The effect of all this on the budget is shown in the estimates for 1873, the expenses being set down at 2,388,000,000 francs, and the receipts requiring 579,000,000 francs (£23,880,000) of new taxes to balance the account. These new taxes include both direct and indirect dues, the former being placed on horses and carriages, clubs and billiards, stamps, and registration fees, railway fares, postage of letters, &c., the latter on coffee, tea, sugar, cocoa, chicory, potable liquors, tobacco, mineral oils, and other articles, as well as on navigation. What will be the effect of all these taxes on importation, exportation, and consumption, it is quite impossible even to guess; and when, in addition, we look at the other taxes to be laid on raw materials and general imports, the financial prospect is dark indeed. Lastly, the annual charge on the consolidated debt in France is stated (by the editors of the *Annuaire*) to be about 1,050,000,000 francs (£42,000,000). For the working of the new taxes, and the effects of the new import duties, we must wait some time, but as movement is a fair representative of trade and commerce, the condition of the omnibus company becomes an important matter. The receipts of the company this year, at least during the first six months, have never, even in the case of the lines of the great boulevards, reached the maximum amounts before the war, while on several lines, some of them especially commercial, such as those from the Bourse and the docks, the loss amounts to forty and fifty francs per omnibus per diem. The number of omnibus riders during the first half of the present year six millions was less than during the same period of the year 1870. A diminution in the use of cabs might be ascribed to reasons of economy, but in Paris, where there are not yet any really urban railways, and where everybody uses the omnibus, the serious falling off in the receipts of the company can scarcely indicate anything else than a diminution of business.

Standard Metre and Kilogramme.—M. Tresca has announced officially to the Academy of Sciences the adoption of the metre and kilogramme by the International Commission, and, further, that a mixture of 90 parts of platinum and 10 parts of iridium, forming the most durable composition known, has been selected for the standards, which will be tested by the most rigorous rules that science can supply. The congress also impressed the desire that a permanent commission of twelve members, selected from various countries, should be appointed to carry the above determination into effect. It is proposed that a special building shall be constructed to contain the standard metre and kilogramme. It is proposed to make at once thirty copies of the standard metre in the French archives, and then to take the average of these as the standard; it is not thought that the differences will amount to so much as the 1,000th part of a millimetre, or, in round numbers, the 25,000th of an English inch.

MEETINGS FOR THE ENSUING WEEK.

MON......Royal Institution of British Architects, 8. Opening Address by the President.
Royal Institution, 2. General Monthly Meeting.
Society of Engineers, 7½. Mr. Henry Davey, "Milford Haven, and its New Pier Works."

TUES ...Society of Biblical Archeology, 8½. 1. Rev. D. Haigh, adjourned discussion upon "Israel in Egypt." 2. Mr. Henry Fox Talbot, "On an Assyrian Prayer." 3. Mr. Henry Fox Talbot, "On the Religious Beliefs of the Assyrians, No. II." 4. Professor Donaldson, "On the Tomb of Jacob at Shechem." 5. Mr. Richard Cull, "A T Conjugation such as exists in Assyrian, shown to be a character of early Shemite speech by its vestiges found in the Hebrew, Phenician, Aramaic, and Arabic Languages."
Zoological Society, 8½. 1. The Secretary, Report on additions to the Society's Menagerie. 2. Dr. G. L. Le Conte, "On *Platypsyllidæ*, a new family of Coleoptera." 3. Messrs. A. G. Butler and H. Druce, "On Lepidoptera collected by Dr. Van Patten in Costa Rica."

THURS......Linnæan, 8. 1. Mr. T. H. Potts, "On the 'Piopio' of New Zealand (*Keropia crassirostris*, Genel.) 2. George Dickie, "On the buds developed on leaves of *Malaxis*."

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* Guillaumin et Cie, Paris. 12mo. 1872.

Journal of the Society of Arts.

No. 1,042. Vol. XX.

FRIDAY, NOVEMBER 8, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

EXAMINATIONS, 1873.

The Programme of Examinations for 1873 is now ready, and may be had gratis, on application to the Secretary.

The following subjects, which were in the Programme for this year, do not appear in that for 1873:—

Metrical System.
Mensuration.
Domestic Economy.
Geography.
Latin.
Elementary Musical Composition.

The Final Examinations, in 1873, will be held on the evenings of the 22nd, 23rd, 24th, and 25th April. The Time-table has been arranged as follows:—

TUESDAY, 22nd April, From 7 to 10 p.m.	WEDNESDAY, 23rd April, From 7 to 10 p.m.	THURSDAY, 24th April, From 7 to 10 p.m.	FRIDAY, 25th April, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music. English History German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

Friday, 25th April, 6 to 7 p.m.—Dictation.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 4th, 5th, and 6th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

INTERNATIONAL EXHIBITION, 1872.

The Council, having been informed that Her Majesty's Commissioners do not intend to publish reports on the different departments of the Exhibition of the present year, and looking to the great importance to Arts, Manufactures, and Commerce that these annual displays should not pass away without some record, have decided to undertake that duty, and for this purpose have engaged the services of gentlemen specially skilled in the subjects of the several sections, to prepare such reports, for publication in the Society's *Journal.* The Council, however, desire it to be understood that, in publishing these reports, they do not necessarily adopt all the views expressed in them, which must be taken as those of the writers only.

The following is the seventh and last of the series:—

INDIAN COTTON AT THE INTERNATIONAL EXHIBITION.

The International Exhibition of 1872, the programme of which included raw cotton, and everything connected with cotton manufacture, appeared to offer an excellent opportunity for bringing together a complete collection of the cottons grown in India, and of the articles manufactured therefrom; and of illustrating at the same time the measures adopted during the last few years by the Indian government to improve the cultivation and preparation of the staple, and to assist the trade in this most important article of Indian produce.

Considerable interest was taken in the subject by the late Earl of Mayo, and careful instructions were issued by his government to the central and local committees appointed in India to forward the views of her Majesty's Commissioners for the International Exhibition, and to render the collection as perfect as possible. The result is the large array of Indian raw cotton, together with specimens of everything connected with the cultivation of the plant, its preparation for market, and the various processes of the manufacture in India of thread and cloth, exhibited in the West Quadrant adjoining the Albert Hall, specially assigned by her Majesty's Commissioners for the purpose.

It is proposed in the present paper to give a brief sketch of the cultivation of the cotton plant in India, and to notice the chief points of interest in this collection.

Owing to climatic and other influences, the staple of Indian cotton is unfortunately short, and not so well adapted to spinning as American, Egyptian, and other superior varieties. Until the commencement of the American civil war, and the consequent scarcity of cotton, the demand for "Surats," as Indian cotton was generally called, was comparatively small, both in the United Kingdom and on the continent of Europe. The year 1862, however, saw the manufacturers glad to get almost any description of cotton for their mills, and then came a great demand for the despised Surats, at prices far beyond the native cultivator's wildest hopes. Although the quantity that up to that time had found its way to Europe was, comparatively speaking, inconsiderable, cotton had always been cultivated on a large scale in India, chiefly for local consumption, and for exportation to China and elsewhere. The crop is one well adapted to the soil of many of the more fertile provinces of India, and is well understood by and popular among the peasantry. The consequence of the greatly enhanced prices offered for the produce was a remarkable extension of the cultivation of cotton throughout India, accompanied by the withdrawal of some quantities from local consumption. It is not very easy to collect accurate statistics of the area under cotton cultivation throughout all the provinces and presidencies in India. In some cases, the returns prepared are merely rough estimates, but, on the whole, they give a fair idea of the effect on the cultivation of the sudden rise in the price of cotton. Thus, for instance, in the Central Provinces of India the area under cotton cultivation in the year 1862 was 375,000 acres. In the year 1865 it rose to 690,000 acres; and, although of recent years the cultivation has followed the prices, and has somewhat fallen off, there are still about 600,000 acres sown with cotton in those provinces. In the adjoining district of the Berars, in which some of the best Indian cotton is grown, the proportion of increase was hardly less than that noticed above, and the same may be said of the extension of cultivation in the Bombay Presidency. The following table shows approximately the area sown with cotton in the several provinces and presidencies of India, with the yield roughly calculated in bales of 400 lbs.

Approximate Statement of Cotton Cultivation in India.

Political Divisions.		Cultivation in Acres.	Average produce per acre in lbs.	Total produce in bales of 400 lbs.
Country drained by Bombay.	Bombay Presidency and Sindh	2,200,000	80	440,000
	Bombay Feudatories.	2,000,000	80	400,000
	Central Provinces and	750,000	80	150,000
	the Berars	1,250,000	80	250,000
	Nizam's Territories Central India Rajpootana, &c.	2,000,000	50	250,000
	Punjab sends to Kurachee	800,000	50	100,000
Total Bombay Drained Country		9,000,000	80	1,590,000
Madras	Madras	1,320,000	80	264,000
	Mysore	30,000	80	6,000
Total Madras		1,350,000	...	270,000
Bengal	Lower Bengal	400,000	50	50,000
	N. W. P.	1,600,000	80	320,000
	Oudh	80,000	50	10,000
	Punjab (see above)	...	...	...
Total Bengal		2,080,000	...	380,000
British Burmah (Total)		60,000	50	7,500
Sundry Cultivation in the Interior in Native States (produce not exported)		400,000	50	50,000
Grand Total		12,890,000	75	2,297,500

The Chief Sorts.

It will be seen from the foregoing table that the average quantity of cotton produced on an acre of land varies in different parts of India. This of course depends very much on the soil; and this brings us to the collection of the chief cotton-growing soils of India, which forms the first division of the annexe devoted to Indian cotton. The collection is very large, and includes a great variety of specimens sent by Messrs. FitzGerald and Terry, the honorary secretaries of the Bombay Committee, illustrating the chief soils of the Bombay Presidency, and by Mr. Dunlop, the honorary secretary of the Berars Committee, showing the class of land on which cotton is grown in these provinces. These pecimens are preserved in air-tight, glass-stoppered bottles, and a large number of them will hereafter be analysed, with a view to ascertain the class of nourishment which ought to be returned to the land in the shape of manure, with a view to an increase in the produce. The sort most common throughout the cotton-growing tracts of Western India, and on which the best cotton is produced, is the "regur," or "black cotton soil," of the Deccan, which stretches from the Western Coast to the centre of India, near Nagpore, where it meets the lighter soil which covers the sandstone formation. The "regur" is thus described in Ansted's "Geology," page 343:—"Its colour is bluish black, greenish, or dark grey. It forms into a paste with water, and gives a clayey odour. It absorbs moisture rapidly, and parts with it in dry and hot weather. Its thickness varies from three to about twenty feet. It is cultivated very easily, yielding a rotation of crops, consisting of cotton and two kinds of corn. It rarely requires to be left fallow, and demands but little husbandry, although for the last 2,000 years this soil has continued in cultivation without manure, retaining the utmost fertility.

The following is an analysis of the "regur," taken from the same authority:—

Silica	48·20
Alumina	20·30
Carbonate of lime	16·00
Carbonate of magnesia	10·20
Oxide of iron	1·00
Water and organic matter	4·30
Total	100·00

Several specimens of this soil are shown in the collection. In a sample-box, sent by Mr. Dunlop from the Berars, samples of the black cotton soil, and the subsoils, from rich black mould to hard basalt rock, are exhibited.

Manures.

The second division of the collection shows the manures in use in India for fertilising the soil on which the cotton is grown. The Indian cultivator is shrewd enough, and thoroughly appreciates the value of manure. But in highly cultivated tracts, where cotton is grown, wood is scarce, and cow-dung, which would otherwise be returned to the soil as manure, is universally used for fuel. The quantity of manure available is thus small. Some attempts have been made, of recent years, to introduce artificial manures or fertilisers, which have been used with so much success in America. A specimen of one of these, distributed by the Cotton Supply Association of Manchester, is exhibited in the collection. It is composed as follows:—

10 parts soluble phosphate.
3 parts sulphate of ammonia.
3 parts nitrate of soda.
4 parts Peruvian guano.

The ingredients promise well for the recruiting of the exhausted soils. As yet the results of the experiments with these manures have not been very decided, consequent upon the unfavourable seasons during which they were tried. Much attention was paid to the subject by the late Earl of Mayo and by Sir Seymour FitzGerald, the late Governor of Bombay. In India, however, manure cannot be used, as a rule, without a liberal supply of water, and in the cotton districts the question of irrigation is yet in its infancy.

Implements used for Preparing the Soil.

A complete set of the instruments used in preparing the soil is next shown. The manner in which these implements are worked is illustrated by a series of sketches, prepared by J. Lockwood Kipling, Esq., of the School of Art, Bombay, and by photographs exhibited by the several local committees. The simplicity, and what may be considered the clumsiness, of the native appliances will perhaps be noticed. The implements have certainly undergone but little change for centuries. But, although to our eyes clumsy, they are wonderfully well adapted to the requirements of the people; they seldom get out of order, and what few repairs are required can be effected without difficulty by the carpenter and blacksmith, who form part of the institutions of every Indian village.

I cannot do better than quote Mr. Kipling's description of the *nágur*, or heavy plough, which accompanies the excellent sketch he has made of the process of breaking up the ground with this formidable looking implement. He says:—"The *nágur* is a heavy plough, used in breaking up stiff land, and where, as in fallows, *kundar*, or conch grass, has taken firm root. The projecting iron bar shown in the sketch takes the place of the coulter of an English plough, while the elegant curves of the English ploughshare are represented by the rude hollowness of the under surfaces of the block which support it. Yet the *nágur* is a very effective instrument; it is cheaply made and easily repaired. Six bullocks are required for the draught, and each pair is attended by a driver." The *buckhur*, of which a specimen is shown, is more generally used throughout the cotton-growing tracts for preparing the land. It is thus described by Mr. Kipling in the note which accompanies his very lifelike and accurate sketch:—"The *buckhur* is the plough in common use when the land is fit and easily workable. It is, perhaps, the most useful implement employed in the cotton field and in general cultivation. Practically it is a wide Dutch hoe, with a blade of about one foot ten inches wide, set in two feruled pegs depending from a heavy block of wood, from which a pole ascends to the yoke, and fitted to a short handle sloping backwards. The parts are separately carried to a field, and there joined up, while the simple rope-gearing is so contrived that the stress of the draught pulls all tightly together. An important feature in the simple machine is the bamboo carried by the driver, used to stimulate the animals, but mainly to steady the plough. Two indentations are cut in the upper face of the main block of the *bukhur*, and in one of them the point of the bamboo is rested. It will thus be seen that the cultivator in this sketch is not gracefully posing himself, since his weight, though comparatively slight, as he leans on his bamboo, is of vital importance as a steadying power."

The process of sowing the cotton is simple. The seed, prepared beforehand so as to make it run with ease, is dropped down hollow bamboo tubes carried by labourers, who follow the *buckhur* described above. The cotton is thus sown in rows of about three feet apart, soon after the first fall of rain, about the commencement of the month of June. It ripens in the month of November, when the picking commences, and about the end of the year the up-country markets are active. As yet it can hardly be said that much improvement has taken place in the agricultural implements in India. Light English and American ploughs, specimens of which are exhibited, have been found to answer well; but they are somewhat expensive, and the native cultivators hardly understand them yet.

The Cotton Plant.

The next step in the cotton collection is the ripe plant. Several specimens of these are to be found in the Indian annexe, and an extensive variety are to be seen in the hothouses attached to the exhibition, belonging to Major Trevor Clarke, who has conducted many important experiments with Indian cotton, especially with hybrids. The commonest variety in India is the *Gossypium indicum* or *herbaceum*. The *Gossypium Barbadense* and the *Gossypium Peruvianum* or *acuminatum* are to be found in temples, gardens, &c., in India, but they do not form any part of the cotton of commerce.

A complete collection of the weeds which give so much trouble in cotton cultivation has been sent to England, and will be of interest to botanists.

Measures Adopted to Improve the Cultivation of Cotton in India.

Of recent years, the government of India paid much attention to the improvement of cotton cultivation. Attempts have been made to introduce foreign varieties, but the result has not been satisfactory, save in the Dharwar country in the south of the Bombay Presidency, where the New Orleans cotton seed has been successfully acclimatised. In the Dharwar country, however, the climate is exceptionally favourable, and the foreign plant is cultivated there under conditions which cannot be secured for it in other parts of India. Endeavours have, therefore, been made to improve the indigenous plant, which, though inferior to its American rival, produces a very fairly satisfactory cotton. With this view, model farms have been established, under the charge of trained European superintendents, in the chief cotton-growing tracts of the Bombay presidency and in the Berars, central provinces, north-west provinces, and in Madras. The experiments, so far as they have gone, seem to indicate that the staple of the Broach, Hingunghat, and of the superior Indian cottons, are about as good as can be grown under all the conditions of climate and soil with which the plant has to contend in India. But although there appears to be small prospect of improving the length of the staple, it is hoped that the yield may be increased by improved cultivation, and to this subject, which in the present state of the cotton trade is of great importance, much attention is being paid at the model farms established by the government. The question all turns upon the cost of the improvements. Greater care in cultivation means, in most cases, an increase of expense. If the return obtained by the improved cultivation more than counterbalances the extra expense incurred, the natives will, in course of time, adopt the suggested improvements. And it is with a view to prove practically the merits of these improvements that the model farms have been established in the centres of the cotton-growing tracts. Many specimens of the produce grown on these farms are exhibited.

Preparation of the Cotton for Market.

The branch of the cotton trade which has undergone the greatest improvement during the last few years is the preparation of the staple for market. It is not only to the cultivation of the crop that more attention is required before a really satisfactory article can be supplied to the European market. The picking of the article is conducted carelessly enough, and the effect is shown in the quantities of dirt and leaf found in Indian cotton. The high prices given by the European merchant of late years have very fortunately made the cultivator somewhat more careful in the manner in which cottton is cleaned and sent to market. By "cleaning" is meant the separation of the seed from the cotton wool. The cotton, when picked from the plant, is in the shape of "*kupas*," or cotton in the seed, the fibre adhering to the seed in the manner shown in the many samples sent to the Exhibition.

Cleaning the Cotton.

Several of the native instruments by which this process is performed are shown. The most primitive of these is the foot-roller, used in the southern Mahratta country of the Bombay Presidency. This consists of a metal roller, which, with the aid of a wooden slipper, is worked by the foot backwards and forwards amidst the cotton and the seed. By degrees the seeds become loosened and separated from the fibre, which is drawn under the roller, and remains on one side of it, whilst the seed remains on the other.

An improvement on this machine is the churka, or ordinary native gin, used with slight modifications in most parts of India. It consists of two rollers, either one of iron and one of wood, or both of wood, revolving in opposite directions. The fibre is drawn through between the rollers, the seed, which is too bulky to pass through, falling on the other side. The machine is very simple, and seldom gets out of order, and the principle on which it works is the foundation of most of the cotton gins made from time to time in Europe. Many valuable improvements have been made of late years, and several of the excellent machines now in use were to be seen at work in the cotton department of the Exhibition. The subject, too, is of so much importance that a series of trials with the gins of every class was held early in the present year at Manchester, and the report of Dr. Forbes Watson, of the India-office, on this subject will be awaited with interest. Since the date of the last Exhibition many new gins have been introduced into India. Dr. Forbes, the cotton commissioner, Bombay, paid much attention to the subject, and made some valuable improvements in the gins used in the Dharwar country. Large ginning factories, worked by steam, have been set up in the Broach, in the Berars, and in other parts of India, and a considerable proportion of the Indian cotton crop is now cleaned by the Platt-Macarthney gin, which is found to suit the Indian staple better than any other. Specimens of the ginned Broach cotton were exhibited, and considered to be of excellent quality. If the greater part of the Indian cotton crop could be brought up to this standard, there would be less cause to complain of Indian cotton. The machinery separates the seed from the fibre very thoroughly, without cutting or tearing it, and the absence of seed and leaf in this cotton makes it very popular. The Dharwar cotton grown from American seed is cleaned with the saw-gin process, which is sometimes found rather trying to the fibre. The native gins do their work fairly enough, but much seed is sometimes found with the cotton thus cleaned, some portion of it being doubtless often thrown in on purpose to increase the weight. Of the improvements made in India of late years in cotton gins, may be noticed, in addition to those of Dr. Forbes, already mentioned, the gin invented by Mr. Jones, of Dharwar, and by Mr. Henderson, of the Mofussil Ginning and Dressing Company, at Oomraotee, in Berar, both of which are considered very successful.

THE COTTON READY FOR MARKET.

The cotton, having passed through the cleaning process, is now ready for sale, and it is packed by the cultivator, and carried by him to market. It was in this process that, in old days, Indian cotton suffered considerably in character. Little care was taken in packing it, and consequently the damage done by the weather, and by the dust and dirt that accumulated in transit, was generally considerable. The collection contains specimens of the nets and bags in which the staple is packed, and models of the carts and sketches of the bullocks and camels by which the bags of cotton are carried to market. In former times, in consequence of the state of the roads, the traffic was chiefly carried on by bullocks, on each of which a *bhojah*, or "load" of two bags, was slung, pannier-fashion, and carried thus for great distances. Although this means of transit is now but little used, the word *bhojah* still remains in the name of the conventional weight by which cotton is sold. Of late years the state of the roads, and the state of the trade also, have been greatly improved. European agents are to be found established at all the chief cotton markets in the interior of India, and as they pay a high price for cotton that has been well cleaned and carefully packed, much more attention is bestowed by the cultivators on these important processes. In fact, the great improvement that can be claimed to have taken place in Indian cotton since the date of the Exhibition of 1862, is superior purity, consequent on the manner in which it is now prepared for market and sent to England. It was at one time hoped that the staple might be much improved, and a greater length and fineness obtained; but, as already mentioned, it would appear that the climate of India militates against success in this direction. Still, the improvement in the condition in which Indian cotton is now brought to Europe is generally admitted, and is of no small importance. The circumstances to which this improvement is due are now to be noticed.

THE COTTON MARKETS IN THE INTERIOR OF INDIA.

In Mr. Kipling's very clever sketches, and in the series of photographs contributed by Mr. Fitz-Gerald and Mr. Dunlop, the hon. secretaries respectively of the Bombay and Berar Committees for the Exhibition, a very accurate idea is given of the manner in which the trade is carried on in the interior of India, and at Bombay and Calcutta, where most of the cotton is sent for export. Space will not permit of the subject being dwelt upon at any length in this paper. But it is to be noted that the extension of railway communication has, of late years, quite revolutionised the trade. In old days, when the chief cotton markets in the interior were separated from the sea-board by three weeks' journey over almost impassable roads, it was hardly to be expected that many European merchants would penetrate into the districts, and carry on business at out-of-the-way markets. The trade was then entirely in the hands of native dealers, and the cotton, before it reached Bombay, besides having to undergo a long journey across difficult country and along indifferent roads, had to pass through the hands of many middlemen, whose interest in preserving it from dirt and damage was often small. The European merchant at the seaport was obliged to take what he could get. And this, as a rule, was cotton not inferior in staple to that which is produced in the present day, but which, from careless picking, bad packing, and too often from admixture with inferior cottons grown in other parts of India, was not not fit for any but the most ordinary class of work. The railways have now connected Bombay with Allahabad, Madras, Nagpore, Calcutta, and Lahore, and nearly all the cotton-markets in India have been brought into easy communication with the most important ports of shipment. Heavy machinery (to transport which over the roads of the interior was formerly a physical impossibility) can now with ease be carried to any of the up-country markets. The introduction of machinery has of late years largely increased, and in addition to the steam-machines for cleaning the cotton already noticed, there is hardly an important market in the interior which is not now supplied with powerful steam-pressers for packing the cotton for export. The number of European merchants settled in the interior has increased in like proportion, and the consequence is that the cotton grown in a district, instead of passing through the hands of a series of middlemen, and being sent carelessly packed to the seaboard, is now bought direct from the cultivator by the European agent, and then packed on the spot, in full-pressed bales, and sent by railway direct to Bombay for shipment.

The extent to which the cotton trade in the interior has, of late years, passed into the hands of the European agents now established at most of the up-country markets, is indicated by the following figures of the exports of cotton in full-pressed bales from the Berars during the last few years.

COTTON EXPORTED FROM THE BERARS.

Season.	Proportion of the crop exported in full-pressed bales. Per cent.
1867-68	12
1868-69	29
1869-70	66
1870-71	74
1871-72	81

Although the figures given above refer to the Berars only, they give a fair notion of what has been going on in other parts of India also. The system has long since been extended into the chief provinces of the Bombay Presidency, and steam factories, managed by Europeans, are now to be found on the line of railway which connects Bombay and Madras. The screws, or full-presses, worked by hand are numerous in the North-Western Provinces, every considerable market of which has now one or two European agents established there for the purchase of country produce.

Specimens of cotton packed in full-pressed bales at the steam factories in the interior of India are shown in the Exhibition, and form one of the most important features of the improvement that has taken place since the date of the last Exhibition.

With the full-pressed bale the section of the cotton exports of India are closed. The adjoining table shows approximately the proportion in which each province of India produces cotton, the quantity exported, and the amount retained for home consumption. The parts which drain off their cotton supply are also shown.

APPROXIMATE STATEMENT OF THE EXPORT OF COTTON IN INDIA.

Political Divisions.	Name of Cotton.	Approximate quantity of each sort exported.	Season of coming in to the Market.	Approximate quantity retained for Home Consumption.	Exports in Detail, in Bales of 400 lbs.				
					Port.	To Great Britain.	To the Continent direct.	To China.	Total.
Country drained by Bombay.									
Bombay Presidency and Sindh	Dharwar ... Koompta ...	200,000	March..	360,000					
	Broach ...... Surat	150,000	January		Bombay.........	991,000	135,000	53,000	1,179,000
	Kandesh ..... Sindh	75,000 20,000	January						
Bombay Feudatories	Dhollera	375,000	January						
Central Provinces and the Berars	Hingunghat...	50,000	Dec. and January		Karwar	25,000	...	...	25,000
	Oomraotee Akote	225,000							
Nizam's Territories .... Central India .... Rajpootana, &c.	Barsee .... Bengal ...... Oomraotee ...	125,000	January and March..						
Punjaub sends to Kurrachee	Bengal ...... Sindh	5,000	January		Kurrachee ...	26,000	...	...	26,000
Total Bombay Drained Country	...	1,230,000	...	360,000	Total Bombay	1,042,000	135,000	53,000	1,230,000
Madras ... Madras .... Mysore	Western ..... Northern	240,000 ..	March.. ...	30,000	Coconada ...... Madras .... Tutocorin	32,000 94,000 84,000	30,000	...	32,000 124,000 84,000
Total Madras	...	...	...	30,000	Total Madras	210,000	30,000	...	240,000
Bengal ... Lower Bengal N. W. P. .... Oudh .... Punjab (see above)	Bengal	200,000	Feb. ...	180,000	Calcutta	116,000	2,000	82,000	200,000
Total Bengal	...	...	...	...	Total Bengal	116,000	2,000	82,000	200,000
British Burmah	...	...	...	1,500	Rangoon ...	3,000	3,000	...	6,000
Total Burmah	...	...	..	...	Total Rangoon	3,000	3,000	...	6,000
Sundry Cultivation in the interior in Native States, Produce not exported				50,000	Not	exported.	...	...	...
Grand Total				621,500		1,371,000	170,000	135,000	1,676,000

Cotton Retained in India for Home Consumption.

That portion of the cotton plant retained in the country, and not available for export, has now to be noticed:—

The Cotton Stalk.—In the first place some use is made of the cotton stalk and of that portion of the cotton seed that is not required for sewing. The stalk of the plant is used as fuel. Then, again, baskets and hurdles are made of it, and some portion of it is employed in thatching. Some attempts have been made lately to prepare a rough fibre from the stalk, but the result has not been successful. Specimens of articles made from the stalk are to be seen in the collection.

The Cotton Seed.—The cotton seed not required for sowing is chiefly used in the cotton districts for feeding cattle, with whom it is very popular. The seed contains much oil, and is nourishing. Of late years endeavours have been made to crush the seed and extract the oil, and with this view steam machinery has been set up in one of the large cotton markets of the Berars. Specimens of the oil are exhibited, and are highly spoken of. The refuse, consisting chiefly of the shell of the seed, can be made into a cake for feeding cattle, and may also be utilised in the manufacture of paper.

Raw Cotton retained for Local Consumption.

The quantity of raw cotton retained in India for home consumption is very large, and a rough estimate of this is given in the preceding table. The figures do not pretend to accuracy; there can be no doubt, however, that the quantity locally used is very large, and this fact is perhaps not always thoroughly realised in England. With this view, a complete collection of the various uses to which raw cotton is put in India has been brought together. Thus, the lampwicks burnt with the *chiragh*, or earthenware lamp, in every native household are shown. Then there is a large assortment of tapes, and ropes used for harnessing bullocks and horses, and for tents, and of fishing nets of all sorts and sizes made from cotton. Pillows, mattrasses, quilts are all stuffed with cotton, and specimens re exhibited. In Upper India, where the cold in the winter is great, nearly every native wears a coat padded with cotton; and tents, and *sutringar*, or rugs, are largely manufactured from cotton. It will therefore be readily understood that the quantity of cotton used in the above processes is not inconsiderable.

Manufacture of Cotton Yarn and Cloth.

This most important branch of the manufacture yet remains to be noticed. The subject is well illustrated by Mr. Kipling's excellent sketches, and by specimens of the rough but effective machinery in use throughout India.

The cotton when it leaves the gin, or *churka*, is not quite fit for spinning; it is too "lumpy." It therefore has to undergo the process of being "bowed." This is performed by the *punjara*, who, with the assistance of a "bow," "fluffs up" the cotton. It is then raked into *pootlees*, without which the spinner cannot perform his delicate operations. The simplicity of the spinning-wheel used throughout India is remarkable. At first sight it appears to be a clumsy little machine, but with practice yarn of an extraordinary fineness can be spun from it.

The specimens of yarn exhibited are numerous. The finest yarn is that manufactured in Dacca and in Central India. In the Nagpore province, the fine yarn is spun by the Dhers, or outcasts, during the damp weather, as in the hot weather the thread is liable to snap. The finest specimen exhibited is one which, according to English classification, would be put down as about No. 240 yarn; and it is calculated that a pound of this fine yarn, if drawn out into a single thread, would reach a distance of 117 miles.

The yarn manufactured by the cotton-spinning mills, worked by steam in Bombay, Broach, Calcutta, Cawnpore, and other parts of India, is represented in the Exhibition. This branch of industry is making considerable progress in India, the mills in Bombay being particularly successful.

Cotton Cloth.

The last specimens shown are the various plain and coloured cloths manufactured in India. The increased importation of comparatively cheap Manchester goods has, of late years, much affected the weavers. The middle-classes wear English cloth in large quantities. There are, however, two classes of cloth manufactured in India, which are not likely to be easily supplanted by foreign goods. The one is the common, coarse, strong cloth used by the peasantry. The people say that it is stouter than English cloth, and stands wear and tear better. The other is the luxurious fine cloth, used by the richer classes only, which the Manchester mills do not appear to have imitated as yet with much success. Many beautiful specimens of their rich fancy goods are exhibited. The yarn is very fine, the cloth woven with great care and precision. Some specimens have rich silk borders, others are embroidered with gold thread. They are very expensive, and are used only by the rich. The cloths with the rich borders are manufactured chiefly in the Nagpore country. The trade was fostered by the former Rajah of Nagpore, who brought together weavers from different parts of India, and who patronised them largely. The trade has somewhat fallen off since the breaking up of the rich native court at Nagpore, but most of the leading Hindoo noblemen and gentlemen of India still draw their supplies from Nagpore. Before the mutinies, the notorious Nana of Bhitoor used annually to send large orders to the Nagpore weavers.

Some of the cloth manufactories of the Nizam's territory are celebrated, and good specimens are exhibited. Dacca, too, still produces muslins of the most exquisite fineness, and a specimen of the "woven air" from a Dacca loom is to be seen contrasted with the strong thick cloth manufactured in Central India, and in common use among the peasantry there.

Indian Dyes.

The last section in the exhibition of Indian cottons and cotton manufactures is a collection of the dyes and of the blocks used in printing Indian cloths. The collection of dyes used in the Bombay presidency has been brought together by Dr. Bhan Dajee, of Bombay, and is of much interest. They represent accurately enough the dyes used throughout the provinces. In India, as elsewhere, successful dyeing depends much on the water. Some of the villages situated on the sandstone formation beyond Nagpore are celebrated for the excellence of the water obtained there, and the best specimens of dyed goods come from that neighbourhood.

Blocks used in Printing Cotton Goods.

The collection of blocks is very perfect and interesting. Mr. Fitz-Gerald has brought together specimens of every block used in the Bombay Presidency, and Mr. Dunlop has done the same for Central India; and thus nearly every popular pattern used in India is shown. Some of the patterns are very quaint, others are particularly graceful, and they all deserve the attention of manufacturers who desire to please the popular taste in India.

Mr. Griffiths' Sketches of Indian Costumes.

The last point to be noticed is the series of water-colour sketches exhibited by Mr. Griffiths, of the School of Art, Bombay, showing the manner in which the cotton cloths exhibited are worn in India. These pictures have been very much admired for their artistic excellence. They are equally valuable as accurate representations of Indian costumes.

This concludes this collection, brought together with a view of showing specimens of everything connected with the trade and the cultivation of cotton in India. Each stage is illustrated by Mr. Kipling's excellent sketches, and by lithographs of the several processes through which cotton passes, from the seed to the loom; and those who take an interest in the cotton trade of India will find in the collection as practical a representation as it is at present possible to give of the state of the trade in that country. The limit of this paper will not admit of the prospects of this trade being noticed at any length. But it may be mentioned that, although the Indian cotton may feel the recovery of the American trade, the very large increase of the American supply has not as yet affected India as much as might have been anticipated. Of late years Indian cotton has become popular among the Continental spinners.

The opening of the Suez Canal has much facilitated communication between India and the Mediterranean ports. The trade in this direction has largely increased, and there seems to be reason to hope that if a standard of cotton as high as that grown in most parts of the Bombay Presidency and Central India can be maintained, the demand for Indian cotton, on both the Continent of Europe and in the United Kingdom, will not fall off to any considerable extent.

THE EXHIBITION OF 1873.

In the last *Journal* some account was given of the proposed arrangements for the exhibition of articles of food, and of the various appliances connected with the manufacture, cooking, and partaking of them. Reference was also made to the desire of the Commissioners to get together a collection of ancient drinking-cups, in order to compare them with those in modern use. The Commissioners are also desirous, in addition to these ancient drinking-cups, to get together a collection of implements of all kinds for drinking, of peculiar shape or novelty, and also various implements for the use of tobacco.

The desire is to secure from all parts of the world such collections as possess forms and ornament handed down from the earliest ages, and having a local distinctive character. There is no doubt that it would be of great interest to exhibit a complete series of characteristic implements for drinking and the use of narcotics in all countries, and especially from those in the following list:—Afghanistan (Kabul, Candahar); Asia Minor (Natolia, Donieh, Smyrna; Arabia (El Ratif, Mascate, Mecca); Algeria (Algiers); Armenia (Erzeroum, Betlis); Africa, N. (Morocco, Mequinez); Africa, S. (Cape of Good Hope); America; Argentine Republic (Buenos Ayres); Bolivia (La Paz); Australia (Melbourne, Sydney); Canada (Kingstown, Quebec); Brazil (Rio Janeiro); Uruguay (Monte Video); Chili (Santiago, Valparaiso); Austria (Vienna and Pesth, Neustadt); Bermuda; Bavaria (Munich [porcelain pipes]); Belgium (Antwerp, Mons, Brussels, Bruges); Bengal; Bombay; Burmah (Ava); Denmark (Copenhagen); China (Hong Kong, Amoy, Pekin, Shanghai, Hangtchou, Canton); Egypt (Cairo, Alexandria, Suez); France (Paris, Besançons, Sèvres); Greece (Valmada, Athens); Germany (Cassel [porcelain pipes], Lemgo [meerschaum], Belin, Frankfort, Dornheim [Gotha], Hamburg, Ulm [Wurtemburg], Altona, Hohr [Nassau]); Holland (Gouda, La Hague, Rotterdam); Ionian Isles (Corfu); Japan (Yeddo, Semeda, Miako); Italy (Savona, Genoa, Florence, Rome, Naples, Perugia); Kashmir (Srinagar); Madras; Norway (Lillehammer, Christiania); Persia (Teheran, Ispahan); Peru (Lima); Portugal (Lisbon); Russia (St. Petersburg, Moscow); Saxony (Leipsic); Switzerland (Zurich, Brienz, Wyon); Siam; Spain (Madrid, Segovia, Seville); Sweden (Stockholm); Turkey (Constantinople, Beyrout, Shaeer, Widin, Haskioy, Damascus, Islimia).

It should be said that mere duplicates of objects from any one country are not desired, and collections should only consist of some of the most remarkable specimens, with a sufficient variety to represent the implements generally in use or produced in any one locality.

With regard to the other classes of manufactured goods that are included in the Exhibition of 1873, there are several important points that the Commissioners, with a view to the thorough representation of them, desire to elucidate. In the Carriage Section, for instance, it will be particularly interesting to obtain, if not specimens, at least models or drawings of such carriages as are peculiar to certain countries, such as the hackory and ekka of India, sledges, post carriages, and others; and it is hoped that all countries will voluntarily contribute collections of this nature; but the Commissioners will be prepared to consider the purchase of objects, under certain conditions, from such localities as are not likely to undertake their own representation officially.

In silk also, in order that the representation shall be thoroughly international, it is particularly desirable that specimens of silk sent from various countries should be of the patterns commonly worn in those countries, with prices at which they are sold; therefore, besides specimens of modern silk, her Majesty's Commissioners are desirous of obtaining, if possible, specimens of silks of older manufacture, in order to be able to institute a direct comparison between the work and patterns of the present day and those of earlier times. The Commissioners are prepared to do the same with regard to the purchase of such silk specimens as they are for carriages.

With regard to the representation of steel, cutlery, and edge tools, it is desired that the specimens contributed by foreign countries should be so selected as to illustrate the chief differences in manufacture and form between the English and foreign steel goods, as manufactured at the present date. Even imitations of English goods would prove interesting and instructive. It is also proposed to form a collection of steel and steel goods manufactured at prior dates, so as to institute comparisons between the work and patterns of the present day and those of earlier times.

EXHIBITIONS.

MOSCOW POLYTECHNIC EXHIBITION.

Professor T. C. Archer, having visited the Moscow Exhibition, at the request of her Majesty's Commissioners for the Exhibition of 1851, has made a report, in which he says:—

The Polytechnic Exhibition of Moscow differs in one respect from all others which have been held; it not only aims at showing the progress of the manufacturing arts, but, to a much larger extent than ever before attempted, it is sought to show the processes by which the various manufactured articles are produced and applied to the purpose for which they are made; thus the operations of several hundreds of artisans are watched with great interest, and doubtless also profit, by the visitors. This is the leading feature of the exhibition.

The exhibition is in the Alexander-gardens, which occupy the place of the former moat and glacis of the Kremlin for about two-thirds of its circumference. These gardens vary in width, spreading out more or less on each side of a fine avenue or boulevard of lime-trees. Their entire extent is sixty-eight English acres, and from end to end the length is three versts, or about two English miles.

Tastefully placed amongst the groves, and on either side of the boulevard, are the buildings of the exhibition, together with the refreshment-rooms, offices, &c.—in all more than seventy detached buildings, all of them but one being expressly constructed for this exhibition; the exception being the Ménage, or great riding-school, the largest room in existence with a flat ceiling, unsupported except by the walls, its dimensions being five hundred and sixty feet in length, and one hundred and fifty feet in breadth. The new structures, with few exceptions, are built of wood, in the Slavonic style.

The conservatory for the department of horticulture is, however, as usual, built of glass and wood, so also is the great building in which the naval department is arranged. The latter is seventy-five sazhane, or five hundred and fifteen feet in length, built after the style of the Crystal Palace, at the expense of one citizen of Moscow, and presented by him to the Commission.

The exhibition is divided into two parts, both by the natural position of the ground, and by the fact that one-half is occupied by the special government departments of the army and navy, and the other by the general exhibition, the form of the exhibition ground being that of the letter V, one arm of which is almost exclusively occupied by the government departments, and the other by the rest of the exhibition. As each building is devoted to a separate class or group, and as they are all numbered consecutively on the plan, I will follow the numerical order.

The first group is that of horticulture. In the large conservatory (No. 1) previously mentioned, there is a fine display of tropical, sub-tropical, and greenhouse plants, but nothing very remarkable; surrounding it, however, are smaller houses (No. 2), in which all the methods of propagating plants are shown in operation, and a very large series of fruit trees in pots shows the various methods of training, pruning, &c.; whilst in a series of beds out of doors are shown all the culinary plants and potherbs used in Russia. To this I beg your especial attention. I believe the idea is quite new, and I think such a display, managed as our horticulturists can manage it, would be a most interesting and instructive accessory to the Food Section of next year's Exhibition.

The plants were reared in pots, which are plunged and covered, so as to appear as if planted in the beds, and they are very distinctly labelled with the scientific and vernacular names.

In Nos. 3, 4, 5, 6, and 7 are placed the various groups into which they have divided economic zoology; in No. 3, the central pavilion, are arranged stuffed and other prepared specimens of wild animals, useful or obnoxious to man. Then of the former the means of capturing are shown—this includes fishing nets and whaling weapons, &c., but not fire-arms, as there is a special section for "instruments and accoutrements for the chase"—the products of their capture and destruction, as, for instance, furs for the furrier, which are shown in process of preservation by furriers working at their trade; skins for the tanner, bones, integuments, &c. Wax models on an extensive scale show the anatomical structure of many of the invertebrate animals, and the embryology of the vertebrates.

The rearing of fish and other useful animals is shown either actually in aquaria, or by pictures and other illustrations.

The scientific investigation of the various branches of knowledge connected with economic zoology is largely illustrated by diagrams, microscopic slides, and microscopes, so placed and kept in order by the attendants as to be available to the public; whilst here, as in all other departments of the exhibition, competent expositors attend daily at fixed hours, and explain to those interested the various objects and arrangements of the section. This also is a novel feature, which may be worth consideration.

In the same pavilion are collections of fishes used for food, and illustrations of the ways in which they are prepared for commercial purposes, with all their products, such as isinglass, caviare, visyaga, botargo, oils, fins, skins, maws, and sounds. Models of fishing-boats and boat gear, dresses of fishermen, besides every kind of net, free or fixed; charts of fishing-grounds, and drawings representing various modes of captures. A collection of stuffed specimens of all dogs used in the chase in Russia; tents for huntsmen; dried or otherwise preserved flesh of quadrupeds; eggs and stuffed specimens of edible birds; dressed skins, hair, feathers, horn, bones, &c., fully illustrate all that appertains to the economic employment of wild vertebrate animal. In another section are shown a collection of domestic animals used as food, especially poultry; and in another group animals destructive to game and poultry.

No. 4 contains a very complete illustration of apiculture, a most interesting subject, and one deserving of ample development next year in the class of food. First, the bee is represented by enlarged drawings and models, and a beautiful series of wax-models show its development from the ovum to the perfect insect, through all its metamorphoses, and next a collection of its insect enemies. Then there is an immense display of bee-hives in endless variety, illustrating every known system of apiculture, also, I think, a desirable feature for next year's Exhibition; all varieties of honey, from the exquisite lime-flower honey, so celebrated in Russia, down to the most inferior brown honey, only used for mead or metheglin; the sundry uses to which honey is applied in the manufacture of drinks, and in confectionery; especially large cakes of wheaten flour, sweetened with honey, and impressed with the most ancient imperial insignia, which are given on special festivals to members of the imperial family. The wax was shown in every condition, raw and refined, and in all its general applications, and finally, a collection of wax flowers of the sorts most suitable for cultivation by the apiculturist in the vicinity of his hives.

No. 5 contains illustrations of sericulture, from the eggs or "seed" of the silkworm to the weaving of the silk through the processes of winding, doubling, throwing, &c. The varieties of silk-producing insects are shown alive, or prepared as cabinet specimens, and outside are the various trees and other plants upon which they feed. This, again, could be rendered an attractive feature in the Exhibition of 1873.

No. 6 is devoted to pigeon rearing, every variety, especially the English carrier, being exhibited.

No. 7 contains an immense collection of weapons used in the chase, beginning with those of antiquity, and coming up to the best fowling-pieces, &c., of the most eminent European makers; also every kind of sportmen's carriage, trappings and harness for horses, dresses, and other requisites of sportsmen; furniture and trophies for hunting-lodges, bronze and other ornaments, representing subjects connected with the chase, stuffed specimens of the more important kinds of game animals, especially an extraordinary fine collection of game birds, numbering nearly a hundred species.

The section of economic geology, mineralogy, and metallurgy is contained in three buildings, Nos. 8, 9, 10. No. 8, or the central pavilion, contains the chief collection, in which I saw nothing of any novel importance. It is a good collection of practical geology, and brings together a large collection of ores, metals, building stones, coal, &c., with numerous mining and metallurgical models, especially those of the Freiberg school. Nos. 9 and 10 are occupied by artisans working at the hard-stone work for which Russia is so famous; and the visitor sees the processes by which the beautiful inlaid work is done, and the veneering with lapis-lazuli and malachite.

The educational section (pedagogy), pavilion No. 11, is occupied with toys for the amusement and training of children.

No. 12 is a model school, large enough for 30 scholars, with all its fittings and other necessaries, such as diagrams, books, &c.

No. 13 contains an extensive collection of the peasants' works, such as they are taught to execute in the schools, as wood-turnery, lacquered wood-work, ornamentation of leather, bark-work, knitting, platting, clothing of cotton, woollen, and furs, boot and shoe-making, catgut making, lace, linen, tin-work, and a variety of other small handicrafts for economising time in winter.

Under the wide wings of the section of technology is embraced a very miscellaneous group of objects in numerous buildings grouped around the Central Pavilion of the division, No. 14. In the centre of this very large building is an interesting and extensive collection of the products and manufactures of the Caucasian provinces, amongst which are some beautiful rugs and cotton cloths, and very tasteful metal work. The other portions of the building are occupied by the general collections of manufactured goods from all parts of the world. Pottery and porcelain from England, Denmark, Germany, Russia, &c.; chemicals from the same countries, and others, the specimens from the Russian Chemical Works at Viatka surpassing all the rest. Products of distillation, vinification, brewing, liquor-making, bakery, &c.; manufacture of table necessaries, such as glass, cutlery, spoons, &c.; manufactures of sugar, oils, soap, paper, perfumes, hats (chiefly by Christy, of London); preparation and preservation of all kinds of food, animal and vegetable; tobacco, cigars, and all the articles required in the use of tobacco; and sewing machines in great numbers, and of every known pattern, including one perfecely new, with a self-acting clock-work arrangement. The whole of this department is on a large scale, and very well arranged.

No. 15 is devoted to textile manufactures, and several eminent British exhibitors have sent their well-known manufactures in cotton, linen, jute, sewing-thread, &c.; whilst the beautiful silks and brocades of the Moscow looms are not only seen in the cases, but also in course of weaving. Beautiful specimens of Russian lace, and the figured dress-pieces for various national costumes, render this court very interesting and attractive.

No. 16 may be represented as a manufactory of ornamental plate in silver and silver gilt; besides a splendid display in what may be termed the show-room, there are two very roomy and well-fitted up workshops, in which the artisans may be seen working the richly wrought and characteristic Slavonic designs which are so notable in the plate produced in Moscow by the great firms of gold and silversmiths. The schools of art established about eight years ago, on the model of those at South Kensington, have, under the direction of Mr. Bowtoffski, greatly stimulated and improved the national taste, and have especially led it to accept the pure Slavonic models, of which the imperial treasury in the Kremlin contains such an abundance of the best examples. The working goldsmiths who are employed in the Exhibition are from the manufactory of Gospodi Ootchinnckov.

No. 17 is occupied in a similar way by the working jewellery establishment of Gospodi Tchutcheleva, who stands high in this particular art.

No. 18 is devoted to paper-hangings, of which the exhibited specimens are in no respect remarkable. The operations of the workmen employed in printing them, however, are very interesting to the public.

No. 19 is for showing the process of gold chasing, which is seen carried on in all its stages by the workmen of Gospodi Posmikov, whose collection of finished work contains some of the most remarkable examples of fine art in the precious metals.

Nos. 20 and 21 are refreshment rooms; 22 and 23 for exhibiting perfumery and the art of working in human hair; and 24 is occupied by the machines in operation, making chocolate of all kinds.

No. 25 is a grand reproduction of a Turkistan or Tashkand Palace. In the court-yard of this building are grouped fine life-sized models of the different grades of the Turkistan people, all dressed in their various costumes, and some of them represented as engaged in their various occupations. Thus, a confectioner and his assistant are engaged in cooking; a grocer and an egg merchant in their respective shops are placed among their wares; next to them are living men engaged in embroidery; and so cleverly is the whole managed, that it is difficult to distinguish at first which are real and which are models. Besides these, there are separate figures, some on foot, others mounted on horses or camels, representing the various classes of the people; whilst around the palace are grouped a number of tents of the wandering tribes, some of them furnished and peopled. In the apartments of the palace are collections of the mineral, vegetable, and animal products of Turkistan, models of the implements of trade and agriculture, dresses and other objects of ethnological interest, and a collection of large maps of the district. Besides these are collections of works in metal, beautiful embroidered leather, gold and silk brocades, fine carpets of exquisite design, and very characteristic printed cottons, with the blocks and colours used for printing them. There is also a collection of the dried plants of the country, of the animals stuffed, of the crania of the people, and small models of houses, with figures of ladies and domestics engaged in various occupations.

Near to the Turkistan group of buildings is the tent of a Kirghis family, with all its household material arranged, and life-sized figures of the members of the family, male and female, adults and children.

The section of medical science is very complete in every particular; it is contained in three buildings, Nos. 26, 27, and 28. The first contains surgical, obstetric, ophthalmic, and optical instruments; the second, the instruments, working materials, and appliances used by the dentist; and the third is filled with therapeutical and anatomical instruments and appliances. In each of these departments every instrument, &c., in use is shown perfectly classified and arranged with great care, in fact, by their arrangement, forming a valuable study even to skilled medical men.

No. 29 is an establishment for American drinks, all of which are sold as well as exhibited.

No. 30 is the Ménage, or great riding-school previously mentioned. This vast hall is occupied by the machinery in motion—which is of almost every kind and from every manufacturing country in Europe, and by numerous artisans, all engaged in working at their various trades; it is an especially interesting and well-managed department, and comprises the following trades, all in active operation:—Jewellers, chasers of metal, gold-chain makers, polishing and burnishing of metals, rose-engine turning, gold and silver plate engravers, jewel-setting, gold-beating, gilders of books, &c., pewter-turners, needle-making, picture-frame moulders, makers of heald-eyes, reeds, and other loom fittings; card-makers, accordion-makers, bootmakers, saddlers, whip-makers, bookbinders, gold and silver embroiderers, paper-rulers, hat-makers, gold-lace-makers, tassel-makers, workers in swansdown, envelope makers, weavers of many kinds of goods, needle-workers, block-printers, match-makers, pottery, wood and ivory turners, umbrella-makers, and some others.

Nos. 31 to 35 are refreshment-rooms, &c.; and these are followed by the section for pharmacy, of which the general collection is in No. 36, and consists of every kind of apparatus, utensil, and preparation of the pharmaceutist, and a completely-arranged shop, with every drug, &c., in its place, with all kinds of novel inventions in the way of scales and weights, measure, powder-folders, pill machines, poison bottles, &c.

Nos. 37 and 38 are manufactories of hot and cold mineral waters, and therein is displayed every kind of fixed or portable gazogene, the waters being prepared and sold to the visitors.

No. 39 completes this section; it is a garden, in which are shown growing every medicinal plant of the Russian pharmacopæia, arranged systematically and with such good taste as to make it conduce to the general effect.

The section of forestry, as might be expected in a country where the subject is one of such vital importance, is most exhaustively illustrated. It occupies one large building (No. 40) and a nursery garden (No. 41); in the latter are shown young trees of all the kinds which can be grown for useful purposes in any part of Russia. In the building, the series begins with pictures or diagrams representing the forest trees, next a dried specimen framed and glazed, showing the foliage, flower, and fruit; below these are arranged in regular order sections of the timber, cut in all directions to show grain, &c., and associated with these any other portions of the tree which may have economic value, such as occasional wens, gnarled roots, &c.; and a series of cleverly-prepared models, showing defects in the timber from excessive knotting and other causes. Then a series of entomological preparations of the insects injurious to trees, with specimens illustrating their depredations. A very extensive and beautifully-arranged series of models, &c., show how the timber is removed from the forests after being felled, and the method of transporting it to its ultimate destination. Then there are models of various kinds of shutes for sliding the timber down inclines to the roads or rivers, ingenious forest railways constructed of trees, models of every kind of timber wagons, with the different methods of loading them, models of every kind of vessel for water-borne timber, from a small boat or an open barge up to a large decked ship, and several of each kind, to show how every kind of timber and sawn wood is stowed in them to the best advantage; and, lastly, a set of models of timber trains for ordinary railways, showing the same useful information about stowage, &c. The conversion of the lumber into charcoal, the distillation of tar and pitch, are all shown by numerous and well-constructed models, which fully instruct the visitor in all the operations of the woodman. The manufacture of the bast, or inner bark of the lime tree, into mats, ropes, and other useful articles is also exhibited; and the building is surrounded with charts and statistical tables, showing how thoroughly the science of forestry is understood in Russia.

No. 42 is devoted to applied physics. In this department philosophical instruments of all kinds are shown, apparatus and illustrations for electro-depositing, gas apparatus, with a large dark chamber filled with photometric apparatus of every kind in use, and various methods of illuminating; also musical instruments and acoustic apparatus. The whole of this collection is so complete and well-arranged that it is one of the most instructive in the exhibition.

No. 43, photography. In this department Germany is best represented; it is extensive, but beyond a large series of life-size portraits from Wurtemburg, there is nothing very remarkable in the collection of pictures; but there is a well-appointed laboratory and workrooms attached, and a collection of all the materials and apparatus used by photographers, and by the workers of the carbon and other processes for permanent printing.

No. 44 is occupied by the section of rural economy and agriculture. The machinery, which is largely of British make, from Messrs. James and Frederic Howard, of Bedford; Messrs. Rokeby, of Lincoln; Messrs. Clayton and Shuttleworth, Messrs. Henry and George Kearsley, and Messrs. Richard Garrett and Sons, is on the whole, a pretty good display. In a room attached is the collection of wools and fleeces, some of them very fine, and indicating remarkable care in rearing, &c. The most notable are some fine cot-fed fleeces sent by the Grand Duchess Helene, from her estate at Karlovka, which equal, if they do not surpass, any produced by the fine races of Bohemia and Moravia. In another place are shown the various methods of slaughtering animals and cutting up the carcases, according to the customs of different countries; and butchers' tools of all kinds are exhibited; the methods of cutting up are shown by large diagrams. Another compartment contains all that appertains to the dairy and to cheese-making, with a large display of cheese. Here are churns in great variety, milk dishes in glass, pottery, wood, and metal, cheese presses of numerous patterns, butter stamps, spatulas, &c. In the centre pavilion, all the cereals and other vegetable products of agriculture are exhibited, with that profusion and evident knowledge of this important branch of industry which characterised the Russian departments in former English and French exhibitions.

No. 45 is the postal and telegraph section, one of the most interesting and complete in the exhibition, its deficiencies being chiefly in a few English specimens, which the president of the section said he had been unable to get from the English postal department. An endeavour has been made to show the whole operations of the post and telegraph, from the most simple to the most improved methods. Thus, in two large recesses of the very large buildings in which the section is displayed, very admirable representations are given of the snow-clad country in Kamschatka and Siberia, and real postal sledges, to which are harnessed the stuffed specimens of dogs in life-like attitudes, and life-sized figures of the attendant drivers and guards show the difficulties under which the service is performed in those countries. Then in the great hall are numerous collections, of which the following are the principal:—Costumes of postmen and of officers of every grade; every variety of letter-bag or box, except, which they much regretted, the bag used in the transatlantic postal service of Great Britain; every kind of postage stamp, except those of the British Colonies. These, and the numerous drawings in this section are arranged in the frames after the method of South Kensington. Collections of post carriages of every kind, either the actual vehicles, as in the case of those used by Russia, or by series of drawings of those used in other countries; harness for the horses used by the department; every kind of letter-weighing machine and letter-stamping instrument; pillar posts of all countries; photographs of remarkable post offices; telegraphs, beginning with the semaphore, and including all kinds of fittings and insulators for the electric system, together with instruments of all kinds; then, in addition, there is a library in which all the literature of the subject is collected, and a large series of books, consisting of all the forms used in the transaction of postal business, carefully arranged according to the countries in which they are used. A spacious post office is attached, with writing and other materials, so that the visitors can make practical use of this admirably arranged section.

No. 46 is a full-sized model of a small rural hospital, complete with all its fittings, for a dozen patients, with dispensary attached.

In the section of domestic economy and construction there are four buildings; No. 47 is a model school, with all the necessary appliances; No. 48 a model church; No. 49 a model dwelling house; No. 50 a large country hospital; and No. 51 a nursery for labourers' children (crèche), with cow-house attached; the cradles were occupied by children and nurses attending upon them, and cows in the shed furnished milk for the occupants of this establishment. I was informed that all these buildings and many others were sold as soon as the Exhibition opened, and will be brought into active use in the places to which the purchasers transfer them.

The section of typography, lithography, &c., is in No. 53. The representation of the printing arts is pretty extensive, but in no respect remarkable. It embraces type-founding, type-setting, stereotyping, lithography, chromo-lithography, and zincography, with working presses of many kinds, but none of the more advanced steam presses.

Nos. 53 to 62, besides offices, &c., contain the sections of architectural technology, in which the direct subject of interest to me was the series of models illustrating the domestic architecture of Russia, in respect to wooden buildings; furniture, church decoration, and hydraulics; all these are well carried out, but there were no novel features to note.

The remaining portion of the exhibition is chiefly occupied by the special government collections, and especially those of the army and navy. A pavilion at the commencement of this division, however, contains a remarkable historical and archæological display, the former consisting of relics of Peter the Great, and the latter of books and pictorial illustrations of Russia, and models of remarkable Slavonic monuments, &c. Passing these collections the visitor finds himself in the other half of the exhibition grounds, on the quay of the river Moskva, and the space between it and the hill of the Kremlin, and the first important building is the great naval exhibition buildings, which, as I mentioned before, is the patriotic gift of a citizen of Moscow. Here is a grand display from the national arsenals and building yards, illustrating the history, progress, and present operations of the navy department. The building is decorated with all the great historical paintings of Russian naval engagements; these have been temporarily withdrawn from various picture galleries. Naval construction is illustrated by sections of boats and ships; an admiral's gig is shown in every stage, from placing the keel to its perfectly finished state, painted and varnished. Cabins and cabin furniture for large vessels are largely exhibited, two sides of the cabin, reproduced from the more important war-ships, being the plan taken, and specimens of the furniture, crockery, glass, &c., arranged within them; officers and men's bedding, cooking utensils, and every variety of necessary for life on board ship are arranged in the orderly manner, and with the good taste so characteristic of naval men; the whole being under the charge of distinguished officers.

The varieties of armament are also exhibited, and amongst the heavy guns is one in an unfinished state, 21 feet long and 13-inch bore, a rifled breech-loader. Then follows a collection of all kinds of hemp and wire cordage, and an interesting collection of all the kinds of knots used in cordage, resembling, but far exceeding, the collection in the Conservatoire des Arts-et-Metiers in Paris. Buoys of all kinds, and life-saving apparatus, models of ships and of marine engines, lighthouses and lighthouse illumination; plate belonging to the officers' messes having historical interest, and a multitude of other matters, including the boat built by Peter the Great, make this naval exhibition one of the greatest interest. Outside of the building (No. 64) is a model showing the fore-part of a large ship of about 1,000 tons, with foremast fully rigged, and men's quarters, whilst at the other end is a mid-ship section (No. 65) of a merchantman of about the same size. A small pavilion, in which specimens of Russian-made armour-plates are shown; they are said to be of the finest quality. A small group of buildings (Nos. 68, 69, 70, and 71), are quarters for the officers and men in charge of the naval department. A pontoon and tressle bridge crosses the Neva, and is guarded by the marines who have constructed it, to illustrate that operation of warfare.

Nos. 72 to 75 are for the technical operations of the arsenal, and here are employed a great number of workpeople. The operations carried on are the making of brass cannons, small-arms, and ammunition; weaving of sail-cloth by Tartar girls, who tend the power-looms dressed in their picturesque costume; the carding and spinning, as well as the weaving, are also in operation, the operators being chiefly Caucasian men and women.

At some distance from the naval department, and still on the quay of the Moskva, in buildings No. 86-88, is the department of railways, which is on a very great scale, embracing everything, from a simple rail to a beautiful satin-lined state carriage for the Empress. The signal section is very complete, and the series of models of junctions, sidings, &c., has been prepared with extraordinary care. Foreign firms are the chief exhibitors of the rolling-stock.

Ascending from the quay to the plateau of the Kremlin is a large group of buildings (76 to 85) belonging to the military departments. First is the historical section, which contains a series of all the uniforms used in the Russian army since the time of Peter the Great, and a collection of all the arms used from the earliest times. There is also an immense building in which the siege of Sevastopol is illustrated; the model is so large that the visitors walk up the Mamelon. The mining works are cleverly shown by removing portions of the ground, and connecting the saps with threads of silk, to show their direction; full-sized models of some of the temporary defensive works are also shown, and in a special apartment is a collection of enlarged photographs, taken by the surgeons, of some of the most remarkable operations, and another collection of distorted bullets extracted from the wounded.

Adjoining the Sevastopol section, upon which great care and labour has been bestowed, is a large exhibition, got up by the members of the Geneva Convention, and an extra charge for admission goes to their funds. It is for the purpose of showing all the society provides for the succour of the wounded, and for their comfort in the hospitals. It also endeavours to create a horror of war by a large miscellaneous assemblage of pictures and other things, which illustrate the destruction of human life and the frightful mutilations caused in battle. In smaller buildings of this group there are found barracks, hospitals, ambulances, stables, &c., and placed about the ground every kind of tent used in the army, camp-kitchens, canteens, and everything relating to the soldiers' life on the field.

It is quite impossible to give any fair account of the very exhaustive manner in which each department of this very remarkable exhibition has been carried out. The labour and skill required have been very great, and so also must have been the expense; but that, happily, was all guaranted by the patriotic men who have organised it.

CORRESPONDENCE.

ON THE SCIENCE OF SUBTERRANEAN HYDROLOGY AND ITS APPLICATIONS.

SIR,—Allow me to direct the attention of your readers to a subject yet hardly popular, which is, however, of considerable practical importance, and is not, in my opinion, devoid of interest to the reading public in general. I refer to a new science—subterranean hydrology—and to its applications.

From time immemorial, men inhabiting arid districts, and wanting water, have tried to get it by digging the soil, but never, until recently, have such operations been carried on after rational and reliable rules. Mere chance only has hitherto attended the search for water. However, science in our century will not have left this subject unstudied, nor will it have vainly endeavoured to solve the problem. Some forty years ago, a Dutchman, named Paramelli, basing his researches on a sound knowledge of geology, undertook to discover what becomes of the rain-water absorbed by the soil, and, after many years of studies and travels, laid the foundations of the science which now teaches us to trace the courses of the subterranean water. We now know that the various soils form, as it were, huge natural filters, through which the rain-water percolates; and we can ascertain with great, if not absolute, certainty the places where it gathers and is to be found.

Let the reader think of the practical importance of such a science. There is no country in the world that does not contain within its limits some of those unfortunate districts where scarcity of water impedes all purposes of men, checks industry and agriculture, and makes home uncomfortable. At the present time, such a state of things is no longer irremediable. Within easy access of every village, almost of every house, there exists subterranean streams of water, running generally at a little depth below the surface of the soil. To trace the courses of these hidden streams, point out the spots where they are the less deep, then channel them out, and make them flow on the surface, or sink a well on their course, are now mere matters of rational study and plain engineering. The search for springs and indication of suitable situations for wells are no more cheats of empiricism, but are now applications of science.

Is not such an art really worthy of public attention. Still it is generally hardly known. In England, strange to say, the name of Paramelli is almost unknown; and in many countries those people who manage divining rods have not lost their credit altogether. I think it is time to make popular these notions, that lands deprived of water are no longer doomed to such deficiency; that their arid surface conceals water-streams and water-sheets, the recesses of which can be discovered and made to yield the indispensable liquid; lastly, that the modern processes are founded on science and deserve reliance, so far as the scientific data on which they rest themselves admit of certainty and generality.—I am, &c.,

LEON JOURD'HUI.

Linden House, Twickenham, October, 1872.

ENGLISH INVENTORS AND GERMAN MANUFACTURERS.

SIR,—In your issue of November 1st, you reprint a letter from Mr. Frank Spence, of Manchester, addressed to the *Manchester Guardian*. With most of Mr. Spence's statements and suggestions I cordially agree, but I feel all the more sorry for the remarks which he has seen fit to make about the German patent law, and about its operation upon the intercourse between English and German inventors and manufacturers. It is not quite correct that "it is virtually impossible to patent anything in Germany;" but I shall at once concede the fact that the Prussian patent law puts very great obstacles in the way of inventors, and causes only a few patents yearly to be obtained. This state of affairs has been acknowledged from all sides, for many years past, as being extremely unsatisfactory, one party advocating the total abolition of patents for inventions, whilst the other party exerts itself for a legislation (for the whole of Germany) similar to the English or American one. Between the two, the German government has so far not seen its way to make a choice, any more than has the German Parliament; both, certainly, seem to lean more towards the former party, especially in view of the numerous complaints coming from England and America about the working of their laws on the subject; but such assertions as are conveyed by Mr. Spence—as if the German government wished to seek a profit dishonestly for its own manufactures from inventions made abroad—are totally unjustified, and are best refuted by the indisputable fact that the largest number of German manufacturers support the agitation for a new patent law similar to the American one, whilst the opponents of all patents in Germany are "Manchester men," theoretically educated national economists, formed confessedly in the English school, and often in this country itself. To call their opinions "dishonest" is not only morally wrong, but simply ridiculous, especially in view of the fact that in this country itself not a few men of the highest honour and standing hold the same opinions. Personally, I am able to see this all the more clearly as, in my younger years, my theoretical studies had led me as well in the same direction, till many years' practical experience as an inventor and manufacturer restored my belief in the justice and public utility of patents. I trust that the German government will ultimately be convinced of the same thing, but that object most assuredly will not be furthered by such remarks as "that some steps should be taken to convince Prince Bismark that, in the end, honesty is the best policy, and that it might be wise, if nothing else, to alter the German law." Such supercilious and somewhat pharisaical talk reminds one strikingly of the rebuke administered by Mephistopheles to the unripe scholar for his overbearance:—"My friend, thou seemest not even aware how rude thou art;" and it seems to bear out the censure of Professor Agassiz (see *Nature* of October 17):—"The confidence with which an Englishman applies his English foot-rule to measure the universe is a very marvellous thing; it is as if he thought that the laws and customs of his little island were universal laws of humanity, and he seems incapable of supposing it otherwise." I regret such language as Mr. Spence's (unfortunately too often equalled or exceeded in the public press) most sincerely, and all the more vividly as I quite agree with the proposed alteration of the German patent law, and would like it to be supported by representations of a character less distasteful to the self-respect of a great nation.

Perhaps it is not generally known that the total government charges for a Prussian patent (as experienced by myself) amount to 3s. against £175 in England; also that the English government, although deriving annually a net surplus of more than £30,000 from patent fees, yet declines to grant, as empowered by law, a paltry 25 copies of his specification to an inventor.

Lastly, I am happy to qualify materially Mr. Spence's statement that the practical results of the German patent law has been the beginning of exclusion of Germans as visitors from English manufactories. I know of most chemical manufacturers coming to this country upon technical errands, but I have only heard of one similar case, where a Lancashire inventor would not allow the manager of a German (Prussian) alkali works to see a patent process. Curiously enough, the same works had previously paid a handsome sum to another English inventor for the use of his invention, although not patented in Prussia. If it should unfortunately come to pass that Germans were more generally excluded from English factories, the retaliation would, of course, be instantaneous. And it is very doubtful who would be the greatest sufferers—if I hailed from the Emerald Island, I should say both. But I venture to disbelieve most devoutly that such behaviour will ever be anything but a rare exception. I know for a positive fact that the intercourse between German and English manufacturers is rapidly increasing, just in the matter of new processes and inventions, and the result, even in the present state of the patent laws, cannot be otherwise than mutually beneficial.—I am, &c.,

George Lunge, Ph.D., F.C.S.,
President of the Newcastle-on-Tyne
Chemical Society.

November 2, 1872.

RANSOME'S STONE.

A case has just been tried in the United States, as between Messrs. Ransome and Co. and Richard Norris, the former seeking to restrain the latter from using a patent which he had obtained for an improvement upon the method of making the artificial stone, of which a description was given in *Journal* 1,037. The following was the decision of Mr. Commissioner Leggett. The main question was whether a patentable difference could be held to exist between two processes where, by one, a solution might only be forced into a body, and by the other it could be forced through it.

The invention in the former is defined to be an "Improvement in hardening and washing Ransome's concrete stone;" and that in the latter, "Improvements in the manner of hardening and washing the Ransome concrete stone."

The earliest patent describes substantially the mechanism and process shown in the pending application of Ransome, Bessemer, and Ransome, but claims only the former. That of July 6th describes similar mechanism, and two processes denominated by counsel of applicants respectively the "exhaust" and "filtering" processes.

The Board have, I think, erred in deciding that this patent only describes the former, and therefore is not involved in this interference. Both processes are separately and distinctly described in detail in the specification, which also sets forth that "both processes may be accomplished in the same apparatus," and the claim is so drawn as fully to include and cover them both. In fact, it is with this patent that the most vital interference exists.

The patent of May 11th, covering merely the machinery employed, is of minor importance, and would be comparatively valueless to either party to this controversy without a monopoly of the process in dispute.

But, notwithstanding the fact seems apparent and indisputable that there are two distinct processes set forth in the patent of July 6th, and now well known in the art of making artificial stone, it is strenuously maintained by counsel for Norris that they are identical in principle, and mere immaterial and unpatentable modifications one of the other.

It is important that this question, if it is a question, should be correctly determined, for it is proved that Norris had knowledge of what is designed the "exhaust" process before the date of the sealing of the English patent of the applicants. Both these alleged processes are designed to be employed in forming the Ransome concrete stone. This stone is a compound of silex and silicate of calcium, but the latter being insoluble, it is found impracticable to cause their direct admixture and union to form a solid.

This is accomplished by first forming a plastic mixture of silex and soluble silicate of soda, and then permeating it with chloride of calcium; the effect is to form silicate of calcium and harden the mixture, and at same time leave a residuum of chloride of sodium, which must be washed away. This effect was first accomplished, imperfectly, it is said, by merely bathing the plastic mixture first formed in chloride of calcium, or by forcing the latter into the interstices of the former by pressure within an exhausted receiver (see English patent of Frederick Ransome, No. 877, of 1861).

This latter process of placing the plastic mixture in an exhausted air-tight vessel, and then admitting chloride of calcium, and applying hydraulic pressure to it, is the one first described in the Norris patent of July 6th. The one next described, which is alleged to be much superior to that now in controversy, consists in placing the plastic mixture described in a vessel having a perforated bottom enclosed by an air-tight chamber, which is connected by a pipe with an air-pump. Chloride of calcium is placed in the vessel over the mixture, and the air exhausted from beneath. Pressure from above, other than that of the atmosphere, may or may not be applied at option to drive the solution through the mass. Afterwards water may be applied in the same manner to wash away the residuary chloride of soda. This is termed the "filtering" process.

It is evident to me that by the process first named, or the "exhaust" process, the chloride of calcium or water could only be forced into, not through the mass, as by the "filtering" process, which affords an opportunity for its escape.

It is also evident, and in proof that the result of employing the "filtering" process would be a more perfect hardening of the stone in all its parts than could be accomplished by the exhaust process. I regard these processes, therefore, as materially different from each other.

I agree with the Board that the rebutting evidence put in by the applicants was properly admitted and considered by the primary examiner, and their decision, awarding priority to Ransome, Bessemer, and Ransome, is affirmed.

MEAT PRESERVATION.

The process of Messrs. Mort and Nicolle, according to the *Melbourne Leader*, is being pursued in that city with success. The following is a description of the preserving room:—"The preserving house is the size of an ordinary pantry in a large-sized ship. It is constructed of pine boards, with an inner lining of sawdust, and is almost hermetically sealed from the external atmosphere by a framework covering the hinges and the interstices around the door. A series of pipes run round the length and along the roof of the apartment, and on the occasion of our visit on Saturday, with a temperature in the open air of 70 degrees, the temperature within was 17 degrees under zero. The area being too large for the reception of meat alone, a number of blocks of ice were piled in some of the compartments, and the frigidity was remarkable. On advancing, and at the end was found a considerable quantity of meat, such as legs of mutton. There were also turkeys and geese, which, on being rapped with the knuckles, were as hard as petrifactions; plover and curlew, and native game, in feather, with heaps of oysters and baskets of eggs swathed in ice, and in perfect condition. A mullet that had been kept some months was as hard as a piece of marble, and the degree of rigidity imparted by the process to a small guardfish may be gathered from the fact that Mr. Nicolle broke a block of ice with it at one sharp blow. The front apartment contains an artificial icemaking trough, about nine feet long by three feet broad, containing about ninety moulds. The ice is made by the waste cold air from the meat-preserving room, and the apparatus has a capacity of turning out several tons of ice per week. Subsidiary arrangements are provided for gradually cooling down the water contained in tanks for purposes of the manufacture, and the whole machinery is so simple that it could be moved by a boy. The more important part of the patent, however, lies in this, that the principle upon which the meat-preserving invention is founded can be carried out upon a larger scale on board ship. It is claimed that the apparatus can be applied to a similar reduction of temperature in the hold of any vessel, rendering the export of fresh meat from Australia to England practical, without resorting to chemical means for preserving it in tins, or for salting it down in casks. The inventor states that only ten tons of fuel will be required to provide for the export of 500 tons to Europe.

The following letter appeared in the *Standard*, written by Mr. H. H. Roche, agent for Bray's refrigerating process:—

The meat question—preserved and fresh—has been so prominently brought under the notice of the readers of your paper that I have the less hesitation in asking, at the request of my New York correspondent, space for a few further remarks, specially called for, as he deems, by the letters appearing in your impressions of the 7th and 8th instant. These remarks shall illustrate, by the records of an actual test, the possibility of keeping fresh meat for a very considerable period—sufficient, that is, to allow of its extensive importation in aid of our home supplies.

I will deal with facts only, premising that the system used was Bray's refrigerating process. As the result of the first trial, experimental only, meat was kept in a warehouse quite sound for 153 days. Following that, in actual practice, two cargoes of 200 tons each were imported into New Orleans in August, 1870, the cattle in question having been killed, transported by steamer, and retailed under an average summer heat of fully 90 degrees.

A cargo was next sent to Philadelphia, which, like the two above-named, met with the unanimous approval of the medical men and press representatives appointed to test it. The only steam-ship owned by the patentees was then lost, and a year's delay has ensued in building a new one.

Your impression of the 7th inst. referred to has a letter from Mr. Shand, whom I have not the pleasure of knowing, but whose ideas evidently correspond with those of Mr. Bray, the patentee of the above system in America and Europe.

Professor Gamgee, on the following day, gives it as his opinion that meat cannot be preserved by this process.

No opinion, however, can override facts, and these we have before us, already fully confirmed by the safe arrival of three cargoes of meat; while the new steamer now at sea, and expected at Philadelphia within a few weeks, will be, we anticipate, the fourth confirmation of the system adopted.

Testimonials cannot find a fitting place in this letter, but they are both numerous and influential, and can be inspected by anyone sufficiently interested in the commercial aspect of the subject, now assuming a national importance in this country of high prices and strikes.

STATISTICS OF NEW ZEALAND.

Mr. Julius Vogel, the Colonial Treasurer of New Zealand, in the course of his late financial statement in the New Zealand Parliament, said he had prepared some interesting statistics, comparing New Zealand with other countries. Taking the year 1869, which was the latest for which returns could be found, it appeared that the revenue of the United Kingdom was £65,000,000, of which less than £24,000,000 was obtained under the Customs, and £20,000,000 the amount of the Excise, as represented by the duties on spirits. During the same year, the total amount collected in New Zealand, including the taxes collected by the provinces, was £902,000. If there were the same taxation in New Zealand as existed in Great Britain, although the English Customs' tariff would not of itself yield so much as that of the colony, the total revenue would be much larger than it was at present. Stamp duties in the

United Kingdom represents 6s. per head of the population, or nearly 50 per cent. more than New Zealand. A comparison of the quantities of high-dutied goods consumed in New Zealand and the United Kingdom showed conclusively the wealthier comparative condition of the colony. Of spirits there was consumed in the United Kingdom per head of the population per year under one gallon, but in New Zealand the average was 2·1 gallons; tobacco, 1·3lb. per head in the United Kingdom, in New Zealand, 2·6 lbs. per head; wine, 0·5 gallon per head in Great Britain, against 0·6 gallon in New Zealand; tea, 3·4 lbs. in the United Kingdom, against 7·1 lbs. in New Zealand; coffee a little under 1 lb. per head in the United Kingdom, as against a litle over 2 lbs. per head in New Zealand; sugar, 46 lbs. per head in the United Kingdom, against 67 lbs. in New Zealand. The English tariff would have yielded in New Zealand, £643,000, as against £823,000 actually obtained here for Customs' duties; but if the other taxation bore the same proportion to the Customs duties here as in the United Kingdom, the total revenue of New Zealand would have been £1,200,000 in 1869, as against £894,000, actually received during that year. But, besides, the local taxation in the United Kingdom amounted to over 50 per cent. of the general taxation, while in New Zealand the local taxation was very much less. The secret of the apparent heavy taxation in this colony was to be found in the fact that the rate per head of the value of imports and exports was considerably higher than it was in the United Kingdom during 1869. The value of imports into the United Kingdom represented £9 14s. 9d. per head of the population, and the exports represented a value of £7 16s. per head; but in New Zealand, during the same year, the imports represented £18 4s. per head, and the exports £15 9s. per head. The imports represented not merely consumable or perishable goods, but articles of lasting value and means of increasing wealth. During the five years ending 1871 the total value of our exports was £24,000,000, of which £5,650,000 was the value of non-consumable articles, so that to that amount articles of permanent value and means of increasing wealth were added to the colony. By another return it appeared that for the year ending April 1, 1872, the value of imports into Great Britain, less the value of re-exports, represented £8 3s. per head of the population; while in New Zealand, during the same year and under the same conditions, the imports represented £15 6s. per head. The British produce and manufactures exported from the United Kingdom represented a value equal to £6 6s. per head; but the value of New Zealand produce exported from the colony represented £17 16s. per head. During the same year the Post-office revenue in the United Kingdom was equal to 2s. 11d. per head of the population, as against 3s. 4d. per head in New Zealand; and the telegraph revenue amounted to 5¾d. per head in the former case and 1s. 9d. in the latter. The population of England and Wales in 1861 showed a proportion of males between the ages of 16 and 65 equal to 28 per cent., while in New Zealand, in 1871, the proportion between those ages was 37 per cent. Turning to the neighbouring colonies, it appears that the per-centage of persons between the ages of 21 and 40 was 38 per cent., as against 29 per cent. each in New South Wales and Victoria. The increase of population during the ten years ending 1871, was, in New Zealand, equal to 165 per cent. as against 46 per cent. in New South Wales, and 36 per cent. in Victoria. During the same ten years the increase in the population between the ages of 21 and 40 was 162 per cent. in New South Wales, while in Victoria there was actually a decrease of 10 per cent. A comparison of the exports and imports showed most favourably for New Zealand. Leaving on one side imports, and the value of re-exports, the result was:—Victoria, £14 4s. per head; New South Wales, £12 9s. per head; New Zealand, £21 16s. per head, or, if the native population were included, £18 4s. per head. Taking exports the figures were:—Victoria, £14 10s. per head; New South Wales, £12 16s. per head; New Zealand, £19 2s. per head, or, including the native population, £16 8s. per head. If the principal products of the colonies were considered, the result would be more strikingly favourable to New Zealand. Thus, upon the average of the five years ending 1871, New Zealand exported gold to the amount of £10 8s. per head per annum of the population, against £7 19s. in the case of Victoria, and 10s. in that of New South Wales. For the same perion, New Zealand's average export of wool was equivalent to £6 9s. per head, as against £5 7s. for Victoria, and £4 19s. for New South Wales. The exports of agricultural produce and timber from New Zealand for the same period were equal to 13s. per head of the population per year. From Victoria these exports averaged only 3s. 4d. per head, and from New South Wales 10s. 6d. per head. A further sum must be added in the case of this colony for flax, the export of which, including the native population, was equal to 4s. 11d. per head. Much had been said and written respecting New Zealand's oppressive Customs tariff; but if the Victorian rates, including *ad valorem* duties, had existed, and if the values were entered the same as at present, we should have raised as Customs revenue during 1871 £781,000, against £731,000 which we actually raised. That disposed of the allegations as to the higher rate of taxation in New Zealand as compared with Victoria. It was to be borne in mind that the native question had cost New Zealand five millions sterling in the shape of expenditure, more than would be required in a colony situated like Victoria, and that fact showed how great the resources of this colony really were. It was alleged that the cost of government here was heavy. Of course the rate per head of that cost was large, because the population was small. It was especially to be remembered that here the smallest aggregation of population asked for, and expected to receive, all the conveniences which, in older countries, were only expected by large communities. Still the comparison of the departmental cost of government was favourable to New Zealand.

GENERAL NOTES.

Crystal Palace Aquarium.—An interesting *conversazione* was held on Wednesday evening, the 6th instant, when Mr. Gerald Weir gave a lecture upon the aquarium and its contents. A very large audience listened to the lecture, and afterwards inspected the tanks and examined the specimens and instruments exhibited by the West Kent Microscopical Society, by Messrs. Steward and others. It is interesting to know that the success of the effort made by Mr. Lloyd to preserve the sea-water in the aquarium is perfect. Though thousands of tons of food have been consumed by the fish, the water is absolutely devoid of any contaminating matter, and is perfectly pure. Under the direction of Mr. Lloyd an aquarium is contemplated at the Vienna Exhibition.

Palm-Tree at Rome.—The magnificent palm-tree that has for the last 35 years formed one of the principal ornaments of the garden of Sig. Franz, in his Via Nazionale, at Rome, has just been purchased by the municipality of that city, in consequence of the area occupied by this garden being now about to be built upon. Sig. Formilli, the head gardener of the Pincio, is now superintending the removal of this tree, which is 8 metres in height and 1·8 metres in diameter, and the roots, together with about 8 cubic metres of soil, have been placed in a box, so that there will be no fear of them being injured. The site intended for its replantation is at the end of the alley skirting the Villa Medici.

Theatres in Europe.—A Berlin paper gives the following statistics of the number of theatres in Europe:—Italy, 348; France, 337; Germany, 191; Spain, 168; Australia, 152; England, 150; Russia, 44; Belgium, 34; Holland, 23; Switzerland, 20; Portugal, 16; Sweden, 10; Denmark, 10; Greece, 4; Turkey, 4; Roumania, 3; Swabia, 1. In Egypt there are three theatres.

Cuba.—The Island of Cuba has an area of about 45,000 square miles, or more than twenty millions of land, which in point of fertility may be said to be unsurpassed. According to the latest statistics, scarcely 15 per cent. of the soil has been reduced to cultivation, yet the value of the animal agricultural products, including live stock, is estimated at 140,000,000 dollars. The lands under cultivation have been valued at 322,131,778 dollars; the cattle estates at 58,422,740 dollars; the real estates of the cities, 170,400,823 dollars; and the capital invested in trade, 773,846,469 dollars. The value of the exports from Cuba, in 1860, was 8,612,277 dollars, of which the United States took 36,115,279 dollars, and, in return, exported to Cuba products value £18,288,553. The eastern part of the island is said to comprise some of the best soil for cane-growing. The cane is rarely planted more often than once in seven, and frequently once in ten years. The climate is so favourable that the cane may be cut and converted into sugar at leisure. In former times considerable attention was given to the culture of coffee, but for some cause the Spanish government objected to it, and the crop is not now of much importance. More than a third of the island is covered with forests, including choice cabinet woods. The annual revenue that Spain has been deriving from Cuba has been estimated at 37,000,000 dollars, of which from six to ten millions has gone to the mother country, the rest to the Spanish officials.

The Commerce of the United States with Japan.—It is little more than a quarter of a century since Japan was a sealed book to the commerce of the Western world, its intercourse with the outside barbarians having been a sort of desultory trade with the Dutch. Captain Perry's expedition in 1854 resulted in the opening of a few ports, extended subsequently through other treaties, until at length a firm foothold has been obtained for American commerce, and the fruitions of which are becoming annually more important, especially the tea trade. The first Japan tea of any consequence received in America was in 1859-60, when 365,306lbs. were imported; and from that small beginning the imports have gone on increasing each succeeding year, till, in 1870-71, the imports reached 13,449,157lbs. The following table shows the shipments for the last thirteen years:—

	lbs.
1859-60	365,306
1860-61	1,060,448
1861-62	476,389
1862-63	1,798,208
1863-64	1,884,698
1864-65	1,569,540
1865-66	6,966,200
1866-67	5,979,633
1867-68	6,836,596
1868-69	9,719,790
1869-70	10,138,412
1870-71	13,449,157
1871-72	11,482,173

These are direct shipments; a considerable quantity comes to America from China, where the native leaf is sent from Nagasaki and some of the southern ports of Japan, to be coloured, for the purpose of mixing with the China leaf. The opening of new ports in Japan has given a remarkable impetus to the tea-trade, and the quantity promises to be greatly increased, and the quality improved. The exports from America to Japan have not yet assumed large proportions, but they increase a little as the commercial relations of the two countries become more intimate.

Coal.—The authorities of the department of the Seine Inférieure have opened a credit of five thousand francs, in aid of the scientific search for a vein of coal, of which the existence is suspected. The discovery of such a supply in the neighbourhood of Rouen, Havre, and many other manufacturing towns in the valley of the Seine, would, of course, be a grand boon.

The Harston Rifle.—An improvement of the Martini lock has been patented by Mr. Greville Harston, of Birmingham. It simplifies it in a most remarkable manner, and renders the action consequent upon the pull of the trigger much more certain; and a V spring is used for the main-spring, which is easily replaced if broken, though the instances in which such springs break are very rare. One great advantage in the mounting of the rifle is, that the stock is all one piece, and not, as in the Martini-Henry, two pieces; this gives a greater support to the barrel and lessens the recoil.

The Austrian Polar Expedition.—A letter, dated the 16th of August, has been received from Dr. Fischer, of the Austrian Polar Expedition. He says that the expedition lies off Cape Nassau, and that it is surrounded by ice on all sides. The temperature is unusually low for the season, the sea being generally free from ice at this point in the months of August and September, and Dr. Fischer fears that, unless a thaw should come on, the expedition will have to pass the winter in Nova Zembla, instead of on the Siberian coast. The crew are in excellent health, and have provisions and clothes for three years, besides a stock of coal which would suffice for a journey of fifty days.

Vesuvius.—Professor Luigi Palmieri, who, it will be remembered, pursued his observations during the late eruption of Mount Vesuvius, even when the floods of lava threatened to convert the building in which he was sheltered into a furnace, has just published a highly interesting *brochure* on the various phases of the terrible phenomenon which he had predicted, detailing, in fact, almost hour by hour, the progress of the burning torrent, and the transformation which the crater of the mountain underwent. The little work—illustrated by seven wood engravings, showing the state of the cone during the years 1870, 1871, and 1872—shows the extraordinary modifications caused by the terrible eruption of the 26th of April. In conclusion, Professor Palmieri records the material indications which may be of use in future in foretelling coming convulsions of Vesuvius, and discusses the nature of the lava, metals, gases, and acids which the mountain showers forth during eruptions. A more interesting scientific history and disquisition could scarcely be produced.

French Registers.—The amount of labour and of serious inconvenience caused by the destruction of the registers of births, &c., at the Hotel de Ville, may be imagined, but can scarcely be described. The regulations respecting what are called *Actes de l'Etat* are extremely strict, and the production of registers of birth, of the death of parents, &c., is strictly insisted upon in the case of marriage and other engagements. The burning of these registers, then, placed the whole population in a very awkward predicament, and their reproduction has given rise to an immense amount of work. The authorities invited all who possessed copies of the registers, certificates, to send them in to the council. These formed a large portion of the new registers, while duplicates were given to the holders; but in the case of those who held no such certificates, the time of their birth, marriage, &c., could only be fixed by their own statements, or those of parents and relations. The work was distributed amongst the *maires* and officials of the twenty arrondissements of Paris, and it is so advanced that at the end of the present month it will be completed, as far as regards the period commencing with 1860 and ending with 1871. The re-registration of a population of a million and a half must have been no trifling labour.

Tribunals of Commerce.—"The Bill for the establishment of Tribunals of Commerce," which was withdrawn last session, owing to the pressure of other business, is to be reintroduced next year. These tribunals are to have all the jurisdiction of superior courts of law and equity. There is to be a control court, with sub-courts. A lawyer is to preside over the former, assisted by two merchant judges, thus combining legal knowledge and business experience. The sub-courts are constituted by two merchant judges, and the district registrar in the capacity of their legal assessor. The composition of the courts is elastic as respects the number of judges employed, and the frequency of meeting, these depending on the urgency of the business. The tribunals are to have jurisdiction for the recovery of any debt above £20; all questions of fact, and the construction of all commercial documents being decided by the majority of the court, while all questions of law are to be left to the judge alone.

Extent and Value of the Gold Workings in Victoria.—The number of distinct quartz reefs proved to be auriferous in the colony cannot be distinctly ascertained as parts of the same reef, in some localities, are held to be distinct reefs, and named accordingly. As the reefs are further explored, it is found, too, that what were supposed to be separate reefs are not really distinct. The reefs are stated in the last official returns of the colony to number 3 130. The extent of auriferous alluvial and quartz ground worked upon is put down, from estimates made by the mining surveyors and registrars (not from actual surveys), at 985 square miles, and the estimated value of gold-mining claims is stated at £12,275,046. From 924,705 tons of auriferous quartz crushed in 1871, 484,303 oz. of gold were produced, averaging 10oz. 11⅓dwts. The highest yield was 15dwts. 15 grains to the ton in the Ararat district. This does not profess to show the total quantity of quartz crushed, but only the yield of certain crushings, respecting which the mining surveyors have been able to obtain information. Since the first publication of the official statistics in the colony, information has been obtained concerning 8,528,323 tons crushed, which yielded an average of 1 dwts. 2¾ grains per ton. The total gold exported from the colony in 1871 was 1,355,477oz 3dwts., of which 691,322 oz. were from alluvial workings.

Census of Greece.—A new census of the kingdom of Greece was taken, by order of the government, throughout the State, on the 2nd—14th of May, 1870, from which we learn the following results:—The general number of inhabitants of the various municipalities was 1,447,026, added to which were soldiers and sailors in active service and merchant seamen abroad, making the total population 1,457,894 persons. Of these, 754,176 were males, and 703,718 females. This population was distributed in the following manner, viz: — In Greece, as formerly constituted, viz., continental Greece, the Peloponnesus and islands of the Cyclades, 1,225,673; in the Ionian Islands, 232,221. Mr. Mansola, in his report to the Minister of the Interior, deduces from this census that the increase of the centre population during the last decade, which is to say from 1861 to 1870, is 132,415 inhabitants, giving a yearly increase of 13,241 persons, or 1 per cent. per annum in the entire number. The population of the old kingdom, namely, Continental Greece and the Peloponnesus, &c., has augumented, however, during that period by 128,863 souls, or at the rate of 12,836 persons annually, viz., 1 for 85 inhabitants; whereas, in the Ionian Islands the increase during the last ten years is only 3,552 persons, equal to 355 per annum, being one for every 643 inhabitants during the year. Forty-three of the old provinces of Greece show an augumentation of 115,136 persons, while the other five, viz., Skopolis, Nauplia, Hydra, Trezœnia, Zea, and Milos, show a decrease of 4,436 inhabitants in the ten years. In the Ionian Islands the population of three provinces, during the same period, has increased by 14,152 souls, while in the remaining four, namely, Paxos, Cephalonia, Ithaca, and Cerigo, there is a diminution of 13,305 persons. The population of some of the principal towns was as follows:—The town and Demos of Athens, 48,107; Patras, 26,190; Syra, 20,996; Corfu, 24,091; Cephalonia, 14,282; Zante, 20,480; the Piræus of Athens, 11,047; Argos, 10,620. The number of births, deaths, and marriages showed a very considerable fecundity and a low death-rate, in comparison with other countries. Provided these returns are correct, Greece would appear to be the most healthy country in Europe, excepting Great Britain, and most prolific next to Italy and Bavaria.

The St. Gothard Railway,—Up to the present time nothing has been done at the St. Gothard tunnel beyond extensive preparations, and it is anticipated that before long the contractor, M. Favre, will begin the actual work of tunnelling. It is intended at first to employ steam power for the compression of the air for working the tunnelling machinery, until the works for utilising the water-power of the mountain are completed, which will probably occupy a year. The contractor estimated that he will be able to drive 3·50 metres per day from each end by machinery, or 1 metre per day by hand, and at this rate of progress, by the 1st of June, 1873, 1,500 metres of tunnel will be opened. In this case, reckoning a yearly advancement of 2,400 metres, the tunnel will be completed in seven years. According to the conclusions of geologists, the hardest strata will be met with at the entrance to the tunnel, viz., at Göeschenen; the formation is granite, granite schist, and crystalline rocks, containing feldspar and mica; at the southern end, at Ariola, the rocks met with are of a crystalline nature, containing masses of the hardest mica, amphibolite, and groups and veins of quartz.

Museum of Inventions.—At a meeting of the London Association of Foremen Engineers and Draughtsmen, after a paper by Mr. Thomas Webster, Q.C., F.R.S., "On the promotion of Practical Science and Technical education by Museums of Inventions, established and maintained by the surplus of the inventors' fee fund," the following resolution, proposed by Mr. W. Lloyd Wise, Assoc. Inst. C.E., and seconded by Mr. D. Campbell, was put to the meeting, and carried by acclamation:—"That this meeting considers the Patent-office Museum at South Kensington totally inadequate to the requirements of the age, and is of opinion that, after suitable provision has been made for the efficiency of the Patent-office, a reasonable proportion of the surplus funds arising from the granting of patents for inventions should be devoted to the establishment and maintenance of a more comprehensive museum of inventions, for the advancement of practical science and technical education." Mr. Gibbon then proposed and Mr. Campbell seconded:—"That memorials in furtherance of the foregoing resolution be presented, and supported by deputations to the Prime Minister and the Lord Chancellor."

MEETINGS FOR THE ENSUING WEEK.

MON......Social Science Association, 8. Mr. Fitzjames Stephen, Address on Amendment of the Law.
Royal Geographical, 8½. The President's Address on the Opening of the Session. Dr. Behm, "On the Lualaba and the Congo."
Institute of Surveyors, 8. President's Address.

TUES ...Civil Engineers, 8. Discussion upon Mr. Abel's Paper, "Explosive Agents applied to Industrial Purposes."
London Institution, 4. Professor Rutherford, "On the Nutrition of the Body."

WED. .. London Institution, 7. Mr. W. Pengelly, "On Cavern Researches."

FRI ......Architectural Association, 7½. Mr. T. Roger Smith, "On Professional Practice."

Journal of the Society of Arts.

No. 1,043. Vol. XX.

FRIDAY, NOVEMBER 15, 1872.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, London, W.C.

ANNOUNCEMENTS BY THE COUNCIL.

NOTICE TO MEMBERS.

The One-Hundred-and-Nineteenth Session of the Society will commence on Wednesday, the 20th November, when the Opening Address will be delivered by Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council.

The following are the dates of the Wednesday evening meetings, the chair being taken at eight o'clock:—

1872.	November......	—	—	20	27	
,,	December......	4	11	18	—	
1873.	January	—	—	15	22	29
,,	February	5	12	19	26	
,,	March	5	12	19	26	
,,	April..........	2	—	16	23	30
,,	May	7	14	21	28	

For the meetings previous to Christmas, the following arrangements have been made:—

NOVEMBER 20.—Opening Address by Major-General F. EARDLEY-WILMOT, R.A., F.R.S., Chairman of the Council.

[On this evening the Prince Consort's Prize, and the Medals awarded during the last Session, will be presented by the Chairman.]

NOVEMBER 27.—"On Technical Education, and the Means of Promoting it." By THOMAS WEBSTER, Esq., Q.C., F.R.S.

DECEMBER 4.—"On the Manufacture of Horse-nails by Machinery." By J. A. HUGGETT, Esq.

DECEMBER 11.—"On Galvanic Batteries." By the Rev. H. HIGHTON.

DECEMBER 18.—"On Russia, her Industries, Commerce, and Means of Communication." By LEONE LEVI, Esq., Professor of Mercantile Law, King's College, London, and one of the Deputies to the International Statistical Congress at St. Petersburg.

Each Member is privileged to introduce two friends to every meeting, and a book of blank tickets has been forwarded for this purpose.

Members are reminded that should any of their friends wish to join the Society, the opening of the Session is a favourable opportunity for proposing them.

CANTOR LECTURES.

The first course of Cantor Lectures for the ensuing Session will be on "The Practical Applications of Optics to the Arts, Manufactures, and to Medicine," by C. MEYMOTT TIDY, M.B., Joint Lecturer on Chemistry, and Professor of Medical Jurisprudence at the London Hospital, and will consist of five Lectures, to be delivered on the following Monday evenings, at eight o'clock:—

LECTURE I.—MONDAY, NOVEMBER 25TH, 1872.

The Law of the Intensity of Light in its Application to Photometry—Lighthouse Illumination.

LECTURE II.—MONDAY, DECEMBER 2ND, 1872.

Lighthouse Illumination *(continued)*—Applications of Reflection—Lenses and their varieties—Their Application to Medical Purposes, &c.

LECTURE III.—MONDAY, DECEMBER 9TH, 1872.

Applications of Optics in the Arts, illustrated in the Science of Photography.

LECTURE IV.—MONDAY, DECEMBER 16TH, 1872.

Polarised Light, and its Practical Applications.

LECTURE V.—MONDAY, DECEMBER 23RD, 1872.

Spectrum Analysis as Applied to Manufactures, illustrated in the Bessemer process, and to Medicine in the Detection of Blood.

A second course will be given during the Session, by the Rev. ARTHUR RIGG, M.A., "On the Energies of Gravity, Electricity, Vitality, Affinity, Light, and Heat, especially with reference to the Measurement and Utilisation of them."

The third course is not yet arranged.

These Lectures are open to Members, each of whom has the privilege of introducing two friends to each lecture. Tickets for the first course are issued with this *Journal.*

EXAMINATIONS, 1873.

The Programme of Examinations for 1873 is now ready, and may be had gratis, on application to the Secretary.

The following subjects, which were in the Programme for this year, do not appear in that for 1873:—

Metrical System.
Mensuration.
Domestic Economy.
Geography.
Latin.
Elementary Musical Composition.

The Final Examinations, in 1873, will be held on the evenings of the 22nd, 23rd, 24th, and 25th April. The Time-table has been arranged as follows:—

TUESDAY, 22nd April, From 7 to 10 p.m.	WEDNESDAY, 23rd April, From 7 to 10 p.m.	THURSDAY, 24th April, From 7 to 10 p.m.	FRIDAY, 25th April, From 7 to 10 p.m.
Arithmetic. Logic. Floriculture.	Theory of Music. English History German. Spanish.	Political Economy. French. Fruit and Vegetable Culture.	Book-keeping. English Language. Italian.

FRIDAY, 25th April, 6 to p.m.—Dictation.

The Elementary Examinations, held by the District Unions and Local Boards, for which papers are furnished by the Society, are fixed for the 4th, 5th, and 6th March.

Full details in reference to the Examinations are given in the Programme, copies of which should be applied for to the Secretary of the Society of Arts, by all intending to come forward as candidates, or otherwise interested in the Examinations.

BETHNAL GREEN MUSEUM.

The following declaration is in the course of signature, and has already been signed as below. Any Member of the Society desirous of having his name attached thereto, is requested to communicate with the Secretary of the Society of Arts, and give him authority for that purpose:—

1. We, the undersigned members of the Council and members of the Society for the Encouragement of Arts, Manufactures, and Commerce, request the attention of Her Majesty's government to the remarkable proof of the public desire for instruction and pure enjoyment afforded by the examination of works of Art and Science, which has been shown by the opening of the Bethnal-green Museum.

2. This museum, established in one of the poorest and busiest districts of London, where men, women, and children are most laboriously employed, has been frequented during three months by more than 700,000 visitors, a number which probably exceeds that of the visitors to all the other metropolitan museums and galleries during the same period.

3. The undersigned submit that this museum could never have come into useful existence, and have been instrumental in conferring great benefits on the people, without the aid of Parliament; and they desire to press this fact upon the consideration of Her Majesty's government, with the hope that they will submit to Parliament the policy so essentially national of voting increased means to facilitate the establishment of museums, libraries, and galleries of Science and Art in large centres of population, wherever such localities are willing to bear their share in the cost.

(Signed)

Abel, F. A., F.R.S., *Vice-Pres.*	
Akroyd, Col. Edward, M.P.	Halifax.
Amory, John Heathcote, M.P.	Tiverton.
Bartley, G. C. T., *Member of Council.*	
Bath and Wells, Bishop of	
Bazley, Sir Thomas, Bart., M.P.	Manchester.
Beaumont, Somerset A., M.P.	Wakefield.
Bessemer, Henry, *Member of Council.*	
Bodkin, Sir W. H. (*Assist.-Judge*) *Vice-Pres.*	
Bourne, Lt.-Col. James, M.P.	Evesham.
Brocklehurst, William C., M.P.	Macclesfield.
Brooks, William Cunliffe, M.P.	Cheshire (E.)
Cassels, Andrew, *Member of Council.*	
Cawley, Charles Edward, M.P.	Salford.
Churchill, Lord Alfred, *Member of Council.*	
Clarke, Hyde, *Member of Council.*	
Cole, Henry, C.B., *Vice-Pres.*	
Colman, Jeremiah James, M.P.	Norwich.
Cooper, Sir Daniel, Bart., *Vice-Pres.*	
Cowper-Temple, Right Hon. Wm., M.P. *Vice-Pres.*	Hants (S.)
Dalrymple, Dr. Donald, M.P.	Bath.
De L'Isle & Dudley, Lord, *Vice-Pres.*	
Denman, Lord	
Dickinson, Sebastian S., M.P.	Stroud.
Dilke, Sir Charles W., Bart., M.P.	Chelsea.
Dimsdale, Robert, M.P.	Hertford.
Dixon, George, M.P.	Birmingham.
Dodds, Joseph, M.P.	Stockton.
Donnelly, Major, R.E., *Member of Council.*	
Drax, John S. W. S. E., M.P.	Wareham.
Eastwick, Edward B., M.P.	Penryn & Falmouth.
Eardley-Wilmot, Major-General F., R.A., F.R.S., *Chairman of the Council.*	
Ebury, Lord	
Edwards, Henry, M.P.	Weymouth.
Egerton, Hon. Wilbraham, M.P.	Cheshire (Mid.)
Exeter, Marquis of	
Fitz-Gerald, Rt. Hon. Lord O. A., M.P.	Kildare County.
Forster, Charles, M.P.	Walsall.
Gray, Lieut.-Col. W., M.P.	Bolton.
Hambro, Charles J. T., M.P.	Weymouth.
Hardwicke, Admiral the Earl of	
Henderson, John, M.P.	Durham.
Hick, John, M.P.	Bolton.
Holland, Samuel, M.P.	Merioneth.
Hoskyns, Chandos Wren, M.P.	Hereford.
Howard, James, M.P.	Bedford.
Hutt, Right Hon. Sir Wm., K.C.B., M.P.	Gateshead.
Lancaster, John, M.P.	Wigan.
Lawrence, Edwin, *Treasurer.*	
Lennox, Lord Henry George C. G., M.P., *Vice-Pres.*	Chichester.
Lichfield, Earl of	
Longford, Earl of	
McArthur, William, M.P.	Lambeth.
McClean, J. R., M.P.	Staffordshire (E.)
McLagan, Peter, M.P.	Linlithgow.
Morley, Samuel, M.P.	Bristol.
Ommanney, Vice-Admiral Erasmus, C.B., F.R.S., *Member of Council.*	
Paget, Admiral the Right Hon. Lord Clarence, K.C.B., *Member of Council.*	
Pakington, Rt. Hon. Sir J. S., Bart., M.P., *Vice-Pres.*	Droitwich.
Parry, Love Jones, M.P.	Carnarvonshire.
Pease, Joseph Whitwell, M.P.	Durham (S.)
Rawlinson, Robert, C.B., *Member of Council.*	
Redgrave, Samuel, *Vice-Pres.*	
St. David's, Bishop of	
Salomons, Sir David, Bart., M.P.	Greenwich.
Saye and Sele, Lord	
Strange, Lieut.-Col. A., F.R.S., *Member of Council.*	
Straight, Douglas, M.P.	Shrewsbury.
Tite, Sir William, M.P.	Bath.
Torrens, Lt.-Col. Robert R., M.P.	Grantham.
Tufnell, E. Carleton, *Member of Council.*	
Twining, Thomas, *Vice-Pres.*	
Ware, James T., *Auditor.*	
Westbury, Lord	
Westminster, Marquis of	
Whatman, James, M.P.	Maidstone.
Whitwell, John, M.P.	Kendal.
York, Archbishop of	
Zetland, Earl of	

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

PROCEEDINGS OF THE SOCIETY.

CHANNEL PASSAGE.

A party of the Council and members of the Society's Committee, consisting of Messrs. F. A. Abel, F.R.S., G. C. T. Bartley, Andrew Cassels, H. Cole, C.B., E. Chadwick, C.B., Hyde Clarke, C. W. Eborall, W. Hawes, Grosvenor Hodgkinson, M.P., Vice-Admiral Ommanney, C.B., F.R.S., Vice-Admiral Ryder, R. Rawlinson, C.B., Lt.-Col. A. Strange, F.R.S., Capt. R. Scott, R.N., Seymour Teulon, Sir Edward Watkin, Maj.-Gen. Eardley Wilmot, R.A., F.R.S. (Chairman of Council), paid a visit to Mr. Henry Bessemer, especially invited to inspect a working model on a large scale, illustrative of his plan for counteracting the motion of a ship at sea.

Who has not often wondered at the Frenchman's ignorance of England and the English? And doubtless Frenchmen are oftentimes sorely perplexed to think how we can so misunderstand their ideas and feelings when in our public prints we attempt to describe them. Difference of race and language are not sufficient to account for this—geographical distance still less. The secret must lie in the very restricted intercourse between the two peoples; for, notwithstanding the extended means of travel, and the advancing number of travellers, it is beyond controversy that the extent of intercommunication between Great Britain and the Continent falls far short of what it ought to be, and what it certainly would be, if only the means of comfortably crossing the Channel were in existence.

Few that have visited the Continent by any route can have failed to experience the distressing effects of that horrid course, either by their own bitter personal sufferings, or, if happily from those exempt, by the sights and sounds and odours inseparable from the distress of their fellow-passengers. Until now, all this has been endured with a degree of fortitude wonderful to reflect on; but certainly vast numbers have been deterred from making the passage by the fear of the penalty, whether such fear has been actually expressed, or, as is doubtless far more frequent, silently felt, and its potent influence submitted to. By a return printed by order of the House of Commons in 1870, it appears that the total number of passengers between England and France by all routes was between 300,000 and 400,000 per annum, a number probably exceeded by the actual travel between London and one of our own large towns—Manchester, for example—and which undoubtedly still remains at nearly the same figures.

It is unnecessary to enter here on a consideration of the various modes which have been proposed for removing this restriction on transit by taking away the intensely loathsome deterrent—by greatly enlarged steamers, carrying trains; by bridges over and tunnels beneath; by enormous expenditure in harbours on both coasts; and by a double ship, as proposed by Captain Dicey.

Mr. Bessemer stated to the party assembled that he first commenced with the idea of suspending a cabin on gimbals, after the fashion of the mariner's compass. He soon perceived that, from various causes, mere suspension was inadequate. It must in that case rely solely on gravitation for its adjustment, and this was too slow. It was liable to be permanently disturbed from its horizontal position by a strong side breeze, or by the accident of a few passengers gathering to one side, to gaze at a passing vessel, or for any other matter of interest. Hence a controlling agent must be applied—always ready, instantaneous in action, easily worked, and possessing power to grasp and govern the entire structure under any abnormal state of unequal wind-pressure or irregular distribution of passengers,—hydraulic action supplied the necessary means. Here Mr. Bessemer's past experience with the steel converters, with which his name and fame must ever be indissolubly united, came to his aid as a solution of the problem. In the manufacture of Bessemer steel, a huge vessel, known as the converter, containing from 5 to 7 tons of molten metal, and weighing, with all its appurtenances, between 10 and 11 tons, is gently elevated or overturned by a boy at a distance of 60 feet, who, holding a lever, puts in motion the hydraulic power sufficient to wield so ponderous a mass, gentle enough to be managed by a child, delicate enough to pour out any quantity of metal, so small an amount as a few pounds, or even a few ounces. This is the principle by which Mr. Bessemer hopes to permit the most sensitive traveller to cross the seas with the coolness and comfort of the experienced sailor.

Abandoning the idea of simple suspension alone, he has designed a saloon, 70 feet in length, 30 feet in width, and 20 feet in height, carrying on the top a promenade deck at a height of seven feet above the ordinary deck of the vessel. The points of suspension of this saloon will be in a line with the keel of the vessel, and coincident with the neutral axis of the ship when rolling. The saloon will be well lighted and ventilated, and will be fitted at each end with four principal rooms for ladies and four for gentlemen, which, as well as the promenade deck, will be accessible at all times by means of a broad staircase free from all motion. The governing power over this saloon consists of a powerful hydraulic apparatus, connected with the underside of the flooring, and so arranged that, as the vessel rolls to either side, the pressure or resistance from the rams is instantly brought into play and utilised in checking the motion. At a small horizontal lever stands a steersman, who, with a curved spirit-level before him, watches the slightest indication of rolling in the vessel, and in an instant suppresses the least tendency of the saloon to follow the motion of the ship.

It will be seen that, so far, the rolling action of the vessel has been provided against. It may therefore be asked how the effects of pitching are met? This difficulty is met by placing the saloon in the middle of the ship, and by increasing the length of the vessel. The principle of the saloon, in fact, is to be carried out in a steamship which has been specially designed by Mr. E. J. Reed, C.B., for the Channel passage. This vessel will be 350 ft. long, with 45 ft. deck-beam, and 65 ft. over her paddle-boxes, and which, when fully loaded, will draw but 7 ft. 6 in. of water, thus enabling her to meet the requirements of the present shallow harbourage on either side of the channel. The saloon will be placed in the centre of the vessel, a position now generally occupied by the engines, which will be placed fore and aft the saloon, and will drive two pairs of paddle-wheels, as the small draught of the vessel will not admit of the use of a screw. She will be propelled by engines of 750-horse power nominal, indicating up to 4,600-horse power, and is expected to attain a speed of 20 miles an hour. The vessel will be double-ended, so as to enable her to enter and quit existing harbours, and at each end will be a well-appointed cabin for second-class passengers. Each extremity of the ship will have a very low freeboard, so as to cut through the waves instead of rising to them. This, combined with the great length, peculiar shape, and the distribution of the weights carried, will tend largely to get rid of the pitching motion, so as to be scarcely appreciable in a saloon situated midway of the length of the vessel. In order to demonstrate to all the feasibility of his scheme, Mr. Bessemer has constructed a large working model in the grounds of his residence. Model it can hardly be called, inasmuch as it is larger than the midship section of one of the "Citizen" steamboats. The arrangement consists of a 20ft. length of the hull of a vessel of 20ft. beam, sunk in a brick pit, and carried on a longitudinal axis. Suspended within this representative ship is a cabin, measuring 16ft. by 10ft., beneath the floor of which is the hydraulic arrangement for arresting motion, or, in other words, for locking the cabin, and keeping it in a horizontal position. A small square hole in the floor admits the body of the steersman, who stands in front of a double-handled lever working horizontally, and having just beyond it a curved spirit-level surmounted by a graduated scale and pointer. In the centre of the scale is the zero point, and so long as the cabin preserves a true level the pointer stands at zero. Directly, however, the slightest deviation from the horizontal occurs the pointer will stand either to the right or left of zero, according to the direction of the roll of the cabin. The object of the steersman is, of course, to keep the pointer exactly at zero, and this he easily accomplishes by slightly moving the handle either one way or the other, as may be necessary. An oscillating motion, imitative of a ship's roll, is given to the hull through a crank shaft, worked through toothed gearing, by a small steam-engine placed outside the hull. This motion amounts to 14 deg. each way, representing a total roll of 28 deg., the number of oscillations being 10 per minute. It need hardly be pointed out that both the extent and frequency of the roll are much in excess of the average in practice, but notwithstanding this the cabin does not indicate more than a very slight deviation from the horizontal.

It is understood that one or more vessels thus fitted will be shortly built, and the principle actually put in practice in the Channel, and with every prospect of success. Whatever may be the result, and certainly the working of the model gave every assurance of success, this is clear, that Mr. Bessemer will have done very much towards the solution of a very perplexing problem, if, indeed, he has not actually solved it; and he deserves every credit for the spirited manner in which he has set to work to determine a question, not only of national, but of international importance.

CORRESPONDENCE.

THROUGH ROUTE TO INDIA.

Sir,—There is much truth in the observations of Mr P. Le Neve Foster, jun., at page 936. The Ottoman Government has, however, fully decided on continuing the through route, and a small fraction of the section from Constantinople towards the interior of Asia Minor was last month opened.

It is, however, certain, as Mr. Foster implies, that the undertaking must proceed slowly if the governments of England and India will give no assistance, although at no risk, and if the capital is to be raised by the unassisted credit of Turkey, and without the co-operation of our governments in conducting the works. If such aid were given, the Euphrates section might be proceeded with simultaneously.—I am, &c.,

Hyde Clarke.

GENERAL NOTES.

Population of Russia.—According to the late census the population of the Russian Empire is 81,500,000, of which 61,400,000 belong to Russia proper, 6,000,000 to Poland, whilst Finland numbers 1,200,000 inhabitants.

Glove Making at Milan.—According to the evidence of Signor Alloggi Romeo, given at the recent "Inchiesta Industriale" (commission of inquiry on industrial subjects) at Milan, it appears that from 800 to 1,000 dozen of gloves are made daily in that city, whilst only a few years ago the production did not exceed 100 dozen per day.

Ancient Violins.—The Crwth was an early British form of violin; it can be seen depicted in the sculptures of Melrose Abbey, in the mural paintings of the chapter-house, Westminster Abbey, and is mentioned by Hudibras, Leyland, and other writers. These examples exhibit a variety of form—some artistic, others eccentric, and must have given various qualities of tone—the small size hard and scratchy, the middle size nasal and sonorous, and the larger sepulchral in sound; but they must have revealed to musicians qualities of sound peculiar to the viol, and suggestive of future development. We find in the representations the lute-bowl form gradually altering to a flatter instrument, and getting less in depth. About the year 1660 the improved forms of viols gained a temporary favour; the patterns became more like our violin tenor and violoncello. At this time both madrigal singing and concerts of viols were in favour. A familiar illustration of this instrument may be remarked in the second part of the "Pilgrim's Progress," which was written in 1684, where it is stated that "Christiana, if need was, could play upon the viol, and her daughter Mercy upon the lute." Musical families and societies kept a chest of viols, which mostly consisted of six instruments—that is to say, two trebles, two tenors, and two basses; the set, when not in use, was kept in a large chest or case, lined with green baize. The bass viol had six strings, and was originally a concert instrument, used in the performance of fantasias of from two to six parts. It was frequently played alone, and also as an accompaniment to the voice, in the manner of a lute. The number of frets varied according to the nature of its employment. The tenor viol had generally six strings; but both it and the bass varied in this respect, and had sometimes additional sympathetic metallic strings underneath or at the side of the bridge, to cause resonance. These many forms and appliances exhibited effects and phenomena which induced the Italian masters to study further the causes of the varieties of tone, force, energy, and exactness of note which the viols revealed; and during the wave of "increased knowledge" that was given us in the 16th century, the makers effected such great improvements in these instruments that the attention of the musically-minded aristocracy of the period was drawn to their use. Further improvements suggested themselves, frets were abandoned, and the finger-board was left smooth. The sounding-board was made thicker, sympathetic strings abandoned, and the violin—which is called by musicians the prince of instruments—was the result. It attained the greatest perfection about the middle of the 17th century. The greater number of the celebrated makers were natives of Cremona, in Italy. Singular attention was given by the Italian makers in the selection of their wood. The upper part was constructed of a Swiss pine, which appears of a reddish tint when broken. A straight-grained piece was generally selected. Great care was taken with the proportion of thickness of the several parts. The back was usually made of a kind of birch, technically called by the fiddlemakers harewood. The varnish was probably that used by the painters of the period, the composition of which at the present time is unknown; it was transparent, hard, bright, and certainly gave a hardness, durability, and perhaps colouring to the wood. The best examples of these instruments are constructed throughout with the greatest care and finish of execution, and they certainly possess a fine quality of tone that has not been surpassed. The violoncello and basso came into competition with the viola di gamba and bass viol, at the beginning of the 18th century, and has now entirely superseded them.

Newspapers in Russia.—The total number of newspapers and periodicals published in Russia, according to the latest official returns, is 337, of which 286 are printed in the Russian language. Of these, 109 are published at St. Petersburg, 30 at Moscow, and the remaining 147 in various other towns throughout the empire. The number of journals printed in Polish is 40; 6 in French, 30 in German, 2 in Finnish, 3 in Hebrew, and the remainder in other dialects.

Shipbuilding in Italy.—The sale of Italian-built ships to French shipowners is of frequent occurrence at Marseilles, and those of the Ligurian coast are in greatest demand. The present French government, with a view of protecting their own builders, have recently imposed an import duty of 40 francs per ton on foreign-built sailing vessels. This duty, however, will have no effect in checking the import of Italian-built vessels, but will, on the other hand, rather tend to increase it, as by virtue of the treaty of commerce between these two countries the duty is limited to two francs per ton only. The low price of the Italian-built ships, being about 375 francs per ton, against 425 francs per ton of the French, and the superior quality of the oak timber of which the former are built, cannot fail to create a great demand for them in other ports, and which the activity at present displayed in shipbuilding on the Italian coast tends to confirm. It is not improbable that, before long, in consequence of the high price of coal and iron, and rise of wages in England, that iron ships will be built cheaper in Italy than at home, and that Leghorn and Genoa will compete with Glasgow and the Thames for the supply of our merchant navy.

The Woollen Industry of America.—The complete statistics of the manufacture of woollen goods in the United States, as returned at the ninth census for the year ending June 1, 1870, have recently been sent to press from the Census-office, and exhibit the following totals:—Of the 2,891 establishments in the United States, there are in Pennsylvania, 457; New York, 252; Ohio, 223; Massachusetts, 185; Indiana, 175; Missouri, 156; Tennessee, 148; Kentucky, 125; Illinois, 109; Connecticut, 108; Maine, 107; Iowa, 85; New Hampshire, 77; West Virginia, 74; Virginia, 68; Rhode Island, 65; Vermont, 65; Wisconsin, 64; Michigan, 54; North Carolina, 52; Georgia, 46; Maryland, 31; New Jersey, 29; Texas, 20; Utah, 15; South Carolina, 15; Alabama, 14; Arkansas, 13; Delaware, 11; Mississippi, 11; Minnesota, 10; Kansas, 9; Oregon, 9; California, 5; Louisiana, 2; Florida, 1; and New Mexico, 1. The capital of these 2,891 establishments is reported at 98,824,531 dols. The number of steam-engines is 1,050, with a horse-power of 35,900, and water-wheels with a horse-power of 59.332. The number of sets of cards is 8,366, with a daily capacity of 857.392lb. of carded wool, number of broad looms, 14,039; narrow looms, 20.144; spindled, 1.845,496. The average number of hands employed during the year has been—of males above sixteen, 42.728; of females above fifteen, 27,682; of children and youths, 9,643. The amount of wages paid to these hands during the year is reported at 26,877,575 dols.; the total value of the materials used during the year was 96.432,601 dols., of which the amount paid for chemicals and dyestuffs was 5,833.346 dols. There were consumed during the year 17,311,824 pounds of foreign wool; 154.767,075 pounds of domestic wool; 17,571,929 pounds of cotton; 19.372,062 pounds of shoddy; 2,573.419 pounds of woollen yarn; 3,263.949 pounds of cotton yarn; 1,312 560 yards of cotton warp. The value of all other materials used was 5,670.250 dols. Among the production of these 2.891 establishments are 63.340,612 yards of cloth, cassimeres, and doeskins; 51,965,286 yards of flannel; 1,941,865 yards of felted cloth; 2,663.767 yards of repellants, 2,853 458 yards of tweeds and twills, 14.078,559 yards of satinets, 5,507.902 yards of kerseys. 24,489,985 yards of jeans, 14,130,574 yards of linseys, 1.932,382 yards of negro cloth. Number of pairs of blankets, 2,000,439; number of horse blankets, 51,553; number of carriage robes, 22,500; number of coverlids, 226,744; number of shawls, 2,312,761; number of pounds of yarn, 14,156,237; number of pounds of rolls, 8,683,069. Total value of production, 155,405,058.

The Ligurian Railway.—The east and west littoral lines are connected by a tunnel 2,292·18 metres in length, passing directly under the town of Genoa, and which has now been finished about three months. This tunnel puts the railway station of the Piazza Principe in direct communication with that of Piazza Brignola. It is intended to construct a branch line from it to the port, and the necessary works for the junction in the tunnel are already completed. It was originally intended to drive this tunnel from both ends, but during the progress of the work it was found advisable to sink three shafts, 41, 38, and 30 metres in depth respectively, so as to be able to open the line sooner. The entire line from Nice to Leghorn will probably be opened for traffic towards the end of next year, there remaining only a section, from Levante to Spezzia, unfinished, which, owing to the great number of tunnels (47, amounting to a total length of 25,873·58 metres), has necessarily occupied a longer period for construction. Of these tunnels, 10 are completely finished; in 20 the heading has been driven from end to end, amongst which may be mentioned the Mesco tunnel, 3,011·45 metres in length, opened out last July. Of the remaining 17 not yet finished, the principal are the Madonetta tunnel, 120·60 metres in length, with 81·50 remaining to be driven; the Vallegrande, 2,157·25 metres, with 230·38 remaining; the Monterosso, 1,642·76 metres, with 247·45 remaining. Of those in a less forward state, may be mentioned the Biassa, 3,791·21 metres in length, in which 387·46 metres remain to be tunnelled; the Barbieri, 765·29 metres, with 453·40 metres; the Corniglia, 923·75 metres, with 497·50; and the Monteneso, 1,340·71 metres, with 759·11 yet to be opened.

The Leather Industry and Leather Trade of the Argentine Republic.—The export of vast quantities of raw hides and skins which we are continually receiving from the La Plata States may be said to have called into existence such places as Buenos Ayres, Monte Video, Cordova, Corrientes, &c., and to have raised them to their present state of prosperity. These places are well known to leather manufacturers by the different descriptions of raw goods which they draw from them. The absolute inexhaustiveness in cattle of the territory watered by the La Plata river system, and especially its bordering Pampas, however, might be questioned, notwithstanding that statistical comparisons seemingly demonstrate to satisfaction the undiminished productiveness of those States in hides and skins during the last few years. In considering for how long a period consumption in England, France, Germany, and the United States can be supplied, one essential point is often lost sight of, namely, the growing manufacture of leather in those places themselves. Nobody will doubt that it is worth our while to ponder this most important point well, for it is very natural to suppose that the wants of manufacturers there are sure to be covered first, before the requirements of foreign countries can be satisfied. Without ever being in a position to hope to compete with France in the production of finer qualities, the manufacture of leather in the Argentine Republic has gained in importance, and is slowly but steadily increasing. The better sorts will always be imported, but in the qualities for common use, manufacturers there are behind those of no other country. This has lately been illustrated by the Exhibition just closed at Cordova. Most of the manufacturers are Frenchmen; a few Italians produce small skins with success; leather for lining, from sheepskins, for instance. In Buenos Ayres all descriptions are manufactured, sole leather especially in the provinces of Salta and Tucaman. Before the war with Paraguay, bark from Brazil was used for tanning, which gave a more reddish colour to the leather, but without affecting its quality. Now the tanners use the sawdust of the quebracho tree, a kind of cedar, which is cut up into laths and building timber. This wood, the sawdust of which is carefully collected, contains about half the quantity of tannin that ordinary bark does. Black calf, black and coloured morocco, and dull shagreen kid leathers are imported from France. Preference is given to German enamel calf, because it is cheaper than French; the principal reason for this preference, however, is that the skins do not stick together on arrival, as almost all French enamelled leather does. As regards enamelled cow-hides for heads of carriages, Belgian produce is preferred to French; it is from 10 to 15 per cent. cheaper, and, though not quite so good as the latter, is carefully treated. The articles required by shoemakers and saddlers are all imported from France. At the Exhibition of Cordova, Martin Amespil, of Buenos Ayres, obtained the great prize of 1,500 francs, together with the great gold medal of the first class; he exhibited almost all kinds of curried and manufactured leather, and tanned ox and cow-hides. His manufactory is one of the principal ones in the Argentine Republic. Founded in 1860, it comprises now all branches of tanning and currying, as well as the dyeing and enamelling processes. Its produce is greatly esteemed in Buenos Ayres and throughout the provinces, on account of the care bestowed in the manufacture. Bletcber and Co., of Buenos Aryes, obtained the gold medal and the second prize of 750 francs. Of English exhibitors, Messrs. Bradshaw and Co., of Manchester, received a silver medal for the excellence of their sole-leather and their leather for machine straps.

On the Use of Alum for Wool Fabrics.—M. Havrer, professor at the Verviers Polytechnic School, has recently investigated the action of alum when boiled with wool fibre. He found, according to Reimann's paper, that small quantities of alum leave in the interior of that fibre portions of hydrate of alumina, but that this deposit is removed again by using large quantities of alum. Hence it is that in treating wool with much alum a less strong and vivid colouration is obtained than when treating it with a less quantity. The hotter the bath, and the longer the wool remains in it, the greater the effect of the alum. M. Havrer thinks that this is caused by the presence of lime in the water used. The lime decomposes small quantities of alum; meanwhile larger quantities retain their saline qualities better. The lime in the water acts similarly to a reduction of mordant; that is to say, it destroys the active power of a certain quantity of alum. Since it might have been supposed that the alkaline action on the alum was caused by the soap or soda still adhering to the washed wool, or to the ammonia developed in the process, M. Havrer washed the wool with diluted nitric acid, but he found, nevertheless, a decomposition of alum, and a deposit of the hydrate of alumina in the interior of the fibre, the quantity of the deposit being smaller. The decomposition of the alum may be caused by the wool itself. According to Reimann the elements of alum are separated by dialysis. Probably the sulphate of alumina in the alum yields a basic sulphate, the overplus of the acid remaining in the surrounding water. Since the latter acts as a base to small quantities of acid, it is not surprising to find that the surrounding small quantity of sulphuric acid does not dissolve the basic sulphate of alumina deposited in the interior of the fibre. In constant contact with water the deposit will yield part of its sulphuric acid. If larger quantities of alum are present, this deposit of the basic sulphate is prevented, and basic combinations of alum are formed instead. The investigations of Havrer fully bear out the practical experiences hitherto made. It is well known that the use of alum as a mordant, like any other substance, is favourable only to a certain extent to the printing and colouring process. Beyond that limit the colours become less deep and less beautiful. Generally one-tenth of the weight of the wool is added in alum; 30lbs. of wool require 3 lbs. of alum and 1,500 lbs. of water. M. Havrer's observations explain theoretically the fact that a larger quantity of mordant is not only a waste, but an actual detriment in dyeing, which no amount of rinsing will afterwards able to remove.

A New Fuel for Locomotives.—The Russian Steamship and Railway Company announces that it has found the use of naphtha, for steam-generation with locomotives, very advantageous. The material employed by the company is the crude oil from the Caucasian and Volga regions, and, compared by weight, the amount consumed was about one-half that of coal. The arrangement for burning naphtha is stated to be of such a nature that no difficulty will be experienced in substituting one for coal consumption in place of it, should it be found desirable so to do.

Building and Improvements at Rome.—Great activity is now being displayed at Rome in building. A complete new quarter is now in course of construction at Mont Esquilino, in the vicinity of the railway station, and new houses are being built in every part of the city. It is to be trusted that the government and the municipality will not delay the commencement of the works for the embankment of the Tiber, and, at the same time, will provide Rome with a complete system of drainage. A concession has just been granted by the Minister of Public Works to a company for the construction of a line of railway from the banks of the Tiber, at some central point in the city, to Montemario, when a hundred or so handsome villas will be built, together with a public pleasure garden like the Tivoli at Florence. The works of this line are to be commenced within three months of the date of the concession, and the whole project is to be complete in eighteen months. The railway and New Tivoli Gardens, however, are to be opened to the public within a year.

The Manufacture of Beet Sugar.—The Legislature of New Jersey, at its last session, with a view of encouraging the introduction and growth of this important branch of industry in their State, passed an Act to the effect that it is enacted, that for the term of ten years next after the passing of this Act, all the machinery, buildings, real estate, and all other property owned by any individual or individuals, corporation or corporations, organised under any law of this State, and used exclusively in the manufacture of beet sugar, are exempted from taxation for any purpose whatsoever; provided that this exemption from taxation shall not apply to lands upon which beets are raised for the purpose of manufacture; that the stock of any incorporated company engaged exclusively in the manufacture of beet sugar in the State, held and owned by any individual or individuals, shall be exempt from taxation for any purpose for the time specified in the first section of this Act. In order that a just notion of the importance of intelligent legislation upon this subject may be obtained, the *Journal of the Franklin Institute* says:—It may be of service to give, in general terms, a statement of the present extent of the beet-sugar industry in the various European countries, where it has been encouraged for years, and now returns no inconsiderable revenue to the respective States:—

Country.	Number of manufactories.	Beet. Quantity consumed in cwts.	Sugar production in cwts.	Average production of one establishment.
France ...	434	82,850,000	5,800,000	190,915
Germany .	266	51,495,494$\frac{1}{8}$	4,319,640	172,619
Russia ..	300	42,400,000	3,792,000	141,334
Austria ...	212	42,300,000	3,400,000	199,530
Belgium	106	14,200,000	1,000,000	131,482
Holland ..	18	2,143,000	150,000	119,060
Sweden ...	4	770,000	61,600	192,500
	1,370	236,158,404$\frac{1}{8}$	18,523,240	173,380

Meerschaum.—A bank of excellent meerschaum has been discovered in Southern California, and workmen are to be imported from Europe to manufacture it into pipes.

New Buildings at Paris.—According to an official report published by the Prefect of the Seine, it appears that the number of new buildings in Paris during 1871 amounted to 4,230, whilst the number of houses pulled down to make room for improvements was 1,418. In the suburbs the number of new houses built greatly exceeds that of those demolished.

A Solvent for Shellac.—Dr. I. Walz describes the following process for obtaining a neutral solution of shellac in water. The shellac is broken up and covered with a concentrated solution of carbonate of ammonia, and boiled upon the water-bath until the ammoniacal smell has disappeared. More of the solution is added, and the boiling is continued until the shellac forms a coherent sponge-like mass. The carbonate of ammonia is then expelled by further boiling, and the mass will readily dissolve by pouring boiling water upon it. A kind of soap will be found floating on the surface, which may readily be removed by straining. The solution, brought on paper, cloth, &c., dries rapidly, and leaves a thin, lustrous, and adherent film of shellac behind.

The Utilisation of Peat in Italy.—A company has just been formed in Italy for working some of the numerous peat deposits in that country. A machine recently patented by Signor Moro is to be used for compressing the peat, and is stated to have given excellent results at some trials recently made at Florence; and the fuel manufactured on this system has been used extensively by the Alta Italia Railway Company; and, as compared with English coal, a saving of 40 per cent. in expense is effected. The high price of coal in England will doubtless offer an opportunity to utilise the abundant deposits, not only of fuel, but lignite, and other fossil fuel, which are met with in many places in Italy.

Jute.—The jute plant grows with a tall, coarse stalk, in the best Indian fields seldom above fifteen feet high, and perhaps three-quarters of an inch in diameter. Some varieties are branchless, the leaves being set upon long foot-stalks, while others put out limbs somewhat abundantly. It has a small yellow flower, and some varieties yield their seed in a long pod, while in others the seed vessel is a small ball or button. The seed is but little or no value, yielding too little oil to make it worth while to crush, and it is not very nutritious for stock. Moreover, the amount is small, as if all the stalks were allowed to ripen their seed, they would produce scarcely more than 125 lbs. to the acre. More use is made of the stalk, which, like long willow stems, are made into baskets, or plaited into various kinds of wicker-work, or burnt into fine charcoal for certain special purposes, as the manufacture of gunpowder, or for druggists' use. But the chief value of the crop is for the fibre which surrounds the stem, like the fibre of the flax or the hemp plant. This, as is well known, is used for most of the coarser kinds of woven fabric, such as sacking, bagging, mats, &c. Some portion of the better fibre is also mixed with cotton and wool, as in part a substitute for these more expensive materials. Some time ago, certain kinds of shawls were imported into this country at prices considerably lower than it was understood they could be made for at home. The difference was so great as to cause much surprise, when closer examination revealed the fact that no inconsiderable proportion of jute had been woven in with the wool. Coarse as the material usually seems, a certain part of the fibre of some varieties of jute is so soft and silky as even to be used to adulterate silk, and in this form also it appears in our market. The temptation to such uses is readily seen when it is remembered that jute is the cheapest of all fibres. It is said that it can be produced in India for one-fifth, or even one-eighth, the cost of cotton; and perhaps there is no reason why the relative cost of production should not be very nearly the same in this country.

Bamboo Paper.—The Consul-General at the Havana has recently called attention to the enormous quantities of fibrous vegetables which the island of Cuba produces. Some paper-makers have made experiments, it is said with success, on the fibre of the bamboo, and on some of the creeping plants indigenous to the island. The bamboo has been devoted to the service of literature as long as the papyrus itself. More than 2,000 years before the Christian era, the conquerors of China signalised the establishment of a new dynasty in the Flowery Land by a conflagration of the national records. These documents were written on plates of bamboo. How far they went back takes us almost beyond the Flood! The dynasties of Yu, Chang, and Chea had inscribed their records on bamboo plates for a thousand years before their barbarous destruction under the reign of the Thsin kings. Books of this primitive nature may be seen among the curiosities in the King's library at the British Museum. But to use the plant, not as wood, but as paper, to tear asunder the durable and jagged fibres only that they may be felted together in a finer and closer union—to supersede the toil of the *chiffonnier* by that of the cane-cutter—is a new application of an old material. It would be of great utility to those who are making experiments of this nature on the utilisation of the vegetable fibre, to make themselves acquainted with the mode and materials of manufacture now used in Japan. Paper, in that wonderful island empire, serves purposes unknown in literary Europe. It is hard as *papier mache*, or soft and delicate as cambric. It is there used for manufactures as diversified as they are numerous.

Elementary Education at Rome.—The number of public elementary schools at Rome, according to the official returns published recently by the Minister of Public Instruction, is 111, of which 56 are for boys and 55 for girls. The number of boys in these schools is 2,458, of whom 221 are under six years of age, 1,642 between six and ten, and 595 over ten. The number of girls is 1,674, being 210 under 6 years of age, 1,376 over six and under ten, and 88 over ten, giving a total number of children attending these public schools of 4,132. The average number of boys for each school is 43, and of girls 31. The private elementary schools in Rome are 282 in number, of which 166 are for boys, and 116 for girls. The total number of children attending these schools is 11,072, of which 5,927 are boys, and 5,145 girls; of the boys, 1,469 are under six years of age; 3,321 between six and ten; and 1,137 over ten. Of the girls, 1,133 are under six; 2,529 between six and ten; and 1,483 over ten, giving an average number of boys at each school of 35, and of girls 44. The total number of children educated at the elementary schools in Rome would thus amount to 15,204, and deducting from this the 3,033 children of both sexes under six, who, from their early age, cannot receive the full benefits of education, there would remain 12,171, of which 3,701 attend the public, and 8,470 the private schools. The total number of children in Rome old enough to be sent to school being 35,070, it is most lamentable that so small a proportion receive instruction, there still remaining 22,699 children—of whom 10,840 are boys and 11,859 girls—uninstructed, and to provide for their education it would be necessary to establish not less than 323 new schools, supposing that each school should be attended by 70 pupils.

Artificial Butter.—In an extract from the *Révue Hebdomadaire de Chimie*, given in the *Chemical News*, it appears that M. Mege-Mouriez, some years ago, was requested by the Victualling Department of the French Navy to find a wholesome substitute for butter, which would not become rancid by keeping. Experiments made with cows submitted to a very severe and scanty diet, led to the discovery that these animals continue to give milk, although in very much smaller quantity, and that this milk always contained butter; the author surmised that this butter was due to the absorption of the fat contained in the animal tissues, which was converted into butter under the influence of the milk-secreting glands. This led to experiments on the splitting up of animal fats, and, further, to the following process for making butter artificially. Best fresh beef suet is first mechanically cut up by means of circular saws fitted to a cylinder, and is next placed in a vessel containing water, carbonate of potassa, and fresh sheep's stomachs previously cut up into small fragments; the temperature of this mixture having been raised to 45°, the joint influence of the pepsine of the stomachs and heat caused the fat to be separated from the cellular tissue; the fatty matter floating on the top is decanted, and, after cooling, submitted to very powerful hydraulic pressure; the stearine is used in candle-making, and the semi-fluid oleomargarine is used for making the artificial butter in the following manner:—Fifty kilos. of the fat are poured, along with 25 litres of milk and 20 litres of water, into a churn, while there is added 100 grms. of the soluble matter obtained by soaking for some hours in milk from cows' udders and milk glands; a small quantity of annatto is also added, and the operation of churning then proceeded with. The butter thus obtained is well washed with cold water, and, if required to be kept for a long time, melted by a gentle heat, to eliminate all the water. According to reports of sanitary committees, as well as of the authorities of the Victualling Department of the French Navy, this artificial butter is really an excellent substitute for genuine butter, and can be exposed for sale if the vessels are marked to distinguish the artificial from the genuine butter.

MEETINGS FOR THE ENSUING WEEK.

Mon......Social Science Association, 10 a.m. Central Conference of Chairmen and Vice-Chairmen of Boards of Guardians.
British Architects, 8. Mr. T. Roger Smith, "On Professional Esprit de Corps."
Asiatic, 3.

Tues ...Zoological, 8½.
London Institution, 4. Professor Rutherford, "The Nutrition of the Body."
Anthropological, 8.
Civil Engineers, 8. Renewed discussion upon Mr. Abel's Paper, "Explosive Agents applied to Industrial Purposes."
Statistical Society, 7¾. Opening Address by the President. Mr. Samuel Brown, "Report on the International Statistical Congress of 1872."

Wed. .. **SOCIETY OF ARTS, 8.** Opening Address by Major-General F. Eardley-Wilmot, R.A., F.R.S., Chairman of Council.

Thurs ...Linnæan, 8. 1 Mr. C. B. Clarke, "On the *Compositæ* of Bengal." 2. Rev. J. T Gulick, "On diversity of evolution under one set of external conditions."
Chemical, 8. Mr. W. H. Perkin, "On some new derivatives of anthrafluvic acid."

CONTRIBUTIONS TO THE READING-ROOM.

The Council beg to acknowledge, with thanks to the Proprietors, the regular receipt of the following Journals and Periodicals during the year:—

WEEKLY.

Asiatic.
Architect.
Athenæum.
British Journal of Photography.
Builder.
Building News.
Builders' Weekly Reporter.
Chamber of Agriculture Journal.
Chemical News.
Colliery Guardian.
Cosmopolitan.
Draper.
Engineer.
Engineering.
English Mechanic.
Farmer.
Gardeners' Chronicle.
Journal of Gas Lighting.
Land and Water.
Les Mondes.
Mechanics' Magazine.
Metropolitan.
Mining Journal.
Moniteur des Arts.
Musical Standard.
Nature.
North British Agriculturist.
Photographic News.
Public Opinion.
Revue Scientifique.
School Board Chronicle.
Sessional Proceedings of the Social Science Association.
Staffordshire Sentinel.
Warehousemen & Drapers' Journal.

FORTNIGHTLY.

Cotton Supply Reporter.
Spon's Dictionary of Engineering (in continuation).

MONTHLY.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale.
Bulletin de la Société Imperiale Zoologique d'Acclimatation.
Bulletin du Musée de l'Industrie.
Canadian Naturalist and Quarterly Journal of Science.
Educational Times.
Engineers' Journal (Calcutta).
Food Journal.
Indian Economist.
Journal of Applied Science.
Journal of the Chemical Society.
Journal of the Board of Arts and Manufactures for Upper Canada.
Journal of the Franklin Institute.
Journal of the Horticultural Society.
Journal of the National Life Boat Institution.
Journal of the Pharmaceutical Society.
Journal of the Photographic Society.
Journal of the Quekett Microscopical Club.
London, Edinburgh, and Dublin Philosophical Magazine.
Presse Scientifique des Deux Mondes
Revue du Monde Colonial.
St. Crispin.
Symons' Meteorological Magazine.
The Horological Journal.
The Bookseller.

QUARTERLY.

Journal of Mental Science.
Journal of the Geological Society.
Journal of the Linnæan Society.
Journal of the Royal Geographical Society
Journal of the Royal Society.
Journal of the Royal United Service Institution.
Journal of the Statistical Society.
Journal of the Victoria Institute.
Journal of the Asiatic Society.
Journal of Education.

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ERRATA.

Page 678, column 2, line 19, for "Suffolk" read "Sussex."
Page 79, column 1, supply "Hyde Clarke, Esq., as Chairman of India Conference."
Page 417, column 2, line 23, for "Tusser" read "Endi."
Page 417, column 2, line 49, for "year advanced" read "proceeded westward."
Page 791, column 2, line 22, for "was" read "were."

LONDON: PRINTED BY W. TROUNCE, 9, CURSITOR-STREET, CHANCERY-LANE, W.C.

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